United States Department of Agriculture

Progress Report

Title:	Guam Forest Biodiversity Inventory

Sponsoring Agency	NIFA	**Project Status**	ACTIVE
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Project Director

Aubrey Moore

671-735-2086

aubreymoore@triton.uog.edu

Recipient Organization

SAES - UNIVERSITY OF GUAM

UOG STATION

MANGILAO, GUAM 96923

DUNS No. 779908151

Performing Department

Experiment Station

Non-Technical Summary

The main goal of this project is to build and maintain a Guam Forest Biodiversity Inventory. In its simplest form, a biodiversity inventory is a checklist of animals and plants inhabiting a geographic area or habitat of interest. In this case, the habitat of interest is Guam's forests. This project will be a major component of a larger project aimed at building a Guam Terrestrial Biodiversity Inventory to include all life forms found on the island.

Guam's forest ecosystems are rapidly being degraded by invasive insect species and habitat destruction. Impacts of bird extinctions caused by the brown tree snake predation on Guam's forests are well known. But these impacts are rivaled by contemporary ecological disasters:

- In 2002, Guam's endemic cycad, Cycas micronesica, was the most abundant tree (DBH > 5 inches) in Guam's forests (Donnegon et al., 2002). In 2003 the Asian cycad scale (Aulacaspis yasumatsui) was detected on Guam infesting ornamental cycads. The scale quickly spread to wild cycads and started killing them. Within only three years, Cycas micronesica was placed on the IUCN Red List of Threatened Species and in 2016, this plant was placed on the US national endangered species list. It is estimated that 90% of Guam's cycads have been killed and there is no sign of recovery.
- Coconut (Cocos nucifera), is Guam's second most abundant tree species. Guam's palms are rapidly being killed by coconut rhinoceros beetle (Oryctes rhinoceros) which was first detected on the island in 2007. It is likely that 50% or more of the island's coconut palms will be lost.

Despite rapid destruction of Guam's forests, there is not even a basic checklist which can be used to document changes in biodiversity. A biodiversity inventory is needed:

- to document changes in Guam's ecosystems
- to document detection of and impacts caused by invasive species which are arriving at a rapid rate
- to provide free, open access to information on Guam's flora and fauna (including images and occurrence maps) to the global scientific community, policy makers, and the public
- to act as a digital repository for data from biological surveys and biological collections
- to provide links to scientific literature about taxa which occur on Guam
- to document ecological relationships among taxa such as hosts, predators, parasites and diseases

Accomplishments

Major goals of the project

1 Goal: Liberate data from biological collections

1.1 Objective: Complete digitization of the UOG insect collection

The UOG insect collection catalog has already been made available online using Symbiota. Note that Symbiota automatically uploads data to GBIF. The next phase of this digitization project will be imaging of all taxa in the collection. Existing images will be uploaded and linked to specimen data. Images will be made for taxa which have not been previously imaged and these

will also be uploaded.

1.2 Objective: Complete digitization of the UOG herbarium

Digital images are available for all herbarium sheets. The existing herbarium catalog will be converted from a local database to an online database using Symbiota or Specify. Both of these online collection database managers automatically upload to GBIF.

1.3 Objective: Liberate data from the scientific literature

The PI will organize extraction of Guam biodiversity information from primary scientific publications, starting with Insects of Guam I and II.

2 Goal: Provide public access to Guam forest biodiversity data

2.1 Objective: Build the Guam Forest Biodiversity Web Site

The PI will launch a web site to serve as a portal to Guam forest biodiversity data stored in GBIF. Pages will be developed to dynamically generate lists such as those suggested above.

3 Goal: Foster public interest in Guam's forest biodiversity

3.1 Objective: Outreach and Citizen Science Activities

- The PI will offer annual workshops on the use of iNaturalist, a social networking app used by citizen scientists and naturalists which enables them to record biodiversity observations with images and georeferencing using smart phones. iNaturalist data which is validated as research grade by the community is automatically uploaded to GBIF.
- The PI will continue to maintain an iNaturalist project entitled Insects of Micronesia.
- The PI will work with the UOG Center for Island Sustainability to organize annual bioblitzes. A bioblitz is is an intense period of biological surveying in an attempt to record all the living species within a designated area. Participants in the bioblitzes will be trained to useiNaturalist which will be used to document results.

4 Goal: Foster collaboration to help overcome the taxonomic impediment

4.1 Objective: Collaboration with taxonomists, collectors and the biodiversity informatics community

- Collaboration with taxonomists will be cultivated to help identify a large backlog of unidentified specimens in the UOG insect collection.
- Existing collaboration will be maintained with existing partners list in the Collaboration/Cooperation section of this proposal.
- The PI will participate in at least one scientific meeting per year covering biological collections and/or biodiversity informatics.
- The PI will encourage donation of voucher specimens to the UOG insect collection from biological surveys such as those being conducted by the Ecology of Bird Loss and the baseline surveys being done by military contractors in support of the military buildup.

What was accomplished under these goals?

Progress was made on the following objectives:

1.1 Objective: Complete digitization of the UOG insect collection

Three student interns were hired to continue digitization of the University of Guam insect collection. Images of several hundred pinned specimens were made and these will be added to the online catalog.

1.3 Objective: Liberate data from the scientific literature

A data mining project extracted occurrence records and ecological associates (hosts, etc.) for 370 species of insects recorded in Insects of Guam I, Bishop Museum Bulletin 172. Data extraction was done by 15 entomology student volunteers using free crowdsourcing software called Turkle. We plan to publish the resulting dataset, as a Darwin core archive, in the Global Biodiversity Information Facility.

3.1 Objective: Outreach and Citizen Science Activities

Monthly presentations on Guam's insects were made for the Guam Head Start program.

The Insects of Micronesia iNaturalist project now has 2,013 observations of 312 insect species made by 90 people. One thousand and twenty-six observations were added to the project since the start of the reporting period. This iNaturalist project is becoming a useful online resource for identifying common insects on the island. This project is also being used for collecting, mapping, and sharing information on invasive species.

4.1 Objective: Collaboration with taxonomists, collectors and the biodiversity informatics community

Dr. Benita Laird-Hopkins, an ecologist working with the Ecology of Bird Loss Project, has deposited over 5,000 pinned insect vouchers in the University of Guam insect collection. These insects were all reared from identified seeds of forest plants on Guam and Saipan. Batches of specimens have been sent out to specialist taxonomists for species determination. This unique dataset being compiled will extend our understanding of ecological associations between Guam's forest plants and insects.

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What opportunities for training and professional development has the project provided?

https://scan-bugs.org/portal/collections/misc/collprofiles.php?collid=180This project sponsored an internship to train students in curation and digitization of the University of Guam insect collection. During the reporting period, three students participated. Fifteen entomology student volunteers participated in crowd-sourced datamining which extracted taxonomic and ecological information from Insects of Guam I, Bishop Museum Bulletin 172.

How have the results been disseminated to communities of interest?

Information was disseminated to the general public via the Insects of Micronesia Project on iNaturalist.org. This site was also used to transmit technical information on newly arrived invasive insects to government agencies such as USDA-APHIS and the Guam Department of Agriculture.
Specimen records from the University of Guam insect collection were made available to the general public in an online catalog hosted by Symbiota Collections of Arthropods Network(SCAN). Research quality data from iNaturalist and from SCAN were made available to the scientific community by automatic publication on the Global Biodiversity Information System (GBIF).

What do you plan to do during the next reporting period to accomplish the goals?

{Nothing to report}

Participants

Actual FTE's for this Reporting Period

Role	Non-Students or faculty	Students with Staffing Roles			Computed Total by Role
		Undergraduate	Graduate	Post-Doctorate	
Scientist	0.1	0	0	0	0.1
Professional	0	0	0	0	0
Technical	0	0	0	0	0
Administrative	0	0	0	0	0
Other	0	0.2	0	0	0.2
Computed Total	0.1	0.2	0	0	0.3

Student Count by Classification of Instructional Programs (CIP) Code

Undergraduate	Graduate	Post-Doctorate	CIP Code
1	0	0	26.07 Zoology/Animal Biology.

Target Audience

The target audience for project output is the general public, the global scientific community, government agncies, and policy makers. All data and resulting documents will be made freely accessable on the world-wide-web.

Products

Type	Status	Year Published	NIFA Support Acknowledged
Conference Papers and	Published	2018	NO

Citation

Moore A. 2018. Failed attempts to establish IPM for Asian cycad scale and coconut rhinoceros beetle on Guam [Internet]. Annual Meeting of the Entomological Society of America; 2018 Nov 13 [cited 2019 Jan 21]; Vancouver, Canada. Available from: https://zenodo.org/record/2545065/files/Moore-Vancouver-2018.pdf

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Other Products

{Nothing to report}

Changes/Problems

Facilities and environmental conditions in which the University of Guam insect collection are being kept are inadequate and are leading to deterioration of this valuable scientific resource. The project director is attempting to secure sustainable support for the collection via the University of Guam EPSCOR program.