

University of Guam  
College of Natural and Applied Sciences  
Cooperative Extension and Outreach  
Comprehensive Faculty Evaluation System

Work Plan  
June 15, 2016 - June 14, 2017

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August 1, 2016

This document was written using LyX 2.0.8. Zotero and LyZ were used for handling references. Relevant files are stored in a GitHub repository at <https://github.com/aubreymoore/CFES2016>.

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# 1 Personal Information and Roles

## 1.1 Basic Information

**Current Rank and Step:** Entomologist / Associate Professor

**Evaluation Period:** June 15, 2016 - June 14, 2017

## 1.2 Role Assignments

	Percent of Time
<b>Extension and Outreach:</b>	51% (primary focus must be at least 50%)
<b>Creative/Research/Scholarly:</b>	34%
<b>Instruction:</b>	0%
<b>University Service:</b>	15%
<b>TOTAL:</b>	100%

## 1.3 Consulting Activities During Performance Period

None

## 1.4 Signatures

As called for by the University [Comprehensive Faculty Evaluation System](#), I hereby acknowledge that I have notified my unit Chair and unit colleagues of my preferences for role assignments.

Further, I have met with my appropriate administrative supervisor and discussed my evaluation plan for the period above cited. I understand that amendments to my plan are possible and that said amendments, if any, are to be discussed with and agreed upon by my administrator prior to initiating.

_____ Faculty Member	_____ Date
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_____ Associate Dean	_____ Date
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_____ Dean/Director	_____ Date
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## **2 Activities**

### **2.1 Extension and Outreach (51%)**

#### **2.1.1 Insect Diagnostic Services**

As an extension entomologist, a major part of my job is providing insect identification and pest control recommendations to a diverse clientele including commercial growers, gardeners, householders, Gov-Guam and federal agency personnel, and University of Guam colleagues. Most client contacts are initiated by a phone call or a visit by the client to the ANR office. In many cases identification and pest control recommendations require a site visit by me and/or extension associates to collect samples to define the problem and develop recommendations. In some cases, I am sent digital images of insects and damage caused by them.

As an official USDA-APHIS cooperator, I am obligated to identify insects intercepted by Guam Customs and Quarantine and specimens submitted to the USDA-APHIS Guam Plant Inspection Facility.

#### **Planned Activity**

1. Identify insects and make control recommendations when requested.

#### **Planned Evidence of Accomplishment**

1. iNaturalist posts documenting insect identifications

#### **Planned Evaluation By**

#### **Actual Activity**

#### **Actual Evidence of Accomplishment**

#### **Actual Evaluation By**

### 2.1.2 Detection and Documentation of Invasive Species

As with any other tropical island, Guam is extremely susceptible to environmental and economic damage by invasive species. Despite this fact, Guam's biosecurity is very weak and invasive species, many of them insects, are arriving at unprecedented rates. Bioinvasions are grossly under-reported for several reasons:

1. Professional capacity is lacking. Twenty years ago, there were 9 PhD level entomologists practising in Micronesia. Only 2 remain (Moore, Miller), despite an increased workload largely due to arrival of the cycad scale, coconut rhinoceros beetle and little fire ant and other invasive species of insects. UOG typically has 4 entomologists. We now have 2.
2. We suffer from the *taxonomic impediment*. The two remaining PhD level entomologists are generalists without the skills and resources for species determination of most insect groups. Timely and accurate species determination is a necessary first step in response to a new pest invasion.
3. There is no ongoing biological survey of Guam with the goal of establishing a baseline biodiversity inventory and detecting newly arrived invasive species. Unfortunately, CAPS surveys are usually focused on demonstrating absence of specific agricultural pests rather than detecting new invasions.
4. Even when invasive species are detected and properly identified, first island records are not documented and the information is not published in the scientific press.

In an attempt to improve this situation, I have set myself up as a *registrar* for new insect species arriving on Guam with the intent of properly documenting the ongoing bioinvasion of Guam. The procedure I am trying to establish is:

1. First detector sends me a digital image and/or specimen
2. Specimens are prepared and accessioned into the UOG insect collection
3. A fact sheet is prepared using a template for Guam New Invasive Species Alerts
4. The fact sheet is distributed to a list of stakeholders
5. Taxonomic assistance is obtained for an authoritative species determination.
6. A journal article is prepared and published in a refereed scientific journal. At this point the new geographical distribution data become available to the scientific community via the Global Biodiversity Facility (GBIF).

Although I have been able to generate about a dozen invasive species alerts over the past years, only one new island record has made it into a peer reviewed journal.

#### Planned Activity

1. Continue adding to and maintaining the Guam Invasive Species Alerts fact sheet series.

#### Planned Evidence of Accomplishment

1. Guam Invasive Species Alerts fact sheets

#### Planned Evaluation By

#### Actual Activity

#### Actual Evidence of Accomplishment

#### Actual Evaluation By

### 2.1.3 University of Guam Insect Collection

The UOG insect collection is a valuable reference collection for extension entomology, teaching and research. I am a member of the board of directors for the collection and I work with Dr. Ross Miller to curate and catalog this collection.

To increase my knowledge of collection management, I attend the annual meetings of the Entomological Collections Network, which are typically held in conjunction with annual meetings for the Entomological Society of America.

I have a professional goal of building an online website to share all available information on Micronesian insects. This will include specimen level information for the collection complete with digital images and literature references.

Here is a record of progress towards that goal:

1. I built a digital catalog for the collection is using the BioLink Biodiversity Information Management System from CSIRO, Australia. The catalog currently contains 29,200 specimen records. BioLink is currently being redeveloped as an open source project (<http://code.google.com/p/biolink/>). I am an active collaborator in this project. In July 2012 I published an article entitled *Hosting a Biolink Database in the Amazon Web Services Cloud (EC2)* on the project's wiki (<http://code.google.com/p/biolink/wiki/BioLinkEC2>).
2. I have built and evaluated two websites for serving information on Micronesian insect biodiversity, including specimen level data from the collection. One is a Drupal content management system template called LifeDesk provided the Encyclopedia of Life Project and the other is a similar template called ScratchPads provided by the Museum of Natural History in London. I am honored to have been selected as an advocate for ScratchPads as part of the project's Ambassadors program (<http://scratchpads.eu/locate-scratchpad-ambassadors>).
3. In March 2014 I travelled to Honolulu to attend the Biodiversity Collections Digitization in the Pacific workshop sponsored by the Integrated Digitized Biocollections (IDigBio). I made an oral presentation entitled *Evaluation of a Scratchpad Template as an Online Database for the University of Guam Insect Collection* [1] at this workshop.
4. In May 2014 I met with Dr. Bob Foottit at the Canadian National Insect Collection in Ottawa to discuss progress and future directions for the UOG collection. Dr. Foottit is a member of the board of directors for the UOG Insect collection.

#### Planned Activity

1. Continue curation and databasing of the UOG Insect Collection.
2. Continue evaluation of Specify as an online database for the UOG Insect Collection.

#### Planned Evidence of Accomplishment

1. Specimen records.

#### Planned Evaluation By

#### Actual Activity

#### Actual Evidence of Accomplishment

#### Actual Evaluation By

#### **2.1.4 Guam Coconut Rhinoceros Beetle Project**

This is currently my largest and most time consuming project.

The coconut rhinoceros beetle (CRB) was first detected on Guam in the Tumon Beach hotel area on September 11, 2007. CRB is a very serious pest of coconut palms. Adult beetles may kill coconuts and other palms when they bore into the crowns to feed on sap. When CRB invaded Palau during the Second World War, it killed about half of all coconuts through the islands and totally exterminated the coconut palm from some of them. A delimitation survey indicated that the Guam infestation was limited to Tumon Bay and the adjacent Faifai Beach. In consultation with the Guam Department of Agriculture (GDOA), USDA-APHIS, and USDA-Forest Survey, it was decided to launch an eradication project.

I wrote the original eradication plan and this was funded by USDA and local funds. USDA provided funds under the condition that the project was to be run under an Incident Command System with the USDA-APHIS Guam Port Director as the federal commander, and the GDOA Director, or designee, as the local commander.

My original role was to provide scientific/technical support for the project, with the Guam Department of Agriculture (GDOA) providing project management with assistance from USDA-APHIS and USDA-Forest Service. However, it soon became apparent that GDOA had serious bureaucratic impediments which prevented hiring staff and procuring supplies and equipment within a reasonable time frame. The eradication project directors, with the consent of the Dean, agreed to run project staffing, procurement, and fiscal management through the University. As a result, my role expanded to include much of the project management.

In December 2013, an infestation of CRB was detected on Hickam Air Force Base on Oahu. Roland Quitugua and myself were recruited as subject matter experts and spent a week in Honolulu advising an incident command team set up by APHIS.

I have formed two collaborative research groups to do applied research aimed at controlling CRB damage. Dr. Sean Marshall and Dr. Trevor Jackson at AgResearch New Zealand collaborate with me on biological control using oryctes nudivirus (OrNV) and CRB population genetics. Dr. Matthew Siderhurst a chemical ecologist at the Eastern Mennonite University in Virginia collaborates with me on CRB trap improvement and CRB behavior.

In December 2013, an infestation of CRB was detected on Hickam Air Force Base on Oahu. Roland Quitugua and myself were recruited as subject matter experts and spent a week in Honolulu advising an incident command system (ICS) team set up by APHIS. Later, we were both added to a national technical working group (TWG) for CRB.

Early in 2015, the directors of the Western IPM Center at UC Davis asked me to help organize a meeting to prioritize applied research needs for development of CRB IPM. I co-authored an agenda and attendance list with Arnold Hara and Roland Quitugua. The meeting took place at the Hawaii Department of Agriculture on April 3, 2015 and was chaired by WIPM Center Director Kassim Al-Khatib.

#### **Planned Activity**

1. Provide scientific/technical support to the Guam Coconut Rhinoceros Beetle Project. My focus will be on CRB-G biocontrol and monitoring health of coconut palms on Guam. For details, see the CRB Biocontrol section under Creative / Scholarly / Research for details .

#### **Planned Evidence of Accomplishment**

1. Technical reports, refereed journal articles

#### **Planned Evaluation By**

#### **Actual Activity**



Actual Evidence of Accomplishment

Actual Evaluation By

### **2.1.5 National Plant Diagnostic Network (NPDN)**

I am the UOG coordinator for the Western Plant Diagnostic Network (WPDN) which is a regional branch of NPDN. This organization provides financial support for ANR's Plant Diagnostic Laboratory, offers First Detector Training workshops, and organizes identification workshops for important pest groups. As coordinator, I am required to organize First Detector Training workshops, attend monthly conference calls, and attend national meetings which are currently held on a 3 year cycle.

#### **Planned Activity**

1. Participate in monthly conference calls.
2. Train and certify First Detectors.
3. Prepare annual work plan and annual report.

#### **Planned Evidence of Accomplishment**

#### **Planned Evaluation By**

#### **Actual Activity**

#### **Actual Evidence of Accomplishment**

#### **Actual Evaluation By**

### **2.1.6 Guam Invasive Species Advisory Committee (GISAC)**

I am an active, founding member of this informal group of Guam's biologists which meets irregularly about 6 times per year to discuss invasive species and what can be done to keep them out and mitigate the effects of those that do invade the island. I worked with Dr. Russell Campbell and Diane Vice to develop an emergency response plan for invasive species detected on Guam.

A wiki site which I built for GISAC was quickly adopted by the Western Micronesia Regional Invasive Species Council.

#### **Planned Activity**

1. Participate in GISAC meetings.

#### **Planned Evidence of Accomplishment**

#### **Planned Evaluation By**

#### **Actual Activity**

#### **Actual Evidence of Accomplishment**

#### **Actual Evaluation By**

### **2.1.7 Public Outreach (Guest lectures, presentations, interviews)**

#### **Planned Activity**

1. Provide accurate scientific and technical information to the public as required.

#### **Planned Evidence of Accomplishment**

1. Newspaper articles, radio and television interviews

#### **Planned Evaluation By**

#### **Actual Activity**

#### **Actual Evidence of Accomplishment**

#### **Actual Evaluation By**

### 2.1.8 Public Outreach(Internet)

During the past decade I published a lot of content on various websites. I have evaluated several current technologies for building a web presence for the Agriculture and Natural Resources Unit and the Drupal content management system seems to be a good fit. This allows us to publish information for public access while keeping some documents private for internal use only. My print and online output are discussed in more detail in the Creative/Scholarly Activity section.

Previous to establishment of the CNAS-RE WordPress site, I maintained a website for the the UOG Cooperative Extension Service's Agriculture and Natural Resources Program at <http://guaminsects.net/ANR>. I frequently posted blog articles of public interest to this site. I also maintain a website at <http://guaminsects.myspecies.info> which is intended to facilitate sharing information on insects in Micronesia. I submit blog articles to this website which are more technical and are of interest to biologists. To see a list of my blog post on this site, visit <http://guaminsects.myspecies.info/blogs/aubrey-moore>.

Note that these blogs also contain posts containing information which is not intended for the public. These posts are shared with selected groups of clients and colleagues using a password authentication system.

I maintain a website for the Western Micronesia Regional Invasive Species Council (RISC) at <http://www.guaminsects.net/gisac/>. I attend RISC meetings whenever they are held on Guam and I make presentations at these meetings.

#### Planned Activity

1. Phase out use of the ANR Drupal site and move content to the new CNAS-RE WordPress Site.
2. Provide an online database of insect crop pests in Micronesia with links to images and fact sheets. This activity overlaps with plans to create a Guam Biodiversity Inventory (see section in Create/Scholarly/Research).

#### Planned Evidence of Accomplishment

1. Blog posts.

#### Planned Evaluation By

#### Actual Activity

#### Actual Evidence of Accomplishment

#### Actual Evaluation By

## 2.2 Creative / Scholarly / Research (34%)

I am an insect ecologist with broad interests in biology and technology. In my current position of extension entomologist, I apply my knowledge and skills to finding real solutions to real problems caused by insects on Guam. In addition to providing extension services, I currently run four applied research programs:

1. Coconut rhinoceros beetle (CRB) biocontrol.
2. Cycad Aulacaspis scale (CAS) biocontrol.
3. Guam Insect Pest Survey.
4. Eight Spot Butterfly Conservation.

I spend significant time and effort keeping up-to-date with modern technology. I am currently using and learning about the following technologies:

1. Python programming; IPython Notebook; Django web framework; OpenCV digital image analysis software
2. Quantum GIS
3. Open Science Framework [2]
4. iNaturalist [3]
5. Git, GitHub [4]
6. LaTeX, LyX, Zotero, OverLeaf
7. Raspberry Pi
8. Linux (Ubuntu)

### 2.2.1 Coconut Rhinoceros Beetle (CRB) Biocontrol

The 2002, the coconut palm was the second most abundant tree (DBH>5") in Guam's forests [5]. An uncontrolled outbreak of CRB is rapidly killing these trees.

CRB has been invading Pacific Islands for more than 100 years. If left unchecked, CRB has the potential to kill all of the coconut palms on an island. Tree mortality occurs when adult beetles destroy the growing tip of a palm when they bore into the crown to feed on sap. Immature beetles (grubs), which feed on decaying vegetation, do no damage. In a worst case scenario adult CRB become so abundant that they kill large numbers of palms. These dead palms become breeding sites which generate even more adult beetles which kill even more palms. This positive feedback loop may be initiated by an increased availability of CRB breeding sites in massive amounts of decaying vegetation left behind in the wake of a typhoon.

Prior to the CRB invasion of Guam, this pest was effectively controlled wherever it has established by introduction of oryctes nudivirus (OrNV) as a classical biocontrol agent. OrNV is a selective insect pathogen which only kills rhinoceros beetles (Subfamily Dynastinae). The disease it causes spreads naturally through a population. OrNV is a positively density-dependent biocontrol agent, meaning that it attacks a higher proportion of individuals at higher population densities. After introduction of OrNV into a CRB population, damage to coconut palms drops by as much as 90% and population suppression is sustained.

Attempts to control CRB using OrNV have failed for the first time on Guam. Recent research by Sean Marshall at AgResearch New Zealand and myself indicates that Guam has been invaded by a new biotype, CRB-Guam, which is genetically distinct from other other populations of CRB and is resistant

to all 8 isolates of OrNV available in cell culture. Thus we have lost the major biocontrol agent for controlling CRB on Pacific islands.

CRB-Guam has so far been detected in Guam, Hawaii, Palau, and the Port Moresby area of Papua New Guinea and this virus-resistant biotype is likely to spread further unless populations are suppressed. This is a regional problem for Pacific islands and trading partners. Unconstrained population outbreaks of CRB-Guam following typhoons will lead to high levels of local damage to palms and increased risk of accidental export of CRB-Guam to other other islands.

Mapping the geographical extent of CRB-Guam and searching for a strain of OrNV which is highly pathogenic for this biotype should be a priority. Although the Guam CRB Project has developed improved management tools for CRB, these are not sufficient to maintain CRB population levels at acceptable levels on an island-wide basis.

### **Planned Activity**

1. Complete bioassays to recheck pathogenicity of previously tested OrNV samples from AgResearch New Zealand.
2. Participate in the International Congress of Entomology in Orlando, Florida in September 2016. I have been invited to give an oral presentation on CRB-G at a symposium on scarab beetles.
3. I will work to set up an international collaborative project with the goal of mapping the CRB-Guam biotype and finding a strain of OrNV which can be used as an effective biocontrol agent. Potential collaborators are AgResearch NZ, SPC, Philippine Coconut Authority, and USDA. This project will have a foreign exploration component which will collect CRB and virus samples throughout the Asian/Pacific region. Genotyping and virus detection will be done by AgResearch NZ. Bioassays in which CRB-Guam beetles will be challenged with virus candidates will be done in my laboratory at UOG.
4. As per my approved FY2016 Farm Bill grant, I plan to visit Palau and Negros Island, Philippines with Dr. Sean Marshall, AgResearch New Zealand and my graduate student, Ian Iriart in early 2017. CRB-G has been detected at both of these locations.
5. I plan to submit a FY2017 Farm Bill suggestion to continue my work on establish biocontrol of CRB-G to prevent further coconut palm mortality on Guam. This suggestion will also request support for establishment of a semiannual coconut palm health survey.

### **Planned Evidence of Accomplishment**

1. Technical reports, scientific journal articles, presentations.

### **Planned Evaluation By**

### **Actual Activity**

### **Actual Evidence of Accomplishment**

### **Actual Evaluation By**

### 2.2.2 Cycad Aulacaspis Scale Biocontrol

In 2002, the endemic cycad, *Cycas micronesica*, known locally as fadang, was the most abundant tree (DBH>5”) in Guam’s forests [5]. An uncontrolled outbreak of CAS and recently arrived other invasive species has killed about 90% of these trees. Several attempts at establishing effective biocontrol have failed. Note that this project is currently unfunded.

#### Planned Activity

1. Determine if the parasitoid *Coccobius fulvus* which was released twice at Ritidian at the end of 2016 has established.
2. Evaluate the impact of *Arrhenophagus* sp. on the Guam cycad population
3. Write and submit a peer-reviewed scientific journal article on CAS biocontrol.

#### Planned Evidence of Accomplishment

1. Peer reviewed article on CAS biocontrol.

#### Planned Evaluation By

#### Actual Activity

#### Actual Evidence of Accomplishment

#### Actual Evaluation By



### **2.2.3 Guam Forest Insect Survey**

The objective of the proposed survey is to build a knowledgebase on insects associated with plants in Guam's forests. The survey will result in a reference collection of Guam's forest insects and a publicly available online database to facilitate sharing of specimen data, images and ecological associations among plants and insects. The knowledgebase will be usefull to natural resource managers responsible for maintaining the health of Guam's forests and to biologists trying to understand Guam's terrestrial ecosystems in the wake of major biological invasions.

#### **Planned Activity**

1. Information on insects associated with Guam's forest plants will be made available online.

#### **Planned Evidence of Accomplishment**

#### **Planned Evaluation By**

#### **Actual Activity**

#### **Actual Evidence of Accomplishment**

#### **Actual Evaluation By**

#### **2.2.4 Eight Spot Butterfly Conservation**

Larval host plants of this rare butterfly are heavily browsed by ungulates and many areas where they exist are being cleared for military buildup and associated development projects. Although there have been several recent surveys *H. o. marianensis* and its host plants, no work has been done towards establishing captive and managed populations of *H. o. marianensis* and its host plants.

This project will investigate the feasibility of rearing and breeding *H. o. marianensis* on host plants in cages and also in field sites where ungulates are excluded. The establishment of captive breeding colonies and managed populations of this rare butterfly will reduce risk of extinction.

#### **Planned Activity**

1. Propagate and maintain at least 100 plants of each of the eight-spot's known host plants, *Procris pendunculata* and *Elatostema calcareum* in a plant nursery.
2. Establish a self-sustaining, caged, breeding colony of eight-spot butterflies using 30 field-collected caterpillars reared on plants from the nursery.
3. Propagate host plants throughout two 10 x 10 meter, wooded limestone areas at the University of Guam's Agricultural Experiment Station in Yigo.
4. Release 60 cage-reared eight-spot butterflies and larvae on protected host plants.

#### **Planned Evidence of Accomplishment**

1. Technical reports.

#### **Planned Evaluation By**

#### **Actual Activity**

#### **Actual Evidence of Accomplishment**

#### **Actual Evaluation By**

### **2.2.5 Guam Biodiversity Inventory**

A checklist of organisms on Guam and their ecological relationships will be built using modern biodiversity informatics standards. This checklist will have multiple uses including documentation of invasive species and interactions among taxa.

#### **Planned Activity**

1. Design and build Check List Plus (CLP) an online database to store a “tree of life” for Guam using a reference taxonomy from the National Center for Biotechnology (NCBI). The database will contain synonyms, references (to the literature, observations and specimens), and ecological relationships (such as links between herbivores and host plants).
2. Populate CLP with the flora and fauna of Guam from the scientific literature. Initial targets will include a list of all crops and important forest plants growing on Guam, insect pests that feed on these plants, and biocontrol agents controlling these insects.

#### **Planned Evidence of Accomplishment**

1. An online database which can be queried to return useful information such as a list of all caterpillars feeding on cabbage on Guam with links to images and fact sheets for these species.

#### **Planned Evaluation By**

#### **Actual Activity**

#### **Actual Evidence of Accomplishment**

#### **Actual Evaluation By**

## **2.3 University and Community Services (15%)**

### **2.3.1 Instruction**

#### **Planned Activity**

1. I will serve as Ian Iriarte's major professor during his masters program in environmental science.

**Planned Evidence of Accomplishment**   None.

#### **Planned Evaluation By**

#### **Actual Activity**

#### **Actual Evidence of Accomplishment**

#### **Actual Evaluation By**

### **2.3.2 University Technical Advisory Committee**

#### **Planned Activity**

1. I will continue to serve on UTAC as the representative for the College of Natural and Applied Sciences.

#### **Planned Evidence of Accomplishment**

#### **Planned Evaluation By**

#### **Actual Activity**

#### **Actual Evidence of Accomplishment**

#### **Actual Evaluation By**

### **2.3.3 Faculty Building Facilities Committee for the ALS**

#### **Planned Activity**

1. I will continue to serve as chair of the Faculty Building Facilities Committee for the ALS

#### **Planned Evidence of Accomplishment**

#### **Planned Evaluation By**

#### **Actual Activity**

#### **Actual Evidence of Accomplishment**

Actual Evaluation By

### **3 Publications and Grants**

#### **3.1 Publications and Other Media Produced During The Review Period**

##### **3.1.1 Peer Reviewed Journal Articles**

##### **3.1.2 Fact Sheets**

##### **3.1.3 Presentations**

#### **3.2 Grant Proposals Submitted During the Review Period**

#### **3.3 Grants Awarded During the Review Period**

## References

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