

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 to 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?

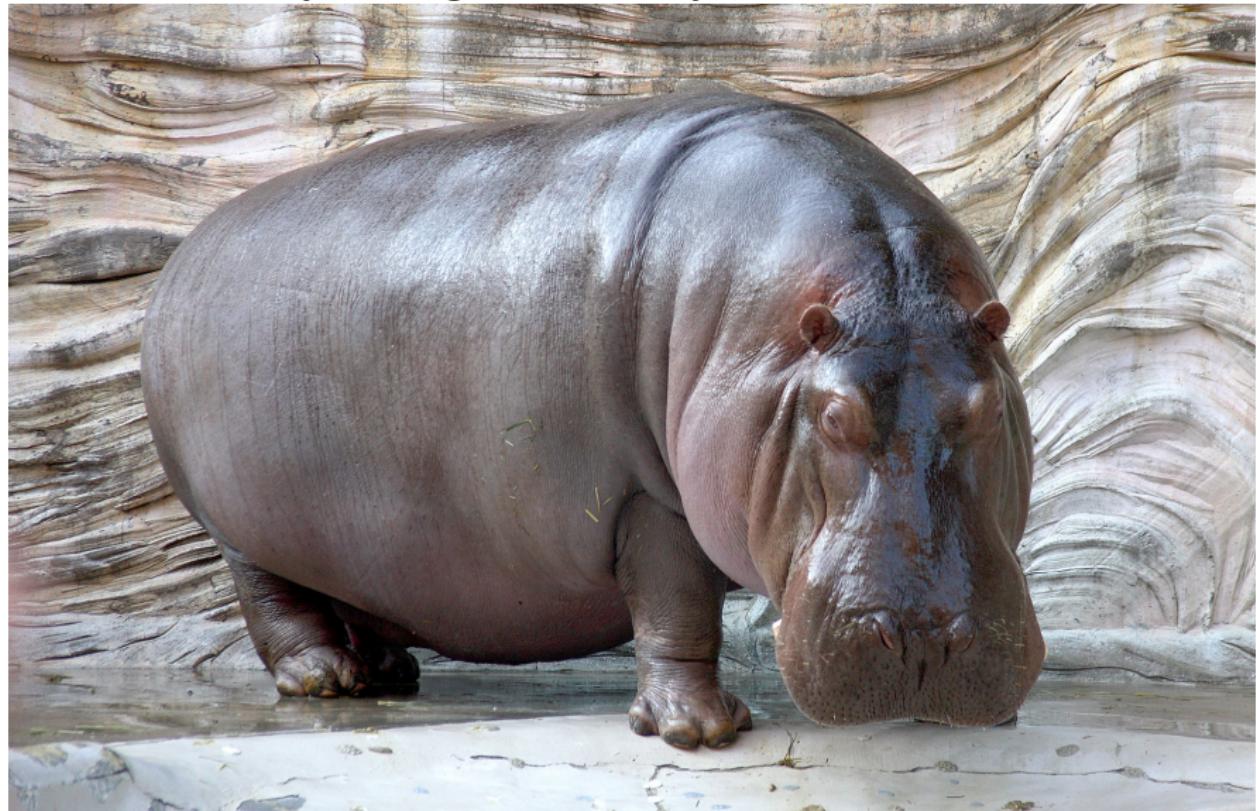
The Guam Biodiversity Inventory will facilitate automatic generation and updates to lists such as:

- 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

0 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

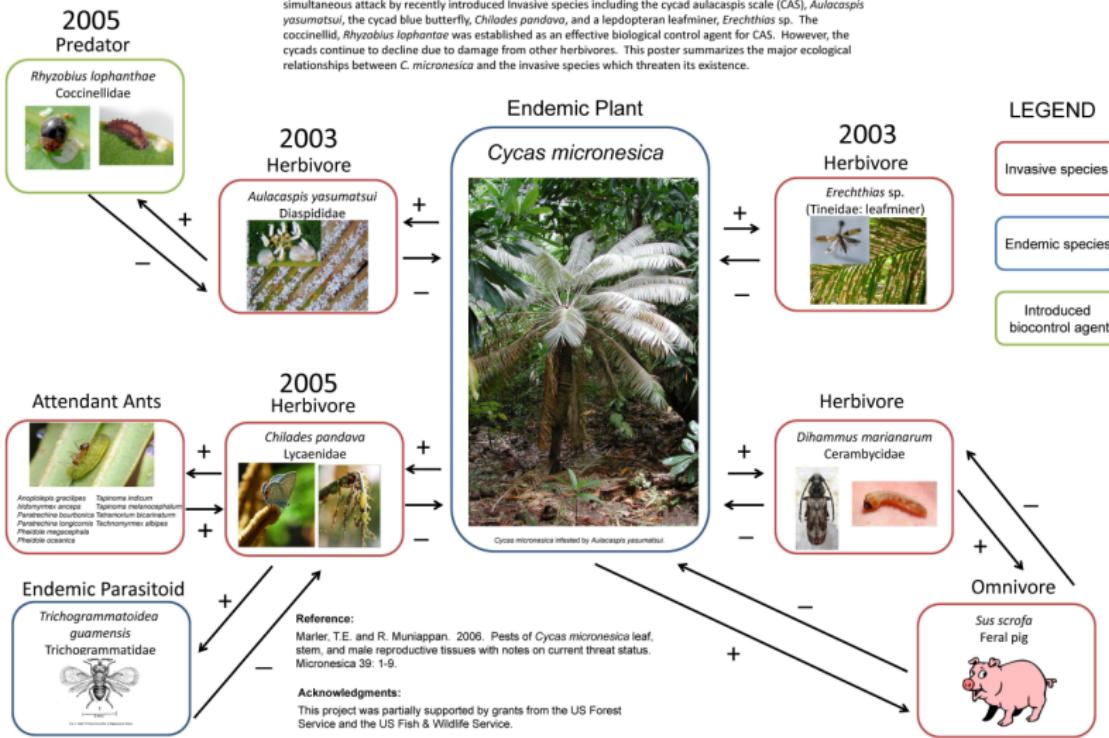
Massive mortality of *Cycas micronesica* by invasive species

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 coccinid beetle, *Chilades pandava*, and a lepidopteran leafminer, *Erechthias* sp. The coccinid, *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

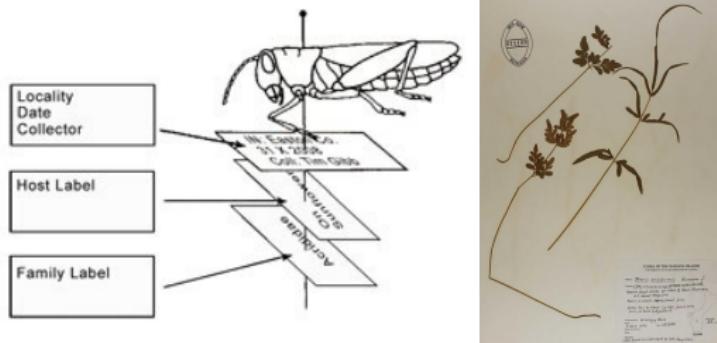
24 species; 14 new island records; 5 new (undescribed) species

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



Get data Share Tools Inside GBIF

GBIF | Global Biodiversity Information Facility

Free and open access to biodiversity data

OCCURRENCES

SPECIES

DATASETS

PUBLISHERS

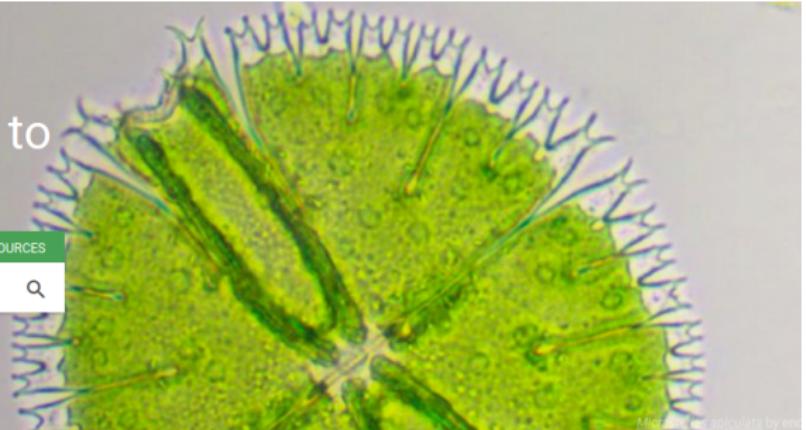
RESOURCES

Search



WHAT IS GBIF?

ABOUT GBIF GUAM



Micromesistia apiculata by eno

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

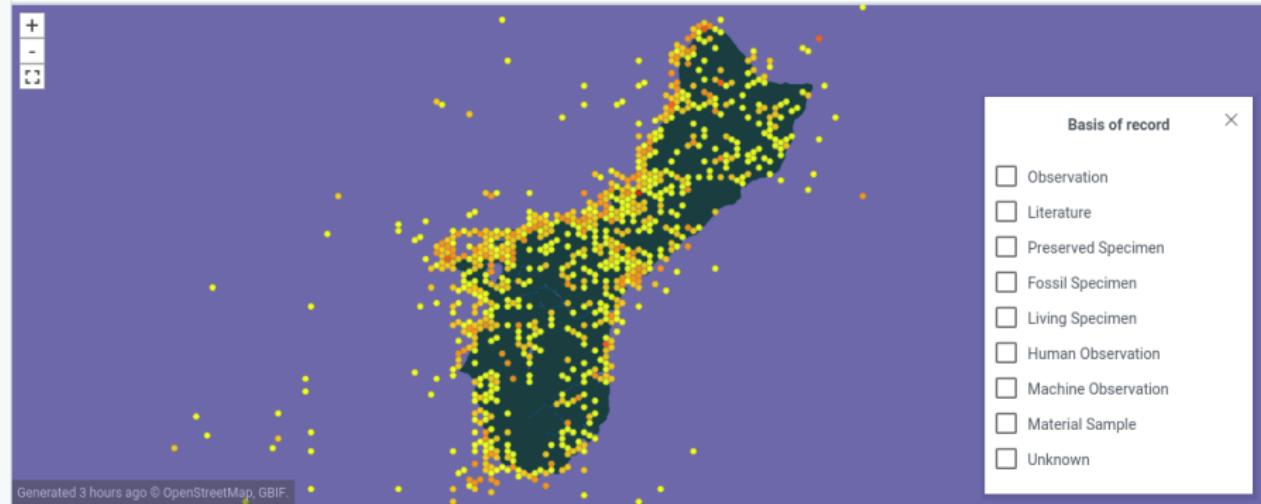
[SUMMARY](#)[DATA ABOUT](#)[DATA PUBLISHING](#)[RESEARCH](#)[NEWS](#)[COUNTRY REPORT](#)

DATA ABOUT GUAM

55,992
Occurrences

224
Datasets

23
countries and areas contribute data



GBIF occurrences table

Occurrences		1	SEARCH OCCURRENCES 55,992 RESULTS									
Search all fields		🔍	TABLE	GALLERY	MAP	TAXONOMY	DATASETS	⬇ DOWNLOAD				
Record Licensee	Simple	Advanced										
Scientific Name			Scientific Name		Country Or Area	Coordinates	Basis Of Record	Month & Year	Dataset	Remarks	Rank	Kingda
Flagellaria indica L.			<i>Intia bijuga</i> Kuntze	Guam	13.5N, 144.9E		human observation	2018 January	iNaturalist Research-grade Observations	2	species	Planta
Location			<i>Intia bijuga</i> Kuntze	Guam	13.5N, 144.9E		human observation	2018 January	iNaturalist Research-grade Observations	2	species	Planta
Year			<i>Ischnura aurora</i> Brauer, 1865	Guam	13.5N, 144.9E		human observation	2018 February	iNaturalist Research-grade Observations	2	species	Animz
Month			<i>Liloa pilisburyi</i> , 1921	Guam	13.5N, 144.7E		preserved specimen	2017 January	Museum of Comparative Zoology, Harvar...	4	genus	Animz
Dataset			<i>Liloa curta</i> A.Adams, 1850	Guam	13.5N, 144.7E		preserved specimen	2017 January	Museum of Comparative Zoology, Harvar...	4	species	Animz
Country Or Area			<i>Ventomnesia iredalei</i> , 1936	Guam	13.5N, 144.7E		preserved specimen	2017 January	Museum of Comparative Zoology, Harvar...	4	genus	Animz
Guam	<input checked="" type="checkbox"/>		<i>Cylindra lutea</i> , 1846	Guam	13.5N, 144.7E		preserved specimen	2017 January	Museum of Comparative Zoology, Harvar...	4	genus	Animz
Issue			<i>Heliacus variegatus</i> (Gmelin, 1791)	Guam	13.5N, 144.7E		preserved specimen	2017 January	Museum of Comparative Zoology, Harvar...	4	species	Animz
Media Type			<i>Cyerce elegans</i> Bergh, 1870	Guam	13.5N, 144.7E		preserved specimen	2017 January	Museum of Comparative Zoology, Harvar...	4	species	Animz
Publisher			<i>Oxyne Rafinesque, 1814</i>	Guam	13.5N, 144.7E		preserved specimen	2017 January	Museum of Comparative Zoology, Harvar...	4	genus	Animz
Institution Code			<i>Ventomnesia iredalei</i> , 1936	Guam	13.5N, 144.7E		preserved specimen	2017 January	Museum of Comparative Zoology, Harvar...	4	genus	Animz
Collection Code			<i>Lamellaria Montagu, 1815</i>	Guam	13.5N, 144.7E		preserved specimen	2017 January	Museum of Comparative Zoology, Harvar...	4	genus	Animz
Catalogue Number			<i>Siphopteron nigromarginatum</i> Gosliner, 1...	Guam	13.5N, 144.7E		preserved specimen	2017 January	Museum of Comparative Zoology, Harvar...	4	species	Animz
Type Status			<i>Aplynia parvula</i> Mörch, 1863	Guam	13.5N, 144.7E		preserved specimen	2017 January	Museum of Comparative Zoology, Harvar...	4	species	Animz
			<i>Philine Ascanius</i> , 1772	Guam	13.5N, 144.7E		preserved specimen	2017 January	Museum of Comparative Zoology, Harvar...	4	genus	Animz
			<i>Vespa tropica</i> (Linnaeus, 1758)	Guam	13.3N, 144.7E		human observation	2017 January	iNaturalist Research-grade Observations	1	species	Animz
			<i>Turbonilla Riso, 1826</i>	Guam	13.4N, 144.8E		preserved specimen	2017 January	Museum of Comparative Zoology, Harvar...	4	genus	Animz

GBIF occurrences datasets

Occurrences  1

SEARCH OCCURRENCES | 55,992 RESULTS

Search all fields 

TABLE GALLERY MAP TAXONOMY DATASETS ± DOWNLOAD

Simple Advanced

	Occurrences	Dataset	Publisher	Type
Record License	17,334	NMNH Extant Specimen Records	National Museum of Natural History, Smithsonian Institution	occurrence dataset
Scientific Name	13,350	UF Invertebrate Zoology	Florida Museum of Natural History	occurrence dataset
Basis Of Record	6,001	MICROBIS database	Marine Biology Laboratory	occurrence dataset
Location	5,130	EOD - eBird Observation Dataset	Cornell Lab of Ornithology	occurrence dataset
Year	1,468	Stuart M. Fullerton Collection of Arthropods (UCFC), University ...	Museum of Biological Diversity, The Ohio State University	occurrence dataset
Month	1,177	CAS Ichthyology (ICH)	California Academy of Sciences	occurrence dataset
Dataset	1,166	MAL	Academy of Natural Sciences	occurrence dataset
Country Or Area	856	Australian Museum provider for OZCAM	Australian Museum	occurrence dataset
Guam	775	Museum of Comparative Zoology, Harvard University	Museum of Comparative Zoology, Harvard University	occurrence dataset
Issue	749	iNaturalist Research-grade Observations	iNaturalist.org	occurrence dataset
Media Type	515	Naturalis Biodiversity Center (NL) - Botany	Naturalis Biodiversity Center	occurrence dataset
Publisher	506	CAS Herpetology (HERP)	California Academy of Sciences	occurrence dataset
Institution Code	444	LSUMZ (LSU MNS) Fishes Collection	Louisiana State University Museum of Natural Science	occurrence dataset
Collection Code	358	Paleobiology Database	Paleobiology Database	occurrence dataset
Catalogue Number	343	LACM Vertebrate Collection	Natural History Museum of Los Angeles County	occurrence dataset
Type Status	309	Diversity of the Indo-Pacific (DiPnet)	The Genomic Observatories Metadatabase (GeOME)	occurrence dataset
	300	Fishbase	FishBase	occurrence dataset
	254	Natural History Museum (London) Collection Specimens	Natural History Museum	occurrence dataset

GBIF occurrences gallery

Secure | <https://www.gbif.org/occurrence/gallery?country=GU>

Apps For quick access, place your bookmarks here on the bookmarks bar. Import bookmarks now...

Get data Share Tools Inside GBIF

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 76,596,001

Australia 67,937,939

United Kingdom 65,971,118

Canada 44,471,800

France 36,446,127

Germany 28,780,698

Norway 27,147,230

Denmark 26,951,786

Spain 26,475,264

Wasmanina auto punctata (Roger, 1863) Chaetodon lunulatus Quoy & Gaimard, 1825 Leucocoprini bambusanae (Codd & Singer) Catopsilia pomona (Fabricius, 1775) Passiflora foetida L. Clerodendrum speciosissimum Drapiez Hypolimnas bolina Linnaeus, 1758

Papilio polytes Linnaeus, 1758 Hibiscus elaeoides L. Hypolimnas octocula marianensis Frivaldszky, 1912 Papilio polytes Linnaeus, 1758 Ximella americana L. Disocalyx megacarpa Merr. Wikstroemia elliptica Merr. Clerodendron paniculatum (L.) Gaertn.

Euphorbia heterophylla L. Phyllanthus mariannensis W.L. Wagner & Lorence Inisa bijuga Kunze Cordia subcordata Lam. Ficus microcarpa var. saffordii (Merr.) Corlett Cycas micromeris K.D.Hill Papilio polytes Linnaeus, 1758 Dolichoschista tongana

Syzygium thompsonii (Men.) N. Snow Protaetia orientalis (Gory & Percheron, 1833) Inisa blaga Kunze Passiflora foetida L. Protaetia prienii (Jansson, 1888) Centrosema pubescens Benth. Ipomoea pes-caprae (L.) R. Brown

Navigation icons: back, forward, search, etc.

GBIF simple search for "Guam"

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

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: Pseudoplesiopinae) 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: Pseudoplesiopinae). *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:

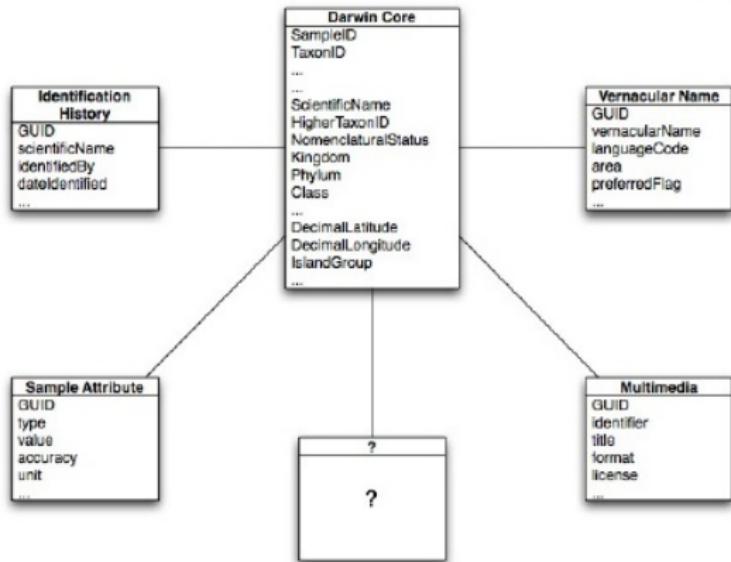
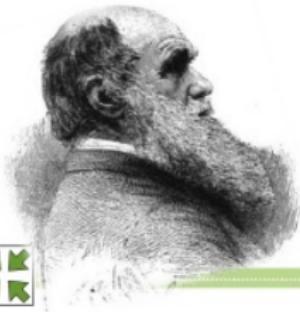
- is the "Tree of Life" used by GBIF to deal with all taxon names within its database
- currently includes 2.7 million accepted taxon names and 2.3 million synonyms
- can be downloaded (as a Darwin Core Archive) for local use



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

