United States Department of Agriculture

Progress Report

Title:	Guam Forest Biodiversity Inventory

Sponsoring Agency	NIFA	**Project Status**	ACTIVE
Funding Source	Mcintire Stennis	**Reporting Frequency**	Annual
Accession No.	1018014	**Project No.**	GUA0930
Project Start Date	10/31/2018	**Project End Date**	09/30/2022
Reporting Period Start Date	10/01/2020	**Reporting Period End Date**	09/30/2021
Submitted By		**Date Submitted to NIFA**	

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Recipient Organization

SAES - UNIVERSITY OF GUAM

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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?

1 Goal: Liberate data from biological collections and scientific literature

We are datamining legacy literature about insects on Guam contained in Insects of Guam I and II. These volumes document insects collected during a comprehensive entomological survey of Guam done in 1936.

All 37 chapters of Guam I and II have been datamined by Plazi with resultant datasets published in Zenodo, Treatment Bank and GBIF. We are currently enhancing materials citations annotation by extracting detailed data for each specimen or series examined in each species treatment section within each chapter. We have completed 12 chapters and are tracking our progress using an online status report at https://aubreymoore.github.io/data-mining-insects-of-guam/MatCit-Validator/status_report.html.

Insect occurrence records for Guam continue to accumulate in the Global Biodiversity Information Facility (GBIF). Most records are from data sources being built and maintained by this project.

GBIF.org (28 December 2020) GBIF Occurrence Download https://doi.org/10.15468/dl.yfwjwt

- 18,604 Guam insect occurrence records
- 15,136 records were sourced from the University of Guam Insect Collection online catalog.
- 457 records were sourced from iNaturalist research-grade observations.

GBIF.org (17 December 2021) GBIF Occurrence Download https://doi.org/10.15468/dl.34ugmb

- 19,187 Guam occurrence records
- 15,147 records were sourced from the University of Guam Insect Collection online catalog.
- 776 records were sourced from iNaturalist research-grade observations

2 Goal: Provide public access to Guam forest biodiversity data

Please see the section entitled How have the results been disseminated to communities of interest.

3 Goal: Foster public interest in Guam's forest biodiversity
The PI participated in a workshop for educators sponsored by the Guam Soil and Water Conservation districts entitled Healthy Forests, Healthy Communities.
The PI participated in making a video recording about Guam's forests:
Ares, Adrian. 2021. Video: Forests of Guam. Presentation for the 15th World Forestry Conference. Western Pacific Tropical Research Center, University of Guam. Accessed July 27, 2021. https://www.youtube.com/watch?v=27D-ovSzLBk.
4 Goal: Foster collaboration to help overcome the taxonomic impediment
Nothing to report.

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

Plazi provided online training sessions specifically for this project. Topics covered where Introduction to Golden Gate Imagine Software and Enhancing Material Citations. See https://osf.io/f498p/wiki/home/ for details.

How have the results been disseminated to communities of interest?

Data from the Scientific literature
For each chapter we annotate, the Plazi workflow creates a journal article published in Zenodo. This is essentially a republished copy of the original chapter with links to files containing extracted data. Links are provided for a GBIF checklist dataset which may be downloaded in several formats including Darwin core archive (DwCA). In addition, a dataset for each taxon within the chapter is created and stored in the Plazi Treatment Bank.
For example, here are the publicly accessible online data products which were automatically appeared on the internet after we annotated the Bees of Guam chapter:
Zenodo article: Cockerell, T. D. A. (1942). Bees of Guam. In Insects of Guam I (pp. 188-190). Bernice P. Bishop Museum. https://doi.org/10.5281/zenodo.5160372
GBIF dataset: Cockerell T D A, carolina (1942). Bees of Guam. Plazi.org taxonomic treatments database. Checklist dataset https://doi.org/10.5281/zenodo.5160372 accessed via GBIF.org on 2021-12-17. This dataset can be downloaded in several formats including Darwin core archive. Note that information within this dataset will be accessed whenever GBIF is queried.
Taxon treatments: A page is available for each taxon which appears in the chapter:

- Cockerell, T. D. A. (1942). Apis mellifera Linnaeus. In Bees of Guam, pp. 188-190 in Insects of Guam I (p. 188). Bernice P. Bishop Museum. https://doi.org/10.5281/zenodo.5211876
- Cockerell, T. D. A. (1942). Megachile laticeps Smith. In Bees of Guam, pp. 188-190 in Insects of Guam I (p. 188). Bernice P. Bishop Museum. https://doi.org/10.5281/zenodo.5164364
- And so on for the 7 species in this chapter.

Data from the University of Guam insect collection
Data and images for each specimen accessioned by the UOG insect collection are uploaded to a publicly available online database at https://scan-bugs.org/portal/collections/misc/collprofiles.php?collid=180 which is hosted by the Symbiota Collections of Arthropods Network. All records are then automatically published on GBIF in a dataset at https://www.gbif.org/dataset/56e311e3-43c6-4b99-aa21-af396074d5e3.

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

In the last year of this project annotation of materials citations in Insects of Guam I and II will be completed and a journal article will be prepared documenting progress that has been made towards realization of a terrestrial biodiversity inventory for Guam.

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	0.2	0	0.300000000000000 4
Professional	0	0	0	0	0
Technical	0	0	0	0	0

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Actual FTE's for this Reporting Period

Role	Non-Students or faculty	Students with Staffing Roles			Computed Total by Role
		Undergraduate	Graduate	Post-Doctorate	
Administrative	0	0	0	0	0
Other	0	0	0	0	0
Computed Total	0.1	0	0.2	0	0.30000000000000004

Student Count by Classification of Instructional Programs (CIP) Code

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

Target Audience

The target audience for data resulting from this project is anybody interested in Guam's biodiversity. This includes biologists, invasive species specialists, ecologists, resource planners, biosecurity officials, students, and the general public.

Products

{Nothing to report}

Other Products

Product Type

Data and Research Material

Description

Moore, Aubrey and Annette Kang 2021. Datamining Insects of Guam. Open Science Framework. https://osf.io/f498p/

Product Type

Data and Research Material

Description

Moore, Aubrey 2021. Datamining Insects of Guam. GitHub repository. https://aubreymoore.github.io/data-mining-insects-of-guam/

Product Type

Data and Research Material

Description

Moore, Aubrey 2021. Insects of Guam Datamining Project Status Report. https://aubreymoore.github.io/data-mining-insects-of-guam/MatCit-Validator/status_report.html

Changes/Problems

The University of Guam insect collection has been mothballed in a small storage room with poor environmental conditions and insufficient work space. These problems impede progress on further digitization of the collection.