University of Guam Insect Collection

Biorepository Component of the New EPSCoR Track I Grant Proposal

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Contents

1 Need for a Guam Biodiversity Inventory

Guam's biodiversity is being rapidly degraded by ecological disasters caused by invasive species:

- Guam's birds have been extirpated by the brown treesnake and the ecosystem services such as seed dispersal, insectivory, and pollination have also been lost.
- Most of Guam's endemic cycads, *Cycas micronesica*, have been killed by the Asian cycad scale, *Aulacaspis yasumatsui*, which was first detected in 2003. *C. micronesica* was enumerated as the island's most populous tree in 2002 US Forest Service survey. In 2015, this species was added to US List of Threatened and Endangered Species following loss of more than 90% of the Guam population.
- Coconut palm, *Cocos nucifera*, and palma brava, *Heterospathe elata*, were enumerated as Guam's second and third most populous trees in the 2002 forest survey. These and other palm species are rapidly being killed by an uncontrolled and unmonitored outbreak of coconut rhinoceros beetle, an invasive species first detected in 2007.
- Little fire ant, *Wasmannia auropunctata*, was first detected on Guam in 2011. Elsewhere, this invasive ant has had negative impacts on invertebrate and vertebrate biodiversity.

Even though Guam's biodiversity is rapidly being degraded by these contemporary ecological disasters, a comprehensive checklist of terrestrial taxa does not exist for Guam. We need a biodiversity inventory:

- to document changes to Guam's ecosystems
- to document detection of and impacts caused by invasive species
- 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 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

The major data sources for the proposed Guam Biodiversity Inventory (GBI) will come from digitized biological collection records and from the scientific literature (Fig. 3).

It has been suggested that the Global Biodiversity Information Facility (GBIF) should be used as a an aggregator and data repository for the GBI. Note that most modern digital collection catalogs facilitate automated publication of records to GBIF using Darwin Core Archives (DwCA) and other biodiversity data formats.

A Guam Biodiversity Inventory web site will be built using the GBIF API (application program interface) to facilitate automatic generation and updates to lists such as:

- A list of all invasive species on Guam with year first recorded
- A list of new species described from specimens collected on Guam
- A list of observations for Guam's endangered species

- A list of Guam's native plants with associated herbivores and pathogens
- A list of crops grown on Guam and pests and pathogens which attack them
- A list of pests and associated biological control agents
- For any taxon, a literature reference list and links to images
- Taxonomic checklists and field guides with images

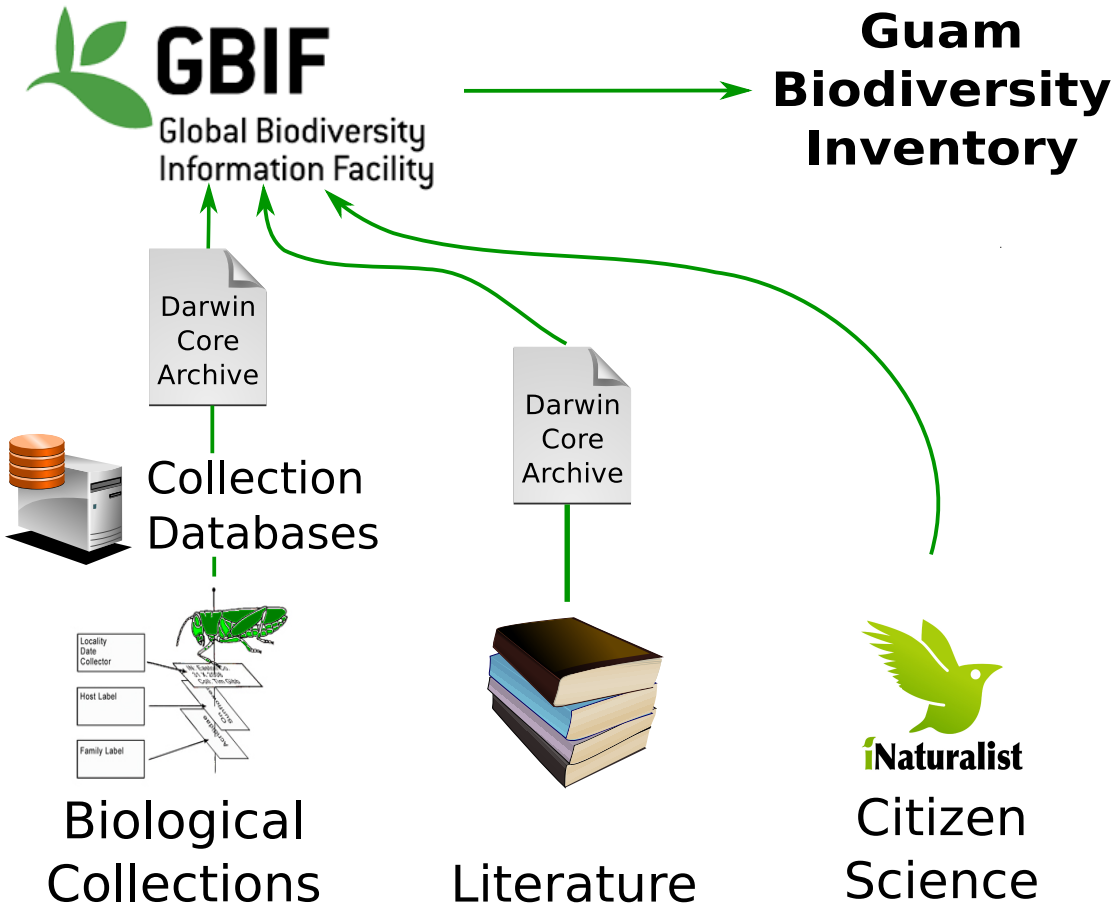

Figure 1: Data sources and information flow for the Guam Biodiversity Inventory.

2 Justification for Maintaining and Improving the University of Guam Insect Collection

A major justification for maintaining and improving the University of Guam Insect Collection is to generate information for building the proposed Guam Biodiversity Inventory described in the previous section.

Although the UOG insect collection is recognized as a valuable scientific resource for it has been neglected for several years.

3 Current Status of the UOG Insect Collection

3.1 Collection Room

- The collection is currently housed in a small (20 ft. by 18 ft.) storage room. This room is too small to allow workspace for microscopic examination, imaging and other activities. All work on the collection necessitates removing drawers from cabinets and transporting them outdoors to a nearby laboratory.

3.2 Specimen Storage

- Pinned Specimens are kept in 17 full size entomological cabinets containing 25 drawers each, and 7 half-size cabinets containing 12 drawers each.
- Specimens in ethanol are stored in one half-sized cabinet.
- Specimens mounted on glass microscope slides are stored in 13 slide boxes.

3.3 Environmental Conditions

- An air conditioner and a dehumidifier are left running continually in an attempt to keep the room cool and dry. Unfortunately, power outages are frequent on the University of Guam campus.
- Napthalene moth balls are placed in all drawers containing pinned insects in an attempt to prevent damage from insects and fungus, especially during prolonged power outages.

3.4 Digitization Progress

- During 2018, label data for pinned specimens were transfered from a CSIRO Biolink database hosted on a desktop computer to a more modern web-based database hosted by the Symbiota Collections of Arthropods Network (SCAN) (Fig. 2). SCAN automatically publishes data from the UOG insect collection on the Global Biodiversity Information Facility web site (Fig. 3) To date, 34,518 specimen records have been entered in the online catalog and published on GBIF.

Figure 2: Screenshot of the UOG Insect Collection details page on the Symbiota Collections of Arthropods Network web site. Accessed February 7, 2019.

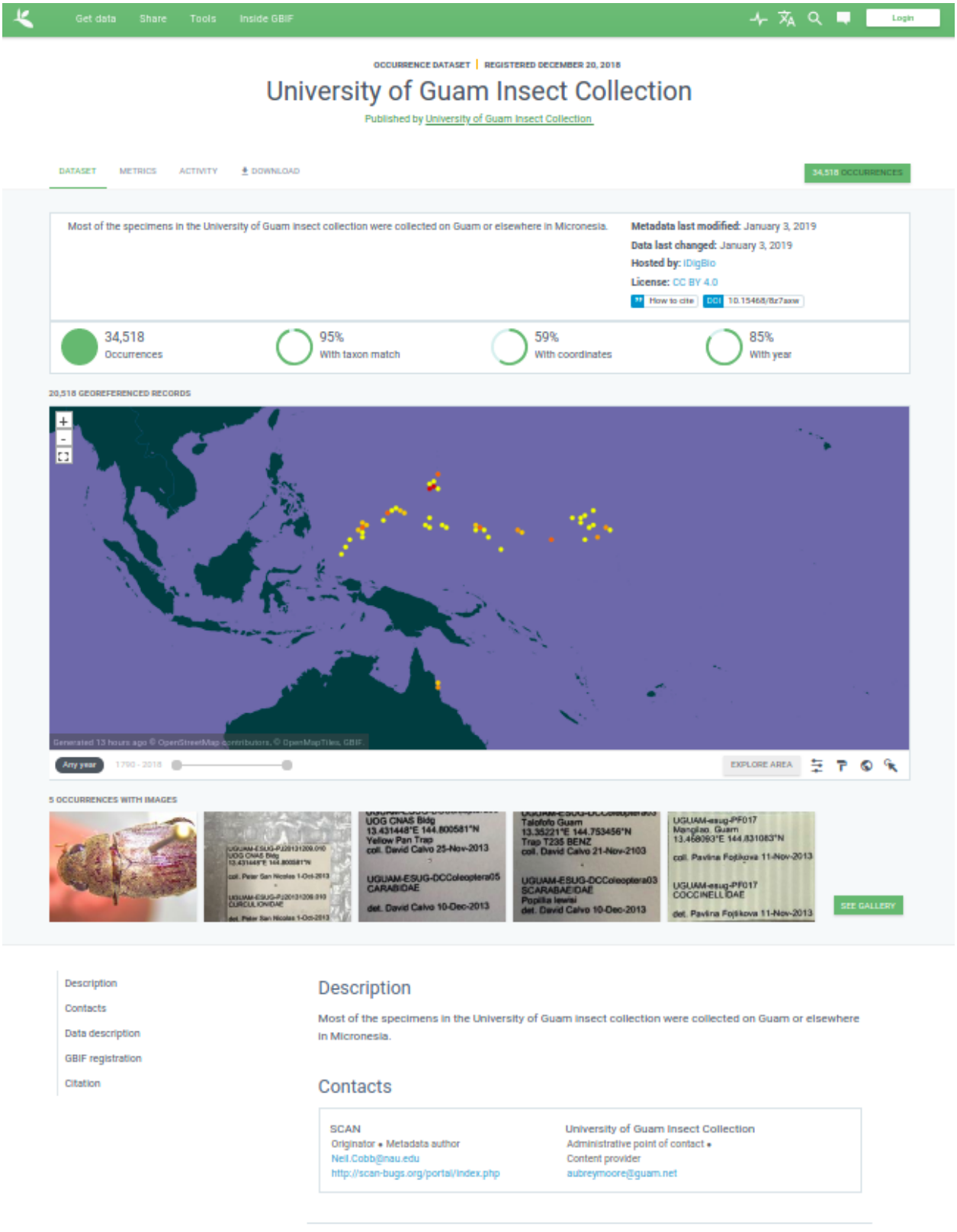

Figure 3: Screenshot of the UOG Insect Collection details page on the Global Biodiversity Information Facility web site. Accessed February 7, 2019.

4 Proposed Improvements for the UOG Insect Collection

4.1 Collection Room

- Development of the UOG insect collection for scientific reference and research requires moving it from the storage room where it currently resides into a laboratory with bench space for sorting, microscopy and imaging. A room size of 1,600 to 2,000 square feet should suffice if a compacter system is installed for the cabinets, larger otherwise.

4.2 Specimen Storage

- Cabinets should be mounted on a compactor system to save floor space.
- The number of cabinets should be doubled to allow for expnsion of the collection over the next decade.

4.3 Environmental Conditions

- Preserved insects, especially those preserved on pins need to be kept dry and cool (<50% relative humidity; <20°C). This can be achieved with a good air conditioning system with a reliable backup generator. Reliably maintaining cool and dry conditions will allow discontinuing the use of napthalene as a fumigant to prevent insects such as dermestid beetles and fungus from destroying specimens. Note that many insect collections do not use napthalene because of health concerns about chronic exposure. Curators rely on quarantine procedures, such as freezing all material at -80°C for 24 h prior to integrating it with the collection.

4.4 Curation

- A collection manager with taxonomic skills should be hired to curate the UOG insect collection. Note that only 21% of pinned specimens are identified to species. Specimens of soft-bodied and/or small insects preserved in ethanol or mounted on microscope slides are in dire need of curation and none of these have been catalogued or digitized.
- Encouraging and subsidizing visits from qualified taxonomists is probably the best way to get the large backlog of unidentified specimens identified. DNA barcoding may also be of use in this regard.

4.5 Digitization

- The next step in digitizing pinned specimens is to generate and database high quality digital images for all species. Necessary microscopes, cameras and computers are available for this work. However, lack of space in the current collection room precludes setting up an efficient workflow.