

Biological Invasion of Guam

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Outline

- 1 What is a biodiversity inventory and why do we need one?
- 2 Status of Guam's biodiversity
- 3 Biodiversity data sources for Guam
- 4 Biodiversity data standards and tools
- 5 System design for the Guam Biodiversity Inventory

What is a biodiversity inventory and why do we need one?

What is a biodiversity inventory?

A biodiversity inventory is essentially a database containing a comprehensive check list of all taxa known occur within a defined area.

Why do we need a biodiversity inventory?

- To document rapid changes to Guam's ecosystems
- To provide free, open access to information on Guam's flora and fauna
- To share Guam biodiversity information with the global scientific community, policy makers and the public

Why do we need a biodiversity inventory?

The Guam Biodiversity Inventory will 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

Status of Guam's biodiversity

Status of Guam's biodiversity

Guam's biodiversity is being threatened by a HIPPO!



Status of Guam's biodiversity

Guam's biodiversity is being threatened by a HIPPO!

- H Habitat loss
- I Invasive Species
- P Pollution
- P Human Population
- O Overharvesting

Status of Guam's biodiversity

Guam's ecosystems are heavily impacted by invasive species

- Most inland bird species on Guam became extinct or extirpated in the wild after arrival of the brown treesnake
- 90% of Guam's endemic fadang plants, *Cycas micronesica*, have been killed by Asian cycad scale and other invasive species
- Guam's coconut palms and other palms are rapidly being killed by coconut rhinoceros beetle
- Estimated arrival rate for invasive species never before recorded on Guam is 1 species per day

Bird extinction by brown treesnake



Courtesy of USGS

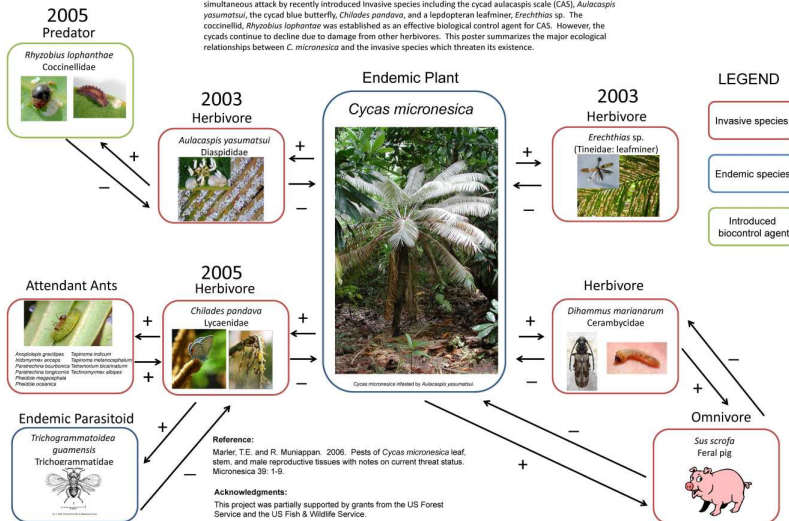
Massive mortality of *Cycas micronesica* by invasive species

A Coalition of Invasive Species Attacks Guam's Native Cycads

Aubrey Moore*, Ross Miller, and Thomas Marler

Western Pacific Tropical Research Center, University of Guam, Mangilao Guam 96923

A 2002 forest survey listed *Cycas micronesica* as the most numerous tree-sized plant in Guam's forests. In 2006 *C. micronesica* was placed on the IUCN Red List of Threatened Species in response to high mortality from simultaneous attack by recently introduced invasive species including the cycad aulacaspis scale (CAS), *Aulacaspis yasumatsui*, the cycad blue butterfly, *Chilades pandava*, and a lepidopteran leafminer, *Erechthias* sp. The coccinellid, *Rhyzobius lophanthae* was established as an effective biological control agent for CAS. However, the cycads continue to decline due to damage from other herbivores. This poster summarizes the major ecological relationships between *C. micronesica* and the invasive species which threaten its existence.



Massive mortality of palm trees by coconut rhinoceros beetle



Courtesy of US Forest Service



Impediments in studying Guam's biodiversity

Endemicity

Many taxa on Guam are endemic and many (most?) of these have not been described.

Taxonomic impediment

It is hard to find taxonomists with specialized knowledge and skills to identify many groups of organisms on Guam (especially insects).

Biodiversity survey examples

DoD Baseline Survey of Terrestrial Arthropods on Pagan 2010

288 taxa; 228 new island records; 4 new (undescribed) species

DoD Baseline Survey of Terrestrial Arthropods on Guam 2012

9,099 specimens collected; identified to taxonomic rank of Order only!!

Bark Beetle (Scolytinae) Trapping on Guam 2011

A single trap at a single location was operated for 2 months.
7 species; 3 new island records

Survey of Drosophilidae on Guam 2012

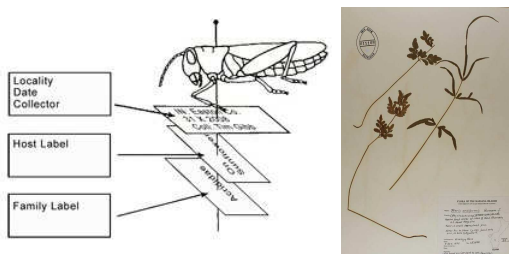
24 species; 14 new island records; 5 new (undescribed) species

Biodiversity data sources for Guam

What data are stored in a biodiversity inventory?

- **Taxonomic data:** A hierarchical checklist containing taxon names, synonyms, vernacular names, and references to publications containing taxon descriptions
- **Occurrence data:** Specimen data including date of collection, location, images, ecological associations, DNA sequences, morphometrics, etc.
- **Literature data:** References to information on taxa published in journals and reports

Biological collections as a biodiversity data source



Collection	Digital Catalog
UOG Insect Collection	Biota; BioLink
UOG Herbarium	Borland Reflex; FileMaker; MS Access
UoG Fish Collection	Specify
UoG Diatom Collection	Specify

Biodiversity data standards and tools

Biodiversity data standards and tools



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GBIF | Global Biodiversity Information Facility

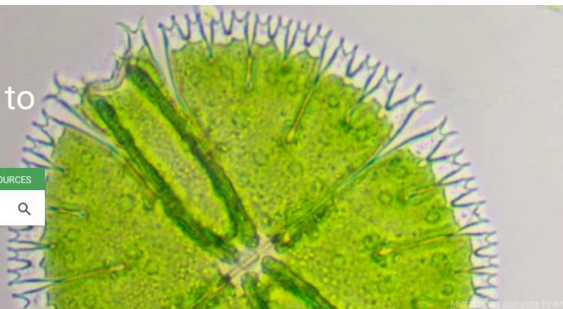
Free and open access to biodiversity data

[OCCURRENCES](#) [SPECIES](#) [DATASETS](#) [PUBLISHERS](#) [RESOURCES](#)



[WHAT IS GBIF?](#)

[ABOUT GBIF GUAM](#)



Occurrence records

981,888,425

Datasets

38,527

Publishing institutions

1,160

Species

Learn more about the number of species covered by data in GBIF.org.



GBIF formalizes collaboration with biodiversity assessment platform

20 March 2018



Identifying Amazonian ferns using a new online key

14 March 2018



2018 GBIF Ebbe Nielsen Challenge to open on 9 May 2018

Deadline: 5 September 2018



Call for nominations opens for 2018 GBIF Young Researchers Award

Deadline: 15 June 2018



GBIF occurrences map

Guam



Names of countries and areas are based on the ISO 3166-1 standard

SUMMARY

DATA ABOUT

DATA PUBLISHING

RESEARCH

NEWS

COUNTRY REPORT

DATA ABOUT GUAM

55,992

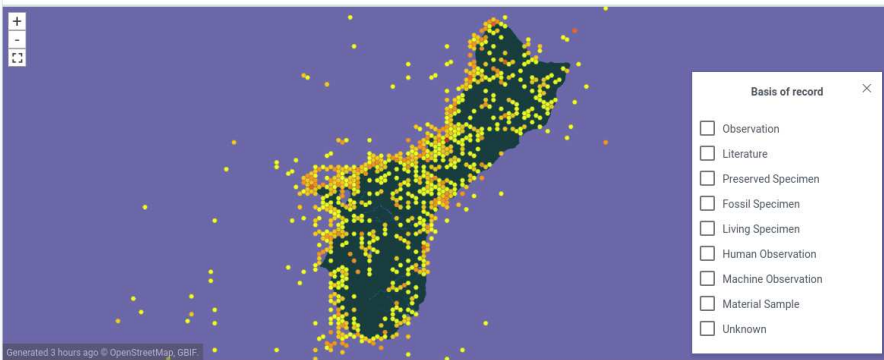
Occurrences

224

Datasets

23

countries and areas contribute data



Generated 3 hours ago © OpenStreetMap, GBIF

Any year 1820 - 2018

EXPLORE AREA



GBIF occurrences table

Occurrences		SEARCH OCCURRENCES 55,992 RESULTS								
Search all fields		TABLE	GALLERY	MAP	TAXONOMY	DATASETS	DOWNLOAD			
Simple Advanced		Scientific Name	Country Or Area	Coordinates	Basis Of Record	Month & Year	Dataset	Remarks	Rank	Kingdom
Record License	▼	Intsia bijuga Kuntze	Guam	13.5N, 144.9E	human observation	2018 January	(Naturalist Research-grade Observations	2	species	Plantae
Scientific Name	▼	Flagellaria indica L.	Guam	13.5N, 144.9E	human observation	2018 January	(Naturalist Research-grade Observations	2	species	Plantae
Basis Of Record	▼	Intsia bijuga Kuntze	Guam	13.5N, 144.9E	human observation	2018 January	(Naturalist Research-grade Observations	2	species	Plantae
Location	▼	Ischnura aurora Brauer, 1865	Guam	13.5N, 144.9E	human observation	2018 February	(Naturalist Research-grade Observations	2	species	Animalia
Year	▼	Lfoa Pilobry, 1921	Guam	13.5N, 144.7E	preserved specimen	2017 January	Museum of Comparative Zoology, Harvar...	4	genus	Animalia
Month	▼	Lfoa curta A. Adams, 1850	Guam	13.5N, 144.7E	preserved specimen	2017 January	Museum of Comparative Zoology, Harvar...	4	species	Animalia
Dataset	▼	Ventomnestia Iredale, 1936	Guam	13.5N, 144.7E	preserved specimen	2017 January	Museum of Comparative Zoology, Harvar...	4	genus	Animalia
Country Or Area	▼	Cylindna Lovén, 1846	Guam	13.5N, 144.7E	preserved specimen	2017 January	Museum of Comparative Zoology, Harvar...	4	genus	Animalia
<input checked="" type="checkbox"/> Guam		Helicoverpa variegatus (Gmelin, 1791)	Guam	13.5N, 144.7E	preserved specimen	2017 January	Museum of Comparative Zoology, Harvar...	4	species	Animalia
Issue	▼	Cyrtoc elegans Bergh, 1870	Guam	13.5N, 144.7E	preserved specimen	2017 January	Museum of Comparative Zoology, Harvar...	4	species	Animalia
Media Type	▼	Oxytropis Rafinesque, 1814	Guam	13.5N, 144.7E	preserved specimen	2017 January	Museum of Comparative Zoology, Harvar...	4	species	Animalia
Publisher	▼	Ventomnestia Iredale, 1936	Guam	13.5N, 144.7E	preserved specimen	2017 January	Museum of Comparative Zoology, Harvar...	4	genus	Animalia
Institution Code	▼	Lamellaria Montagui, 1815	Guam	13.5N, 144.7E	preserved specimen	2017 January	Museum of Comparative Zoology, Harvar...	4	genus	Animalia
Collection Code	▼	Siphonophora nigromarginatum Gosliner, 1...	Guam	13.5N, 144.7E	preserved specimen	2017 January	Museum of Comparative Zoology, Harvar...	4	species	Animalia
Catalogue Number	▼	Aplysia parvula Mörch, 1863	Guam	13.5N, 144.7E	preserved specimen	2017 January	Museum of Comparative Zoology, Harvar...	4	species	Animalia
Type Status	▼	Philina Ascanius, 1772	Guam	13.5N, 144.7E	preserved specimen	2017 January	Museum of Comparative Zoology, Harvar...	4	genus	Animalia
		Vespa tropica (Linnaeus, 1758)	Guam	13.3N, 144.7E	human observation	2017 January	(Naturalist Research-grade Observations	1	species	Animalia
		Tubonilla Risso, 1826	Guam	13.4N, 144.8E	preserved specimen	2017 January	Museum of Comparative Zoology, Harvar...	4	genus	Animalia

GBIF occurrences datasets

Occurrences

1

SEARCH OCCURRENCES | 55,992 RESULTS

Search all fields

TABLEGALLERYMAPTAXONOMYDATASETSDOWNLOAD

SimpleAdvanced

OccurrencesDatasetPublisherType

Record License17,334NMNH Extant Specimen RecordsNational Museum of Natural History, Smithsonian Institutionoccurrence dataset

Scientific Name13,350UF Invertebrate ZoologyFlorida Museum of Natural Historyoccurrence dataset

Basis Of Record6,001MICROBIS databaseMarine Biology Laboratoryoccurrence dataset

Location5,130EOD - eBird Observation DatasetCornell Lab of Ornithologyoccurrence dataset

Year1,468Stuart M. Fullerton Collection of Arthropods (UCFC), University ...Museum of Biological Diversity, The Ohio State Universityoccurrence dataset

Month1,177CAS Ichthyology (ICH)California Academy of Sciencesoccurrence dataset

Dataset1,166MALAcademy of Natural Sciencesoccurrence dataset

Country Or AreaGuam856Australian Museum provider for OZCAMAustralian Museumoccurrence dataset

Issue775Museum of Comparative Zoology, Harvard UniversityMuseum of Comparative Zoology, Harvard Universityoccurrence dataset

Media Type749iNaturalist Research-grade ObservationsiNaturalist.orgoccurrence dataset

Publisher515Naturalis Biodiversity Center (NL) - BotanyNaturalis Biodiversity Centeroccurrence dataset

Institution Code506CAS Herpetology (HERP)California Academy of Sciencesoccurrence dataset

Collection Code444LSUMZ (LSU MNS) Fishes CollectionLouisiana State University Museum of Natural Scienceoccurrence dataset

Catalogue Number358Paleobiology DatabasePaleobiology Databaseoccurrence dataset

Type Status343LACM Vertebrate CollectionNatural History Museum of Los Angeles Countyoccurrence dataset

309Diversity of the Indo-Pacific (DIPnet)The Genomic Observatories Metadatabase (GeOME)occurrence dataset

300FishBaseFishBaseoccurrence dataset

254Natural History Museum (London) Collection SpecimensNatural History Museumoccurrence dataset

GBIF occurrences gallery

Secure <https://www.gbif.org/occurrence/gallery/occurrence/guam>

Apps For quick access, place your bookmarks here on the bookmarks bar: [import bookmarks now...](#)

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Occurrences

Search all fields

Simple Advanced

Record License

Scientific Name

Basis Of Record

Location

Year

Month

Dataset

Country Or Area

☒ Guam 55,992

search

☐ United States 321,242,343

☐ Sweden 76,556,001

☐ Australia 67,837,939

☐ United Kingdom 65,971,138

☐ Canada 44,471,800

☐ France 36,446,127

☐ Germany 28,780,698

☐ Norway 27,147,230

☐ Denmark 26,951,786

☐ Spain 26,475,264

Wasmannia aurouinctata (Roger, 1863)

Chaetodon lunulatus Quoy & Gaimard, 1825

Leucocarpinus benibani (Coida) Singer

Catopilia pemona (Fabricius 1775)

Paspiflora foetida L.

Clorodendrum speciosissimum Drapiez

Hyponomeuta bolina Linnaeus, 1758

Papilio polytes Linnaeus, 1758

Hibiscus siliaceus L.

Hyponomeuta octonula marianensis Fruhstorfer, 1912

Papilio polytes Linnaeus, 1758

Ximelia americana L.

Sisocalyma megacarpa Merr.

Vakstroemia elliptica Merr.

Clorodendrum inornate (L.) Galetti

Eughorbia heterophylla

Phyllanthus marianensis W.L. Wagner & Lorence

Alida brycei Kuntze

Bordia subcordata Lam.

Ficus myriocarpa var. saffordii (Merr.) Corner

Cycas micromedea K.D. Hill

Papilio polytes Linnaeus, 1758

Dolerichthys jansoni

Syngium thomsonii (Merr.) N. Snow

Protaetia orientalis (Gory & Perschonen, 1833)

Intsia brycei Kuntze

Paspiflora foetida L.

Protaetia pygma (Janson, 1888)

Centropomus pubescens Benf.


Ipomoea pes-caprae (L.) R. Brown

GBIF simple search for "Guam"

EVERYTHING OCCURRENCES SPECIES DATASETS PUBLISHER RESOURCES

Guam

55,992 occurrences about 5,130 published occurrences



DATASETS 13 RESULTS

A review of burrower bugs (Hemiptera: Heteroptera: Cydnidae sensu lato) of Guam Checklist Dataset

This dataset contains the digitized treatments in Plazi based on the original journal article Lis, Jerzy A., Zack, Richard S. (2010): A review of burrower bugs (Hemiptera: Heteroptera: Cydnidae sensu

Published by Plazi.org taxonomic treatments database

... sensu lato) of **Guam**. Zootaxa 2523: ...

14 records

Lubbockichthys myersi, a new species of dottyback fish from Guam (Pseudochromidae: Pseudoplesiopsinae). Checklist Dataset

This dataset contains the digitized treatments in Plazi based on the original journal article Anthony C. Gill, Alasdair J. Edwards (2006): Lubbockichthys myersi, a new species of dottyback fish from G

Published by Plazi.org taxonomic treatments database

... dottyback fish from **Guam** (Pseudochromidae: Pseudoplesiopsinae). Zootaxa ...

2 occurrences 8 records 2 citations


First record of Eggplant Mealybug, Coccidohystrix insolita (Hemiptera: Pseudococcidae), on Guam: Potentially a major pest Checklist Dataset

The eggplant mealybug, Coccidohystrix insolita (Green) (Hemiptera: Pseudococcidae), is recorded from the island of Guam in the Mariana Islands for the first time. Factors indicating that this introduc

Published by Biodiversity Data Journal

... the island of **Guam** in the Mariana ...

1 occurrences 7 records 3 citations



GBIF Backbone Taxonomy

The GBIF Backbone Taxonomy:

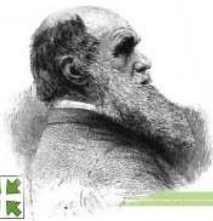
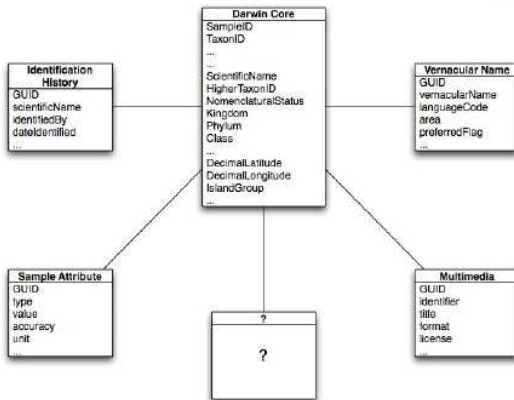
- is the "Tree of Life" used by GBIF to deal with all taxon names within its database
- currently includes 2.7 million accepted taxon names and 2.3 million synonyms
- can be downloaded (as a Darwin Core Archive) for local use



DwC star schema



- ❖ Star schema model
- ❖ Can relate elements one-to-many



System design for the Guam Biodiversity Inventory

System design for the Guam Biodiversity Inventory

