

GUAM

Annual Performance Report

**Fisheries, Wildlife, State Wildlife and Endangered Species
Recovery Programs**

ANNUAL PERFORMANCE REPORTS

FY 2011

January 31, 2012

Division of Aquatic and Wildlife Resources,
Department of Agriculture
163 Dairy Road
Mangilao, Guam 96913671
735-3955/6

GUAM ENDANGERED SPECIES RECOVERY PROGRAM

Final, Interim Annual Performance Reports

FY2011

December 30, 2011

Division of Aquatic and Wildlife Resources,
Department of Agriculture
163 Dairy Road,
Mangilao, Guam 96913

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Final Performance Report

Guam Division of Aquatic and Wildlife Resources, Department of Agriculture
FY 2011

1. State: Guam

Grant number: E-2-12

Grant name: Endangered Species Section 6

Project number and name: Segment 12 Guam Endangered Species Recovery

Subproject and job number and name: Subproject A: Avicultural Management for Rails, Kingfishers and Crows, Job 1: Captive Propagation of Guam Rails

2. Report Period: October 1, 2008 to March 31, 2011

Report due date: June 30, 2011

3. Location of work: Guam

4. Costs: Please identify sources of federal funds and match and indicate amounts budgeted and spent for each. Indicate if match is in-kind. Indicate in table whether costs are "Actual" or "Estimated"

Source	Budgeted	FY 2009	FY2010	FY11	Total Spent
Federal :	\$183,241.00	\$170,370.36	\$7,847.28	\$3,943.00	\$182,160.64
State:					
Total Federal:	\$183,241.00	\$170,370.36	\$7,847.28	\$3,943.00	\$182,160.64
Total match:					
Total project:	\$183,241.00	\$170,370.36	\$7,847.28	\$3,943.00	\$182,160.64

5. Objectives:

- a. Increase the number of actively breeding pairs of Guam rails at the GDAWR facilities until a maximum of 22 pairs is reached.
- b. Produced at least five Guam rails from each pair of rails annually. (Full production potential of GDAWR will be an average of 110 rails annually.)
- c. Maintain a minimum of 30 individual Guam rails at mainland zoo facilities for captive breeding.

- d. Equalize founder representation and maintain the genetic diversity of the captive flock at 90% or higher.
- e. Transfer three ko'ko' to mainland zoos, and 25 ko'ko' from zoos to the GDAWR facility every year to maintain genetic diversity within the captive population, as well as support the release program.

6. If the work in this grant was part of a larger undertaking with other components and funding, present a brief overview of the larger activity and the role of this project.

This grant provided all funding for endangered Guam rail captive propagation on Guam. Other funding was provided by 17 US zoological facilities participating in the Guam Rail Species Survival Plan. Each institution funded the husbandry efforts of maintaining and reproducing rails at their respective facility.

The overall goal of this effort is to increase the captive Guam rail population to supply Guam rails for release into the wild. As the majority of the captive population is located on Guam, our institution is able to reproduce over 90% of rails produced annually.

7. Describe how the objectives were met. See “Supplemental Information” for additional requirements and “Attachments” for specialized tables.

This project was extended for six months in FY11 for the sole purpose of purchasing geckos and skinks. In March, 7886g of lizards were purchased.

This project was extended in FY10 in order to purchase a new computer for the Wildlife Lab, perform ground maintenance in the rail captive breeding facility and purchase food items to feed the birds. Slated also for purchase with the extension funds were repairs, parts, and general maintenance for the tractor, however this was not accomplished due to problems between the Guam company and John Deere on the mainland.

In FY09, 14 pairs produced one hundred chicks that were banded and added to the captive flock (average 7.14 chicks per pair). Nine deaths occurred at the facility: one from old age, one eight year old female with diabetes was euthanized as her quality of life had severely deteriorated, one died of necrotic toxicity from a partially formed egg that attached to her uterus and festered, two died of starvation, four unknown deaths. Sixty-five rails were transferred from Guam and hard released on Rota. Over 30 rails are held at mainland zoos for captive breeding. Genetic diversity ranged between 88% and 89% during FY09. No rails were transferred between Guam and the US mainland.

8. Discuss differences between work anticipated in grant proposal and grant agreement, and that actually carried out with Federal Aid grant funds; include differences between expected and actual costs.

In FY09, the goal of creating 22 pairs was achieved as pairing was difficult. Genetic

diversity below the desired goal of 90% is due to behavior difficulties within genetically compatible pairs as well. Rails were not transferred between Guam and the mainland as the Guam Rail Species Survival Plan Coordinator did not deem this necessary this fiscal year.

9. List any publications or in-house reports resulting from this work.

N/A

Name, title, phone number, and e-mail address of person compiling this report:

Suzanne Medina, Wildlife Biologist III, 671-735-3985, medinasuzanne@gmail.com

Final Performance Report

Guam Division of Aquatic and Wildlife Resources, Department of Agriculture
FY 2011

1. State: Guam

Grant number: E-2-12

Grant name: Endangered Species Section 6

Project number and name: Segment 9 Guam Endangered Species Recovery

Subproject and job number and name: **Subproject A:** Avicultural Management for Rails, Kingfishers and Crows, Job 2: Mariana Crow Avicultural Support

2. Report Period: October 1, 2008 to March 31, 2011

Report due date: June 30, 2011

3. Location of work: Guam

4. Costs: Please identify sources of federal funds and match and indicate amounts budgeted and spent for each. Indicate if match is in-kind. Indicate in table whether costs are "Actual" or "Estimated"

Source	Budget for FY09 only	Spent in FY09 only
Federal :	\$38,979.00	\$24,853.78
State		
Other:		
Total Federal	\$38,979.00	\$24,853.78
Total match		
Total project:	\$38,979.00	\$24,853.78

5. Objectives (list project objectives from grant proposal or grant agreement)

- a. Artificially incubate, hatch, hand-rear and release back into the wild up to nine eggs from nests on Guam.
- b. Prevent imprinting by rearing aga with broodmates and mentor birds.
- c. Maintain ten outdoor aviaries.

6. If the work in this grant was part of a larger undertaking with other components and funding, present a brief overview of the larger activity and the role of this project.

This grant provides all funding for aviculture support for the Mariana crow. This work is part of a larger undertaking to reestablish Mariana crows in northern Guam. Other grants, such as Office of Insular Affairs Brown Treesnake Control Grant and the Department of Defense Civil Engineering Environmental Section grant fund area-wide snake control measures and the installation of brown treesnake barriers on active Mariana crow nesting trees. Guam Wildlife Restoration Grant W-1-R-17 supports search and inventory of released crows.

7. Describe how the objectives were met. See “Supplemental Information” for additional requirements and “Attachments” for specialized tables.

This project was not worked on in FY10 and FY11.

Zero eggs were pulled from the wild in FY09. Intensive crow searches from October to January revealed two males. Breeding attempts with the male and female crows at the GDAWR captive breeding facility were unsuccessful. After clinical exams with the project’s veterinarian, the GDAWR captive female was deemed infertile as an egg had ruptured in her uterus. The ten outdoor aviaries were maintained throughout the year.

8. Discuss differences between work anticipated in grant proposal and grant agreement, and that actually carried out with Federal Aid grant funds; include differences between expected and actual costs.

Due to only two males found in the wild, no crow eggs were reproduced. This resulted in lesser hours worked and funds spent on the project than anticipated.

9. List any publications or in-house reports resulting from this work.

N/A

Name, title, phone number, and e-mail address of person compiling this report:
Suzanne Medina, Wildlife Biologist III, 671-735-3997, medinasuzanne@gmail.com

Final Performance Report

Guam Division of Aquatic and Wildlife Resources, Department of Agriculture
FY 2011

1. State: Guam

Grant number: E-2-12

Grant name: Endangered Species Section 6

Project number and name: Segment 9 Guam Endangered Species Recovery

Subproject and job number and name: Subproject A: Avicultural Management for Rails, Kingfishers and Crows, Job 3: Captive Propagation of Guam Micronesian Kingfishers

2. Report Period: October 1, 2009 to March 31, 2011

Report due date: June 30, 2011

3. Location of work: Guam

4. Costs: Please identify sources of federal funds and match and indicate amounts budgeted and spent for each. Indicate if match is in-kind. Indicate in table whether costs are "Actual" or "Estimated".

Source	Budgeted	FY09	FY10	Total Spent in FY09 and FY10 only
Federal : _____	\$59,470.00	\$26,880.46	\$5,580.00	\$32,460.46
State				
Other: _____				

Total Federal	\$59,470.00	\$26,880.46	\$5,580.00	\$32,460.46
Total match				
Total project:	\$59,470.00	\$26,880.46	\$5,580.00	\$32,460.46

5. Objectives (list project objectives from grant proposal or grant agreement)

- a. Transfer 0.3 (males.females) sihek from mainland zoos to the Guam facility.
- b. Limit hand-rearing of sihek chicks by assisting parents in supplemental feeding of chicks in the nest.

- c. Maintain captive sihek on Guam by feeding locally caught lizards as the main component to their diet.

6. If the work in this grant was part of a larger undertaking with other components and funding, present a brief overview of the larger activity and the role of this project.

This grant provided the funds to captive breed Guam Micronesian kingfishers on Guam. Other funding was provided by 13 zoological facilities participating in the Micronesian Kingfisher Species Survival Plan (SSP). Each institution funds the husbandry efforts of maintaining and reproducing kingfishers at their respective facility.

The overall goal of this effort is to increase the captive Micronesian kingfisher population to sufficient numbers to begin reintroductions in snake-controlled areas on Guam.

7. Describe how the objectives were met. See “Supplemental Information” for additional requirements and “Attachments” for specialized tables.

This project was not worked on in FY11.

During FY10, funds were extended to allow for the purchase of geckos to feed the captive sihek.

In FY09, 1.1 sihek were transferred to Guam in October 2008 from US mainland zoos. Four pairs produced 20 eggs in 10 nesting attempts. Ten eggs were infertile, nine eggs hatched, and one embryo was killed by its sibling. Of those nine hatchings, only four chicks survived to be banded and added to the captive flock. Of the five chicks that did not survive, two were consumed by snakes, one fell out of the nest, and two disappeared. Supplemental feeding at the nest was performed with six of the nine hatchlings (all but one perished), three hatchlings were hand-reared, and one was parent reared. All three hand-reared chicks and the one parent-reared chick survived to fledge. Birds were fed a diet consisting of locally caught geckos and skinks as well as some crickets and mealworms.

8. Discuss differences between work anticipated in grant proposal and grant agreement, and that actually carried out with Federal Aid grant funds; include differences between expected and actual costs.

When the FY09 Section 6 proposals were written, GDAWR requested the transfer of three females from the mainland zoo. Two females arrived in September 2009 and the remaining female arrived October 2009. GDAWR also agreed to accept a male, which was shipped with the female in October 2009.

Six hatchlings were supplemental fed at the nest and, unfortunately, only one fledged. Two the six were consumed by snakes, one fell out of the nest, and two disappeared from the nest. The final chick was supplemental fed by GDAWR staff for the first few days

after hatching but it was apparent that the parents were feeding the chick and GDAWR's involvement ceased. Due to the high risk in losing the chick this fiscal year, GDAWR staff decided to hand-rear the remaining chicks (three).

Of the ten infertile eggs, six eggs were from one male. In FY08, this male was paired with a different female that also resulted in infertile eggs. This male is 15 years old and is most likely senescent.

9. List any publications or in-house reports resulting from this work.

N/A

Name, title, phone number, and e-mail address of person compiling this report:
Suzanne Medina, Wildlife Biologist III, 671-735-3997, medinasuzanne@gmail.com

Final Performance Report

Guam Division of Aquatic and Wildlife Resources, Department of Agriculture
FY 2011

1. State: Guam

Grant number: E-2-12

Grant name: Guam Endangered Species Recovery

Subproject and job number and name: Sub-Project B: Development of an Experimental Population of Guam Rails on Rota and Other Suitable Islands, Job 1: Establishment of Experimental Population of Guam Rails on Rota and Other Suitable Islands.

2. Report Period: October 1, 2009 to March 31, 2011

Report due date: June 30, 2011

3. Location of work: Guam

4. Costs: Please identify sources of federal funds and match and indicate amounts budgeted and spent for each. Indicate if match is in-kind. Indicate in table whether costs are “Actual” or “Estimated”

Source	Budgeted in FY09 only	Spent in FY09 only
Federal :	\$2,000.00	\$815.00
State		
Other:		
Total Federal	\$2,000.00	\$815.00
Total match		
Total project:	\$2,000.00	\$815.00

5. Objectives (list project objectives from grant proposal or grant agreement)

- a. Release at least 100 captive bred ko’ko’ on Rota. The ko’ko’ should be genetically unimportant to the maintenance of the captive gene pool and in excess of numbers

needed for maintaining the integrity of the captive populations.

- b. Monitor survival, dispersal, reproduction and establishment of released rails through radio telemetry and surveys.
- c. Identify and eliminate or control factors limiting establishment of rails in the wild on Rota, including trapping and removal of feral cats, monitor lizards, rats and other potential predators.

6. If the work in this grant was part of a larger undertaking with other components and funding, present a brief overview of the larger activity and the role of this project.

N/A

7. Describe how the objectives were met. See “Supplemental Information” for additional requirements and “Attachments” for specialized tables.

This project was not worked on with E-2-12 extension money in FY10 or FY11.

We had released a total of 65 rails on Rota this past fiscal year: January 2009=15 rails, August 2009=50 rails.

In FY09, 14 rails were released with transmitters and were monitored for survival, dispersal, reproduction and establishment. The rails were tracked for 19 days, however, due to the resignation of the project biologist, tracking was not resumed until 45 days later. At that time, three birds were found alive, three birds were found dead (COD unknown), and the remaining signals were lost.

Tomahawk live traps and Victor Oneida size 1.5 leg-hold traps were baited with dried fish and shrimp paste to capture 55 cats and one dog in 10,848 trap nights on Rota. Animals were dispatched using a 22-caliber air rifle.

8. Discuss differences between work anticipated in grant proposal and grant agreement, and that actually carried out with Federal Aid grant funds; include differences between expected and actual costs

The objective of releasing 100 rails (95 released) was not met in FY09 because eligible individuals were lacking from our breeding population. Rails harnessed with transmitters were not monitored closely due to the sudden departure of the staff biologist.

9. List any publications or in-house reports resulting from this work.

N/A

Name, title, phone number, and e-mail address of person compiling this report:

Suzanne Medina, Wildlife Biologist III, 671-735-3985, medinasuzanne@gmail.com

Interim Project Performance Report

Guam Division of Aquatic and Wildlife Resources, Department of Agriculture
FY 2011

1. State: Guam

Grant number: E-4-TW-1

Grant name: Endangered Species Section 6

Project number and name: Segment 13 Endangered Species Recovery, Avicultural Management of Ko'ko', Sihek and Åga

2. Report Period: October 1, 2010 to September 30, 2011

Report due date: December 29, 2011

3. Location of work: Guam

4. Costs:

Source	Budgeted	FY10 Expenditures	FY11 Expenditures
Federal:	\$262,529.00	\$188,733.64	\$26,132.38
State:			
Other:			
Total Federal:	\$262,529.00	\$188,733.64	\$26,132.38
Total match:			
Total project:	\$262,529.00	\$188,733.64	\$26,132.38

5. Objectives:

1. Increase the number of actively breeding ko'ko' to 22 pairs and sihek to four pairs at the GDAWR facility.
2. Produce at least five ko'ko' and two sihek chicks from each pair.
3. Maintain a separate population of ko'ko' and sihek at mainland zoos for captive breeding and maintaining genetic diversity.
4. Equalize founder representation in both the Guam and mainland populations of

ko'ko' and sihek and maintain genetic diversity at 90% or higher in all populations.

5. Transfer birds within populations when necessary to prevent genetic drift or when genetic diversity of a population is low.
6. Continue to maintain åga in captivity.
7. Maintain the Wildlife Lab and outdoor aviaries.

6. If the work in this grant was part of a larger undertaking with other components and funding, present a brief overview of the larger activity and the role of this project.

This grant provided all funding for endangered Guam rail (*Gallirallus owstoni*) captive propagation on Guam. Other funding was provided by 17 U.S. zoological facilities participating in the Guam Rail Species Survival Plan. Each institution funded the husbandry efforts of maintaining and reproducing rails at their respective facility. The overall goal is to increase the captive Guam rail population to supply Guam rails for release into the wild. As the majority of the captive population is located on Guam, our institution is able to reproduce over 90% of rails produced annually.

The grant also provided funds for the captive Guam Micronesian kingfishers (*Halcyon c. cinnamomina*) on Guam. Other funding was provided by 13 zoological facilities participating in the Micronesian Kingfisher Species Survival Plan (SSP). Each institution funds the husbandry efforts of maintaining and reproducing kingfishers at their respective facility. The overall goal is to increase the captive Micronesian kingfisher population to sufficient numbers to begin reintroductions in snake-controlled areas on Guam.

7. Describe how the objectives were met. See “Supplemental Information” for additional requirements and “Attachments” for specialized tables.

This grant was extended in FY11 and GDAWR purchased the following items: refrigerator, three dog traps, professional blender to make rail food, washing machine, air conditioner, rail transportation and typhoon crates, and a hot water heater. This grant also provided travel for Wildlife Biologist Suzanne Medina and Wildlife Technicians Dante Ganaden and John Quenga to attend egg incubation workshops conducted by staff from the San Diego Zoo and Los Angeles Zoo.

8. Discuss differences between work anticipated in grant proposal and grant agreement, and that actually carried out with Federal Aid grant funds; include differences between expected and actual costs.

We expected to purchase parts for the facility tractor however since the tractor is over 13

years old, we were approved instead to purchase a new one. This grant was extended for FY12 for the sole purpose of purchasing a tractor.

9. List any publications or in-house reports resulting from this work.

N/A

Name, title, phone number, and e-mail address of person compiling this report:

Suzanne Medina, Wildlife Biologist, 671-735-3985, medinasuzanne@gmail.com

Interim Project Performance Report

Guam Division of Aquatic and Wildlife Resources, Department of Agriculture
FY 2011

1. State: Guam

Grant number: E-4-TW-2

Grant name: Endangered Species Section 6

Project number and name: Segment 14 Endangered Species Recovery, Avicultural Management of Ko'ko', Sihek and Åga

2. Report Period: October 1, 2010 to September 30, 2011

Report due date: December 29, 2011

3. Location of work: Guam

4. Costs:

Source	Budgeted	FY11 Expenditures
Federal:	\$279,712.00	\$181,369.69
State:		
Other:		
Total Federal:	\$279,712.00	\$181,369.69
Total match:		
Total project:	\$279,712.00	\$181,369.69

5. Objectives:

1. Increase the number of actively breeding ko'ko' to 22 pairs and sihek to four pairs at the GDAWR facility.
2. Produce at least five ko'ko' and two sihek chicks from each pair.
3. Maintain a separate population of ko'ko' and sihek at mainland zoos for captive breeding and maintaining genetic diversity.
4. Equalize founder representation in both the Guam and mainland populations of

ko'ko' and sihek and maintain genetic diversity at 90% or higher in all populations.

5. Transfer birds within populations when necessary to prevent genetic drift or when genetic diversity of a population is low.
6. Continue to maintain åga in captivity.
7. Maintain the Wildlife Lab and outdoor aviaries.

6. If the work in this grant was part of a larger undertaking with other components and funding, present a brief overview of the larger activity and the role of this project.

This grant provided all funding for endangered Guam rail (*Gallirallus owstoni*) captive propagation on Guam. Other funding was provided by 17 U.S. zoological facilities participating in the Guam Rail Species Survival Plan. Each institution funded the husbandry efforts of maintaining and reproducing rails at their respective facility. The overall goal is to increase the captive Guam rail population to supply Guam rails for release into the wild. As the majority of the captive population is located on Guam, our institution is able to reproduce over 90% of rails produced annually.

The grant also provided funds for the captive Guam Micronesian kingfishers (*Halcyon c. cinnamomina*) on Guam. Other funding was provided by 13 zoological facilities participating in the Micronesian Kingfisher Species Survival Plan (SSP). Each institution funds the husbandry efforts of maintaining and reproducing kingfishers at their respective facility. The overall goal is to increase the captive Micronesian kingfisher population to sufficient numbers to begin reintroductions in snake-controlled areas on Guam.

7. Describe how the objectives were met. See “Supplemental Information” for additional requirements and “Attachments” for specialized tables.

In FY11, 13 Guam rail pairs produced 143 eggs of which 64 hatched. Of the 64, 53 birds were banded and added to the captive population. Fourteen rail deaths occurred at the facility: one from old age, two females died due to reproductive complications (ovarian tumors and ruptured uterus with egg), one bird snagged himself on a piece of tie wire, three deaths are of unknown causes, and seven deaths were due to dogs breaking into the breeding facility then breaking into breeding cages and killing the birds. Due to the damage by the dogs, genetic diversity dropped to a low of 87.5%. Wildlife biologist Suzanne Medina traveled to Chicago to meet with the Guam Rail SSP coordinators and a population biologist from the Lincoln Park Zoo's Population Management Center.

1.0 sihek was raised at the GDAWR facility. While the chick was in the nest, the female was found dead, cause of death unknown. The male continued to raise the chick and the

chick successfully fledged. With the death of this female and the fledgling of this male, the Guam population is 9.3 birds (nine males, three females).

The female crow, Mochong, died at the facility in June. Mochong was over 12 years old and was diagnosed with kidney disease after being examined by the veterinarians from Disney's Animal Kingdom in April. Upon necropsy, cancer was discovered in her internal organs. The male crow remains at GDAWR but discussion is under way to pair him with the one-winged female crow living in captivity on Rota.

8. Discuss differences between work anticipated in grant proposal and grant agreement, and that actually carried out with Federal Aid grant funds; include differences between expected and actual costs.

The goal of creating 22 ko'ko' pairs and four sihek pairs were not achieved due to staff shortage. Genetic diversity remains below the desired 90% level due to lack of reproduction of the rails as well as poor genetic selection of the Guam sihek collection. No birds were transferred between GDAWR and the mainland zoos though during the Guam Rail SSP meeting, birds were selected for transfer both ways. GDAWR requested for the second year that up to five sihek to be sent to Guam from the mainland zoos but this transaction has yet to take place.

9. List any publications or in-house reports resulting from this work.

N/A

Name, title, phone number, and e-mail address of person compiling this report:
Suzanne Medina, Wildlife Biologist, 671-735-3985, medinasuzanne@gmail.com

Final Project Performance Report

Guam Division of Aquatic and Wildlife Resources, Department of Agriculture
FY 2011

1. State: Guam

Grant number: E-5-TW-2

Grant name: Endangered Species Section 6

Project number and name: **Segment 14 Endangered Species Recovery, Establishment of Non-Essential Experimental Population of Ko'ko', *Gallirallus owstoni*, on Rota, CNMI**

2. Report Period: October 1, 2010 to September 30, 2011

Report due date: December 29, 2011

3. Location of work: Guam

4. Costs:

Source	Budgeted	FY11 Expenditures
Federal:	\$4,920.00	\$1,025.81
State:		
Other:		
Total Federal:	\$4,920.00	\$1,025.81
Total match:		
Total project:	\$4,920.00	\$1,025.81

5. Objectives:

1. Release at least 100 captive bred ko'ko' on Rota. The birds released should have low inbreeding coefficients as individuals and high gene diversity as a group.

6. If the work in this grant was part of a larger undertaking with other components and funding, present a brief overview of the larger activity and the role of this project.

N/A

7. Describe how the objectives were met. See “Supplemental Information” for additional requirements and “Attachments” for specialized tables.

No rails were released on Rota during FY11. The captive breeding facility did not produce enough rails to release due to staff shortages. A genetic analysis of the Guam captive population was done to determine if a small release of 18 birds was acceptable. The small release was not carried out as large release cohorts are generally more successful than small cohorts.

8. Discuss differences between work anticipated in grant proposal and grant agreement, and that actually carried out with Federal Aid grant funds; include differences between expected and actual costs.

When the captive breeding facility has a complete staff, the facility is able to reproduce enough birds for two releases of 50 birds each release. A new biologist was hired in FY11 and reproduction with the rails began towards the end of this fiscal year.

9. List any publications or in-house reports resulting from this work.

N/A

Name, title, phone number, and e-mail address of person compiling this report:
Suzanne Medina, Wildlife Biologist, 671-735-3985, medinasuzanne@gmail.com

Final Performance Report

Guam Division of Aquatic and Wildlife Resources, Department of Agriculture
FY 2011

1. State: Guam

Grant number: E-6-TW-2

Grant name: Endangered Species Section 6

Project number and name: Segment 14 Guam Endangered Species Recovery

Subproject and job number and name: Environmental Education for Guam's Endangered Species

2. Report Period: October 1, 2010 to September 30, 2011

Report due date: December 29, 2011

3. Location of work: Guam

4. Costs:

Source	Budget	FY10 Expenditures
Federal:	\$17,033.00	\$11,665.00
State:		
Other:		
Total Federal:	\$17,033.00	\$11,665.00
Total match:		
Total project:	\$17,033.00	\$11,665.00

5. Objective:

1. To complete two community outreach programs per week which focus on Guam's native wildlife.

6. If the work in this grant was part of a larger undertaking with other components and funding, present a brief overview of the larger activity and the role of this project.

The outreach programs funded under this grant complement existing GDAWR outreach efforts. The descriptions of existing programs follows:

General BTS Control Outreach Activities

GDAWR brown treesnake (BTS) outreach and education efforts aim to provide information to the public regarding BTS control in support of endangered species recovery on Guam. The outreach activities include distribution of BTS brochures; response to BTS inquiries from the public; aid in snake removal from homes and businesses; presentations to primary, secondary, and university classes; and participation in events such as the University of Guam's Charter Day by providing displays (posters, preserved specimens, and live animals) and staff to answer questions. The effort is funded by a federal grant from the Office of Insular Affairs, Brown Treesnake Technical Assistance Grant.

Listen Up Guam Campaign

Greenhouse frogs (*Eleutherodactylus planirostris*) were discovered on Guam in October 2003. Through subsequent delineation surveys and general awareness within the biological community, two individual male coqui frogs (*E. coqui*) were collected on Guam in February and April of 2004. A media campaign entitled "Listen Up Guam!" was launched on 30 March 2005, alerting the public to the problems coqui may cause, and encouraging contact with GDAWR upon seeing or hearing a frog. The centerpiece of the campaign was the 687-FROG hotline, sponsored by GUAMCELL Communications. The campaign included: presentations to civic organizations, port and border personal, and schools; print ads in Marine Drive Magazine and Pacific Daily News; posters distributed to government agencies, businesses, NGOs, and mayors' offices; magnets, t-shirts, and bumper stickers distributed to the public; and, a radio jingle.

The Listen Up Guam Campaign continued during the report period as a small part of the "Go Native" social marketing campaign (see below). Although the sponsored hotline is no longer active, GDAWR continues to answer public requests for information regarding frogs and other new or invasive species. As of 31 December 988 calls were received, a total of 73 for the year, on the hotline or at the GDAWR office since initiation of public awareness campaign. Forty-six calls were received from the public during the report period.

State Wildlife Grant funds salary to answer the phone regarding invasive species, visits to investigate public reports, frog surveys, as well as collateral materials in support of Listen Up Guam campaign.

Ko'ko' for Cocos/Go Native Campaign

In order to garner public support for the associated biosecurity protocols included in the Ko'ko' for Cocos Biosecurity Plan, a two-tier public awareness media campaign was initiated in May 2008. The broad over-arching campaign is a "Go Native" Rare Pride program that focuses on instilling local pride in Guam's native natural resources and creating a society that will protect and promote native species through behavior change. The second campaign, known as "Ko'ko' for Cocos", falls within the Go Native campaign and serves as a more direct initiative that promotes Cocos Island as a snake-

free haven for Guam rails and the biosecurity protocols necessary to keep the island free of unwanted pest species. Basically both campaigns work on the premise that native species are good and invasive species are bad for Guam.

The campaigns include presentations to schools and civic organizations, media appearances on TV and radio, articles in traditional print and online formats (including two social networking sites), information booths at public events, the production of collateral materials, such as pencils, t-shirts, bumper stickers, key chains, buttons, posters and bookmarks. Much of the Ko'ko' for Cocos collateral includes "What would Che'lu do?" and follows with the needs to maintain Cocos Island free of pest species (i.e., 1. Che'lu never packs a pest. 2. Che'lu always puts litter in its place. 3. Che'lu loves his island. If you see a cat, rat or snake on Cocos Island please call 488-RAIL (7245). In addition, permanent signs promoting Che'lu's requests to protect his island are placed in key locations.

GDAWR partners with other awareness/outreach programs, such as the Coconut Rhinoceros Beetle Eradication Program, Guam Animals in Need (GAIN), native reforestation programs, and local educators, to increase awareness within the community about the danger of invasive species to Guam's native species. Other concepts that improve Guam's habitat for species recovery and are promoted within campaigns include: report unfamiliar species, plant native species, reduce, reuse, recycle, spay and neuter pets, do not release unwanted pets, and prevent wild fires.

7. Describe how the objectives were met. See "Supplemental Information" for additional requirements and "Attachments" for specialized tables.

During the report period the E-6-TW-2 provided salary for staff to provide presentations and distribute collateral materials at thirty-six different public schools or summer camps, and eighteen public events or agency presentations including high-profile events such as the Guam Liberation Day Parade, the Guam Ko'ko' Road Race and "Green is Life" Music Festival. Highlights of the report period include coordination of the Community fiesta/Release party for public support of the ko'ko' introduction to Cocos Island and continued involvement within the Environmental Education Committee to create an easily-accessibly limestone forest trail for public use.

There were a total of 89 presentations or media events conducted; reaching roughly 11,000 this year, not including those reached via mass media through four radio interviews, one newspaper article, four television appearances.

8. Discuss differences between work anticipated in grant proposal and grant agreement, and that actually carried out with Federal Aid grant funds; include differences between expected and actual costs.

N/A

9. List any publications or in-house reports resulting from this work.

N/A

Name, title, phone number, and e-mail address of person compiling this report:

Cheryl M. Calastro, Wildlife Biologist, 671-735-3957, ccalastro@gmail.com

Final & Interim Annual Performance Reports
Guam Division of Aquatic and Wildlife Resources, Department of Agriculture
FY 2011

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Guam Division of Aquatic and Wildlife Resources, Department of Agriculture
FY 2011

1. State: Guam

Grant number: T-5-HM-1

Grant name: State Wildlife Grant

Project number and name: W-1: Survey of the Terrestrial Gastropods of the Volcanic Highlands and Limestone Habitats in Southern Guam

2. Report Period: October 1, 2006 to March 31, 2011

Report due date: June 30, 2011 (*Submitted June 15, 2011*)

3. Location of work: Guam

4. Costs:

Source	Budget (Revised)	FY 2008 Expenditures	FY 2009 Expenditures	Total Expenditures
Federal:	\$0	\$0	\$0	\$0
State:				
Other:				
Total Federal:	\$0	\$0	\$0	\$0
Total Project:	\$0	\$0	\$0	\$0

5. Objective:

To survey the south island of Guam from Adelup-Pago Fault Zone and south to determine the distribution and current status of native snail populations that remain.

6. If the work in this grant was part of a larger undertaking with other components and funding, present a brief overview of the larger activity and the role of this project.

This work was to be a continuation of a T-3-D State Wildlife Grant project entitled, "Survey of the Terrestrial Gastropods of the Northern Limestone Plateau in Northern Guam".

7. Describe how the objectives were met. See "Supplemental Information" for additional requirements and "Attachments" for specialized tables.

The Memorandum of Understanding for the southern snail survey was completely signed in January 2009. Unfortunately, the Principal Investigator (Barry Smith, UOG) informed the GDAWR that he would be leaving the University of Guam and unable to complete the survey under the current MOU and within the timeframe of the grant.

In August of FY 2009 permission was requested to move the project funding into other projects within the T-5-HM-1 grant. The project was effectively cancelled and the funding used for additional work within the W2: Cocos Island Biosecurity Monitoring and the W4: Insect Biodiversity projects.

8. Discuss differences between work anticipated in grant proposal and grant agreement, and that actually carried out with Federal Aid grant funds; include differences between expected and actual costs.

Please see above.

9. List any publications or in-house reports resulting from this work.

N/A

Name, title, phone number, and e-mail address of person compiling this report:

Diane Vice, Wildlife Biologist III, 671-735-3990, dianevice@gmail.com

FY 2011 State Wildlife Grant Annual Performance Reports

Final Annual Performance Report

Guam Division of Aquatic and Wildlife Resources, Department of Agriculture
FY 2011

1. State: Guam

Grant number: T-5-HM-1

Grant name: State Wildlife Grant

Project number and name: W-2: Cocos Island Biosecurity Monitoring

2. Report Period: October 1, 2006 to March 31, 2011

Report due date: June 30, 2011 (*Submitted June 15, 2011*)

3. Location of work: Guam

4. Costs:

Source	Budget (Revised)	FY 2008	FY 2009	FY 2010	FY 2011	Total Expenditures
Federal:	\$124,394	\$0	\$45,000	\$60,039.94	\$36,487.44	\$141,527.38
State:						
Other:						
Total Federal:	\$124,394	\$0	\$45,000	\$60,039.94	\$36,487.44	\$141,527.38
Total Project:	\$124,394	\$0	\$45,000	\$60,039.94	\$36,487.44	\$141,527.38

5. Objectives:

Initial Objective:

To protect Cocos Island over an eighteen-month period from any incursions of unwanted species including but not limited to, rodents, snakes and cats, by monitoring the island's incoming cargo and vessels.

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Amended Objectives:

An amendment to increase funding within the project was submitted in August of FY 2009 and accepted by Federal Aid.

The amendment stated within the approach that in FY 2010:

1. GDAWR employees will complete surveillance measures as prescribed in the Cocos Island Biosecurity Plan during FY 2010.
2. A vehicle will be purchased to provide transportation from the Mangilao GDAWR office to Merizo pier and other properties to complete biosecurity measures.
3. GDAWR will coordinate with USDA Wildlife Services to inspect high-risk cargo, such as large equipment and vehicles, destined for CI for target species using detector-dogs and visual inspection.

6. If the work in this grant was part of a larger undertaking with other components and funding, present a brief overview of the larger activity and the role of this project.

This work is part of the Cocos Island Restoration Project. The restoration of Cocos is a large undertaking that involves multiple stakeholders, funding and projects that will prepare the island's habitat for the release of federally endangered Guam rails by eradicating rodents, removing monitor lizards, enhancing native forest, and educating the public about the importance of native species.

7. Describe how the objectives were met. See "Supplemental Information" for additional requirements and "Attachments" for specialized tables.

This project was delayed in FY 2008 due to the paperwork involved with completing a Memorandum of Understanding (MOU) between the USDA Wildlife Services and the Government of Guam. The MOU was lost in the mail and neither party realized that the document was no longer moving forward.

In FY 2009 the MOU was finalized and the USDA Wildlife Services implemented the recommended biosecurity procedures within the Cocos Island Biosecurity Plan to protect Cocos Island from incursions of snakes and rodents. The USDA report was attached to the FY09 Interim Report.

In FY 2010 GDAWR employees completed surveillance measures as prescribed in the Cocos Island Biosecurity Plan. Twelve rodent tracking stations were maintained and checked twice weekly. That is, the coconut bait was replaced, the ink was refreshed and the rite-in-the-rain paper was replaced when necessary. There were no signs of rodent

FY 2011 State Wildlife Grant Annual Performance Reports

activity indicated in the tracking stations. Phone calls and emails, as well as five in-person meetings, were conducted with Cocos Island Resort staff to ensure compliance with the biosecurity protocols to protect native species on Cocos Island. Vendors making daily boat visits to Cocos Island were given bait stations and instructions on how and where to store the stations in their boats. Fifteen snake traps, with live mice as an attractant were checked weekly to remove snakes from areas where boats and cargo destined for Cocos Island are kept. The traps are located around the Cocos Resort Pier parking area and on private household property in Merizo.

A Nissan Frontier truck with campershell was purchased to provide transportation from the Mangilao GDAWR office to Merizo pier and other properties to complete biosecurity measures. There were no USDA detector-dog inspections conducted.

In FY 2011 GDAWR employees maintained surveillance measures as prescribed in the Cocos Island Biosecurity Plan. Twelve rodent tracking stations were maintained and checked twice weekly. That is, the coconut bait was replaced, the ink was refreshed and the rite-in-the-rain paper was replaced when necessary. There were no signs of rodent activity indicated in the tracking stations. Fifteen snake traps, with live mice as an attractant were checked weekly to remove snakes from areas where boats and cargo destined for Cocos Island are kept. The traps are located around the Cocos Resort Pier employee parking area and on private household property in Merizo.

8. Discuss differences between work anticipated in grant proposal and grant agreement, and that actually carried out with Federal Aid grant funds; include differences between expected and actual costs.

For the activities within the MOU with USDA Wildlife Services, project costs remained the same, although the period of implementation was modified. Project funding was increased to allow biosecurity procedures to continue through March 2011.

9. List any publications or in-house reports resulting from this work.

N/A

Name, title, phone number, and e-mail address of person compiling this report:

Diane Vice, Wildlife Biologist III, 671-735-3990, dianevice@gmail.com

Final Annual Performance Report

Guam Division of Aquatic and Wildlife Resources, Department of Agriculture
FY 2011

1. State: Guam

Grant number: T-5-HM-1

Grant name: State Wildlife Grant

Project number and name: W-3: Tarague Basin Swiftlet Cave Brown Treesnake Protection

2. Report Period: October 1, 2006 to March 31, 2011

Report due date: June 30, 2011 (*Submitted June 15, 2011*)

3. Location of work: Guam

4. Costs:

Source	Budget (revised)	FY 2008	FY 2009	FY 2010	Total Expenditures
Federal:	\$0	\$0	\$0	\$0	\$0
State:					
Other:					
Total Federal:	\$0	\$0	\$0	\$0	\$0
Total match:					
Total project:	\$0	\$0	\$0	\$0	\$0

5. Objective:

To reduce snake predation of island swiftlets in Tarague Basin cave on AAFB using snake traps, bait stations and other available snake control tools.

6. If the work in this grant was part of a larger undertaking with other components and funding, present a brief overview of the larger activity and the role of this project.

This project was intended to support the T-3-D "Reestablishing Island Swiftlets To Former Swiftlet Caves" project that has not been completed.

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7. Describe how the objectives were met. See “Supplemental Information” for additional requirements and “Attachments” for specialized tables.

No objectives have been met. This project was to follow the T-3-D “Reestablishing Island Swiftlets To Former Swiftlet Caves” project that has not been completed.

An amendment was submitted in August of FY 2009 to use the funding from this project for W2: Cocos Island Biosecurity Monitoring. Federal Aid accepted the amendment to have biosecurity monitoring completed by GDAWR employees during FY 2010.

8. Discuss differences between work anticipated in grant proposal and grant agreement, and that actually carried out with Federal Aid grant funds; include differences between expected and actual costs.

The initial translocation of swiftlets project has not occurred. Due to the delays in the initial project, this project has been cancelled until such time as the translocation of swiftlets can occur.

9. List any publications or in-house reports resulting from this work.

N/A

Name, title, phone number, and e-mail address of person compiling this report:

Diane Vice, Wildlife Biologist III, 671-735-3990, dianevice@gmail.com.

Final Performance Report

Guam Division of Aquatic and Wildlife Resources, Department of Agriculture
FY 2011

1. State: Guam

Grant number: T-5-HM1

Grant name: State Wildlife Grant

Project number and name: W-4: Guam Insect Biodiversity

2. Report Period: October 1, 2006 to March 31, 2011

Report due date: June 30, 2011 (*Submitted June 15, 2011*)

3. Location of work: Guam

4. Costs:

Source	Budget (revised)	FY 2008	FY 2009	FY 2010	FY 2011	Total Expenditures
Federal:	\$38,250	\$10,000	\$8250	\$0	\$20,000	\$38,250
State:						
Other:						
Total Federal:	\$38,250	\$10,000	\$8250	\$0	\$20,000	\$38,250
Total match:						
Total project:	\$38,250	\$10,000	\$8250	\$0	\$20,000	\$38,250

5. Objectives:

1. To support collaboration with an insect taxonomist who can help to clear a backlog of unidentified species in the Guam Territorial Insect Collection. Priority will be given to identifying aquatic insects collected during the ongoing Guam EPA stream survey and unidentified species collected during the recent invasive insects survey of Guam and other Micronesian islands.
2. To complete a cataloging the Guam Territorial Collection using the BioLink Biodiversity Database Management System.
3. To publish a comprehensive checklist of Guam's insect fauna on the World Wide Web, complete with digital images to aid in identification.

6. If the work in this grant was part of a larger undertaking with other components and funding, present a brief overview of the larger activity and the role of this project.

This project is part of an ongoing effort to update the University of Guam (UOG) insect collection. In FY 2009 permission was granted to extend the project with an increase in funding of \$20,000.

This project is part of an effort to assemble a comprehensive biodiversity inventory for terrestrial organisms on Guam. The UOG insect collection and the catalog built during the project can be seen as scientific infrastructure for the insect component of the proposed biodiversity inventory. Without a comprehensive inventory, we are unable to determine the rate of arrival of invasive species, disappearance of rare and threatened endemics, and changes to Guam's ecosystems. The impending Guam military buildup is expected to cause an increase in arrival rate of invasive species coupled with habitat destruction, thus increasing the urgency for completing the biodiversity inventory. Completion of the inventory will provide the taxonomic underpinnings for an understanding of the rapid and sometimes disastrous changes occurring in Guam's ecosystems. (Figure 1, a poster illustrating some ecological relationships between Guam's endemic cycad, invasive species, and endemic species, is provided as an example.)

7. Describe how the objectives were met.

Objective 1: Dr. Richard Zach, Director of the James Museum of Entomology at Washington State University, was on Guam between May 23 and June 11, 2008 to work as a collaborator on this project. During his stay on Guam, Zach identified specimens collected by the Guam Environmental Protection Agency (GEPA) during a stream survey, identified many insects in the UOG insect collection, advised Dr. Moore on curatorial techniques, met with Government of Guam officials from DOA and GEPA, and he collected and pinned 10,850 insect specimens.

A second Memorandum of Understanding for the additional \$20,000 was completed in January 2010. In FY 2010, the specimens were sorted and sent to specialists for determinations. In FY 2011 Dr. Zack returned within the first quarter to finish the project.

Objective 2: A University of Guam biology student was hired at the end of June 2008 as a part-time insect collection technician. Her major task is to catalog all specimens in the collection using a biodiversity information management database called BioLink. There were 16,275 specimens cataloged by the end of December 2009 and 28,792 specimens cataloged by the end of December 2010.

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Objective 3: Two free, web based, open source content management systems were evaluated as a replacement for Biolink, the current collection database; the two systems are Scratchpad from the Natural History Museum in London, and LifeDesk from the Encyclopedia of Life. These systems are very similar and both are intended to facilitate collaboration among scientists while making collection data readily available to clientele and the general public. Our Scratchpad site is at <http://guaminsects.myspecies.info/>, and our LifeDesk site is at <http://micronesianinsects.lifedesks.org/>. After a few months of working with both templates, the PI decided that Scratchpads was slightly better for the intended application.

See Figure 2 for an example of a Scratchpad page for *Leptocoris*, a common plant bug found on Guam. This species received two queries in one week, one from the Guam National Wildlife, and one from a curious hiker. Both submitted digital photos. Clients were referred to the displayed web page that provides taxonomic information, images, bibliography of scientific references, and specimen records.

See Figure 3 for an example of a Scratchpad blog entry, documenting discovery of how katydids are damaging *Serianthes nelsonii* saplings by making oviposition slits in leaders. Blog postings such as this facilitate documentation of miscellaneous ecological observations.

8. Discuss differences between work anticipated in grant proposal and grant agreement, and that actually carried out with Federal Aid grant funds; include differences between expected and actual costs.

N/A

9. List any publications or in-house reports resulting from this work.

Zack, R.S., A. Moore & R.H. Miller 2007. First record of a pigmy backswimmer (Hemiptera: Pleidae) from Micronesia. *Zootaxa* 1617:67-68.

Zack, R.S., A. Moore & R.H. Miller 2008. First record of *Aphanisticus cochinchinae seminulum* Obenberger (Coleoptera: Buprestidae) from Micronesia. *Coleopterist's Bulletin* 63 (1): 41-44.

Schaefer, C. W., R. W. Sites 2010. *Leptocoris rufomarginatus* (Fabricius) (Hemiptera: Rhopalidae) in Vietnam, with a note on *Leptocoris vicinus* (Dallas) in Guam. *Oriental Insects*. [in press]

Lis, J. A. & R. S. Zack 2010. A review of burrower bugs (Hemiptera: Heteroptera: Cydnidae sensu lato) of Guam. *Zootaxa* 2523:57-64.

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Marler, T. E. and A. Moore 2010. Cryptic scale infestations on *Cycas revoluta* facilitate scale invasions. *HortScience* 45(5): 837-839.

Van Driesche, R.G., Carruthers, R.I., Center, T., Hoddle, M.S., Hough-Goldstein, J., Morin, L., Smith, L., Wagner, D.L., Blossey, B., Brancatini, V., Casagrande, R., Causton, C.E., Coetzee, J. A., Cuda, J., Ding, J., Fowler, S.V., Frank, J.H., Fuester, R., Goolsby, J., Grodowitz, M., Heard, T.A., Hill, M.P., Hoffmann, J.H., Huber, J., Julien, M., Kairo, M.T.K., Kenis, M., Mason, P., Medal, J., Messing, R., Miller, R., Moore, A., Neuenschwander, P., Newman, R., Norambuena, H., Palmer, W.A., Pemberton, R., Perez Panduro, A., Pratt, P.D., Rayamajhi, M., Salom, S., Sands, D., Schooler, S., Sheppard, A., Shaw, R., Schwarzlander, M., Tipping, P.W., van Klinken, R.D., 2010. Classical biological control for the protection of natural ecosystems: past achievements and current efforts. *Biological Control* 54 S2-S33.

Mankin, R. W., A. Moore 2010. Acoustic Detection of *Oryctes rhinoceros* (Coleoptera: Scarabaeidae: Dynastinae) and *Nasutitermes luzonicus* (Isoptera: Termitidae) in Palm Trees in Urban Guam. *Journal of Economic Entomology* 103(4) 1135-1143.

Moore A. & R. H. Miller 2010. Comments on the Guam Military Buildup Draft Environmental Impact Statement (DEIS). Comments on Chapter10: Terrestrial and Biological Resources; Potential Impact on the Mariana Eight Spot Butterfly, an Endangered Species Living on Route 15 Lands. [unpublished]

Marler, T. E., L. S. Yudin and A. Moore 2011. *Schedorhinotermes longirostris* (Isoptera: Rhinotermitidae) invades Guam: yet another assault on the endemic *Cycas micronesica*. *Florida Entomologist* [in press]

Name, title, phone number, and e-mail address of person compiling this report:

Diane Vice, Wildlife Biologist III, 671-735-3990, dianevice@gmail.com based on progress report filed by Dr. Aubrey Moore, amoore@uguam.uog.edu.

Table 1: Number of specimens cataloged to date.

Insect Order	Specimens Cataloged
Blattaria	278
Coleoptera	6,894
Dermaptera	58
Diptera	4,311
Hemiptera	2,404
Homoptera	2,342
Hymenoptera	5,699
Ispotera	34
Lepidoptera	4,262
Mantodea	149
Neuroptera	33
Odonata	516
Orthoptera	1,769
Phasmidae	13
Psocoptera	20
Siphonaptera	3
Thysanoptera	5
Trichoptera	2
TOTAL	28,792

Figure 1. A poster illustrating ecological relationships between Guam's endemic cycad, invasive species and endemic species.

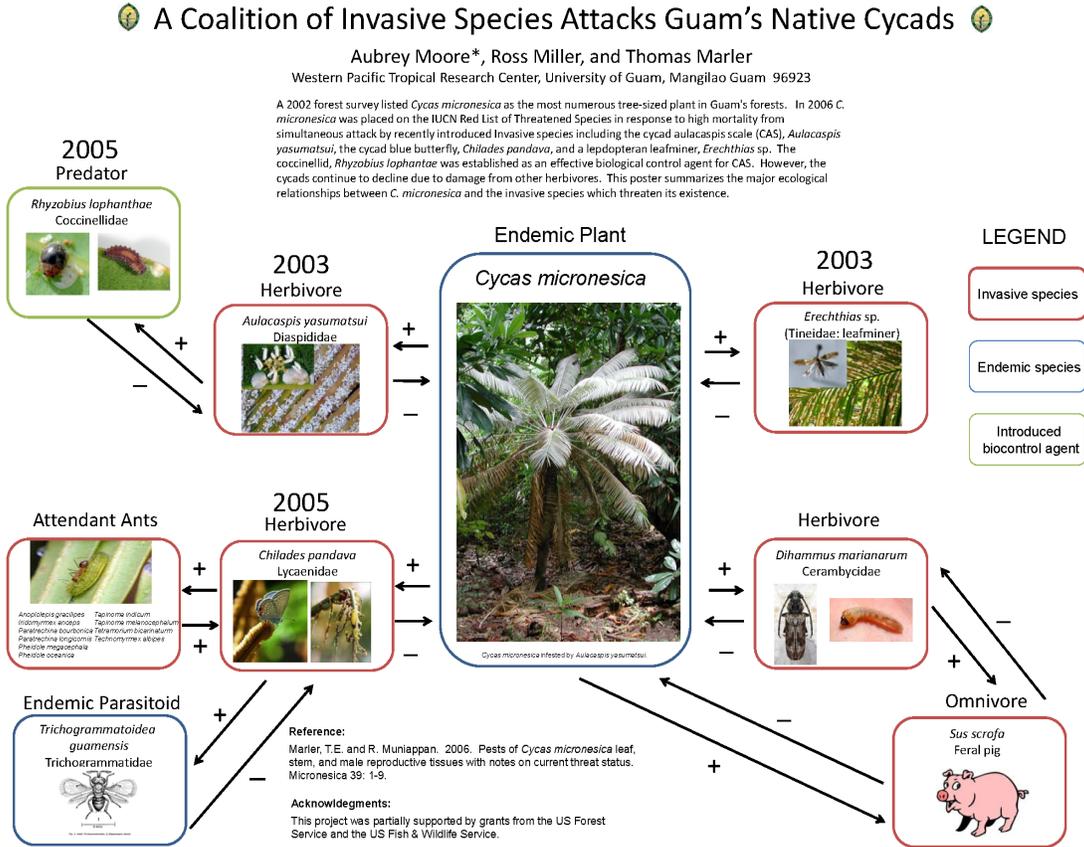


Figure 2: Screen capture of a Scratchpad page for *Leptocoris*.

<http://guaminsects.myspecies.info/category/taxonomy/animalia/arthropoda/insecta/hemiptera/rhopalidae/taxon>

The screenshot shows a web page titled "Insects of Guam" with a green header. The main content area is titled "Leptocoris" and features a photo of a nymph (immature) of a plant bug, *Leptocoris* sp. (Family Rhopalidae), taken by Cari Eggleston at the USFWS, Guam Wildlife Refuge. The page includes a taxonomy sidebar on the right, a "Random image" section, and a "Latest image" section. A "Bibliography" table is located at the bottom of the main content area.

Year of Publication	Authors	Titles
1946	Usinger, RL	Hemiptera of Guam
2010		RHOPALIDAE Coleoptera: Plant Bugs
2008	Schafer, CW, Siles RW	Leptocoris (Hemiptera: Rhopalidae) in Vietnam, with a note on <i>Leptocoris vicinus</i> (Dallas) in Guam
2007	Moore, A	Leptocoris vikits

Figure 3. An example of a Scratchpad blog entry documenting an incidental ecological observation.

<http://guaminsects.myspecies.info/serianthes-nelsonii-saplings-damage-tettigoniid-oviposition>

The screenshot shows a web browser window displaying a blog entry on the 'Insects of Guam' website. The browser's address bar shows the URL: guaminsects.myspecies.info/serianthes-nelsonii-saplings-damage-tettigoniid-oviposition. The website header includes the 'Insects of Guam' logo and navigation links. The main content area features a title 'Serianthes nelsonii saplings damage by tettigoniid oviposition' and a green notification box stating 'Blog entry Serianthes nelsonii saplings damage by tettigoniid oviposition has been updated.' Below this, it is noted that the entry was edited by Aubrey Moore on Mon, 06/13/2011 - 06:26. Two photographs show longitudinal slits on saplings. The text describes the observation on March 15, 2011, at the Ritidian National Wildlife Refuge, Guam, where several saplings had died with slits of 5 to 10 cm in length, containing katydid (Tettigoniidae) eggs. A second observation of similar damage is mentioned on saplings in a nursery. The entry includes links for 'Aubrey Moore's blog', 'Add new comment', '76 reads', 'Printer-friendly version', and 'Quote'. The taxonomy is listed as 'Tettigoniidae'. The right sidebar contains a 'Taxonomy' list, 'Who's online' information (1 user, 0 guests), and a visitor counter showing 1,124 visitors from Oct 2010 to Jun 2011.

Final Performance Report

Guam Division of Aquatic and Wildlife Resources, Department of Agriculture
FY 2011

1. State: Guam

Grant number: T-6-R-1

Grant name: State Wildlife Grant

Project number and name: W-1: Rodent Eradication and Non-target Impacts
Monitoring on Cocos Island, Guam

2. Report Period: October 1, 2008 to March 31, 2011

Report due date: June 30, 2011 (*Submitted June 15, 2011*)

3. Location of work: Guam

4. Costs:

Source	Budget (revised)	FY 2009	FY 2010	FY 2011	Total Expenditures
Federal:	\$0	\$0	\$0	\$0	\$0
State:					
Other:					
Total Federal:	\$0	\$0	\$0	\$0	\$0
Total match:					
Total project:	\$0	\$0	\$0	\$0	\$0

5. Objectives:

1. Assist in the establishment of bait-stations and dispersal of rodenticide on Cocos Island for the duration of the baiting cycles (approximately two months).
2. Monitor up to 10 Micronesian starlings on Cocos Island using radio telemetry to determine if rodenticide is impacting survival of the starlings.

6. If the work in this grant was part of a larger undertaking with other components and funding, present a brief overview of the larger activity and the role of this project.

This work is part of the Cocos Island Restoration Project. The restoration of Cocos is a large undertaking that involves multiple stakeholders, funding and projects that will prepare the island's habitat for the release of federally endangered Guam rails by eradicating rodents, removing monitor lizards, enhancing native forest, and educating the public about the importance of native species and controlling invasive species.

7. Describe how the objectives were met. See "Supplemental Information" for additional requirements and "Attachments" for specialized tables.

Objectives were not met. The grant was amended in FY 2009 to cancel this project and increase the monitor lizard control project by \$12,000.

8. Discuss differences between work anticipated in grant proposal and grant agreement, and that actually carried out with Federal Aid grant funds; include differences between expected and actual costs.

No funds were spent. The initial monitoring of starlings during the planning stages of the rodenticide application by USDA Wildlife Services indicated that the starlings were at minimal risk and, that impacts to starlings would be detected during the recovery of dead rodents conducted by USDA.

9. List any publications or in-house reports resulting from this work.

N/A

Name, title, phone number, and e-mail address of person compiling this report:

Diane Vice, Wildlife Biologist III, 671-735-3990, dianevice@gmail.com

Final Performance Report

Guam Division of Aquatic and Wildlife Resources, Department of Agriculture
FY 2011

1. State: Guam

Grant number: T-6-R

Grant name: State Wildlife Grant

Project number and name: W-2: Early Detection, Monitoring and Control of Invasive Species

2. Report Period: October 1, 2008 to March 31, 2011

Report due date: June 30, 2011 *(Submitted June 15, 2011)*

3. Location of work: Guam

4. Costs:

Source	Budget	FY 2009	FY 2010	FY 2011	Total Expenditures
Federal:	\$28,000	\$4,144.36	\$11,834.55	\$12,974.48	\$28,953.39
State:					
Other:					
Total Federal:	\$28,000	\$4,144.36	\$11,834.55	\$12,974.48	\$28,953.39
Total match:					
Total project:	\$28,000	\$4,144.36	\$11,834.55	\$12,974.48	\$28,953.39

5. Objectives:

1. Prevent the establishment of coqui frogs and other invasive species on Guam that impact Guam's species of greatest concern.
2. Encourage public reporting of new species found on Guam.
3. Develop and purchase social marketing materials to encourage public to call the hotline and report new species.

6. If the work in this grant was part of a larger undertaking with other components and funding, present a brief overview of the larger activity and the role of this project.

This project is in part a continuation of efforts to prevent the coqui frog (*Eleutherodactylus coqui*) from establishing on Guam. A public education program, entitled “Listen Up Guam” was initiated in 2005 with \$100K funding from an Office of Insular Affairs Brown Treesnake Grant. The program included nine months of intensive media and outreach, including the promotion of a hotline to call regarding frog sightings. Other efforts to detect coqui frogs and prevent their establishment on Guam have included surveys of high-risk areas (i.e., golf courses, hotels, plant nurseries, and other manicured grounds with imported plants), as well as the changing of live plant importation regulations for Hawaii by the Guam Plant Inspection Facility. This project provides a continuation of surveys of high-risk areas, collection and identification of unknown species from the public, and the production of updated materials to promote the reporting of new species on Guam by the public.

7. Describe how the objectives were met. See “Supplemental Information” for additional requirements and “Attachments” for specialized tables.

The biennial surveys for coqui frog, initiated in FY 2009, were completed on 12 high-risk properties; 2 private and commercial plant nurseries, 7 golf courses, 3 hotels/shops during October 2009. Although no Coqui were found during the survey, contacts with commercial nurseries were re-established and changes in distribution of established frog populations were reported.

Despite the disconnection of the official Coqui Frog Hotline in April 2008, the public continues to call the Guam Department of Agriculture. A total of 988 calls were received from the public regarding frogs since the inception of the original “Listen Up Guam” campaign. Seventy-three of those calls were made during FY 2010. Please see attached Final Report of Coqui Frog Survey – September/October 2009 for more details.

Activation of the hotline (475-PEST) was initiated in September 2010; the hotline was not in service for the majority of the report period due to delays in company sponsorship. The new hotline was installed at Guam Agriculture’s Plant Inspection Facility (PIF) and will be answered by PIF staff. Depending on the type of species reported, the caller’s information will be directed to the proper agency or section. All invasive prevention/awareness programs will use the new number within collateral produced; all agencies distributing the same number will clarify reporting procedures to the public and all invasive awareness efforts will support each other. T-shirts were produced to encourage the public to call the new pest hotline.

The Guam Invasive Species Advisory Committee (GISAC) meets quarterly and provides a venue for Guam’s invasive species technical and policy experts to provide input and recommendations on actions to address the many invasive species problems faced by our island.

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During FY 2010 two Guam Invasive Species Advisory Committee (GISAC) meetings were organized and attended, as well, minutes were produced and distributed to other committee member organizations and individuals. The dates of the meetings were February 23, 2010 and June 15, 2010. In addition to sharing of information at the meetings, a letter addressed to the Governor from GISAC was developed to encourage the Governor to support increased inspections at the ports of Guam of high-risk imports (i.e., Christmas trees). A Guam Update/Report was produced for the Regional Invasive Species Council & 13th Micronesian Chief Executives' Summit held in Saipan in July 2010.

During FY 2011 thirty-three calls were received since the new pest line was established. Informational tags for attachment to Christmas trees were distributed to vendors selling imported live trees. The tags warned people that there could be frogs, lizards and/or snakes hiding in their tree; the new pest line was listed to call. Guam Invasive Species Advisory Committee meeting was held February 8th, 2011 and minutes were distributed to other committee member organizations and individuals. Diane presented at the National Invasive Species Council Invasive Awareness Conference in Washington, DC held the week of February 28 – March 4, 2011. Her presentation was entitled, “Increasing RISC in Micronesia”.

8. Discuss differences between work anticipated in grant proposal and grant agreement, and that actually carried out with Federal Aid grant funds; include differences between expected and actual costs.

9. List any publications or in-house reports resulting from this work.

N/A

Name, title, phone number, and e-mail address of person compiling this report:

Diane Vice, Wildlife Biologist III, 671-735-3990, dianevice@gmail.com

Cheryl Calauastro, Wildlife Biologist III, 671-735-3957, ccalaastro@gmail.com

Final Performance Report

Guam Division of Aquatic and Wildlife Resources, Department of Agriculture
FY 2011

1. State: Guam

Grant number: T-6-R

Grant name: State Wildlife Grant

Project number and name: W-3: Monitor Lizard Reduction on Cocos Island

2. Report Period: October 1, 2008 to March 31, 2011

Report due date: June 30, 2011 (*Submitted June 15, 2011*)

3. Location of work: Guam

4. Costs:

Source	Budget (revised)	FY 2009	FY 2010	FY 2011	Total Expenditures
Federal:	\$47,000	\$11,349	\$34,563.81	\$0	\$45,912.81
State:					
Other:					
Total Federal:	\$47,000	\$11,349	\$34,563.81	\$0	\$45,912.81
Total match:					
Total project:	\$47,000	\$11,349	\$34,563.81	\$0	\$45,912.81

5. Objective:

Reduce the population of monitor lizards on Cocos Island in support of species of greatest concern, in particular the Guam rail.

6. If the work in this grant was part of a larger undertaking with other components and funding, present a brief overview of the larger activity and the role of this project.

This work is part of the Cocos Island Restoration Project. The restoration of Cocos is a large undertaking that involves multiple stakeholders, funding and projects that will prepare the island's habitat for the release of federally endangered Guam rails (*Gallirallus owstoni*) by eradicating rodents, removing monitor lizards, enhancing native forest, and educating the public about the importance of native species and controlling invasive species.

7. Describe how the objectives were met. See “Supplemental Information” for additional requirements and “Attachments” for specialized tables.

In FY 2010 GDAWR removed monitor lizards from Cocos Island using raccoon-sized live traps and brown treesnake traps baited with dead mice. A total of 104 monitor lizards were removed from Cocos Island; 20 small, 49 medium and 35 large.

Table 1: FY 2010 Monitor Lizard Captures on Cocos Island

Removal Method	Small SVL <30 cm	Medium SVL 30-40 cm	Large SVL >40 cm	Total
• BTS trap	15	0	0	15
• Live trap	5	49	35	89
• Pellet gun	0	0	0	0
Total	20	49	35	104

8. Discuss differences between work anticipated in grant proposal and grant agreement, and that actually carried out with Federal Aid grant funds; include differences between expected and actual costs.

The monitor control effort was not as successful as expected for the removal of the larger animals. The remaining large monitor lizards on Cocos Island pose a significant risk for newly released Guam rails. As of the writing of this report documents were submitted to amend the grant to increase the amount of funds to continue monitor lizard control efforts. The total budget does not appear to be expended because there is an outstanding invoice for the remaining amount of the contract with USDA Wildlife Services of \$15,033.

9. List any publications or in-house reports resulting from this work.

N/A

Name, title, phone number, and e-mail address of person compiling this report:

Diane Vice, Wildlife Biologist III, 671-735-3990, dianevice@gmail.com

Final Performance Report

Guam Division of Aquatic and Wildlife Resources, Department of Agriculture
FY 2011

1. State: Guam

Grant number: T-6-R

Grant name: State Wildlife Grant

Project number and name: W-4: Cocos Island Lizard Survey

2. Report Period: October 1, 2008 to March 31, 2011

Report due date: June 31, 2011 (*Submitted June 15, 2011*)

3. Location of work: Guam

4. Costs:

Source	Budget	FY 2009	FY 2010	Total Expenditures
Federal:	\$10,000	\$0	\$9097.55	\$9097.55
State:				
Other:				
Total Federal:	\$10,000	\$0	\$9097.55	\$9097.55
Total match:				
Total project:	\$10,000	\$0	\$9097.55	\$9097.55

5. Objectives:

Document the lizard species on Cocos Island before and after rodent eradication, as well as following Guam rail establishment.

6. If the work in this grant was part of a larger undertaking with other components and funding, present a brief overview of the larger activity and the role of this project.

This work is part of the Cocos Island Restoration Project. The restoration of Cocos Island is a large undertaking that involves multiple stakeholders, funding and projects that will prepare the island's habitat for the release of federally endangered Guam rails by eradicating rodents, removing monitor lizards, enhancing native forest, and educating the public about the importance of native species and controlling invasive species. The lizard survey provides important information on the presence or absence of rare lizard species

on Cocos Island that have been extirpated from Guam due to the presence of the brown treesnake (*Boiga irregularis*).

7. Describe how the objectives were met. See “Supplemental Information” for additional requirements and “Attachments” for specialized tables.

In FY 2009 a small survey of lizards on Cocos Island was conducted from September to December 2008 to document lizard species prior to rodent eradication. The effort was funded under a Brown Treesnake Technical Assistance Grant.

At the end of FY 2009 and continuing into FY 2010, a larger lizard survey was conducted during October and November 2009 to document lizard species present following the rodent eradication conducted in April 2008. Fifty glue traps were set in the morning and checked the following morning for a total of eleven nights of trapping. There were 13 transects, spaced 25 meters apart, which ran from the lagoon side of the island to the ocean side; traps were set every 10 meters within each transect.

There were five species of geckos, including *Hemidactylus fernanantus*, *Gehyra oceanica*, *Gehyra mutilata*, *Lepidodactylus lugubrus*, and *Nactus pelagicus*. There were six species of skink, including *Carlia fusca*, *Emoia caeruleocauda*, *Emoia cyanura*, *Emoia atrocostata*, *Cryptoblepharis poecilopleurus*, and *Emoia impar*. One species of Anolis was also trapped, *Anolis carolinensis*.

8. Discuss differences between work anticipated in grant proposal and grant agreement, and that actually carried out with Federal Aid grant funds; include differences between expected and actual costs.

Work was not initiated until the beginning of FY 2010 due to the absence of the staff herpetologist. The GDAWR herpetologist’s work visa did not arrive until early September and this delayed his return to Guam. However, the survey was completed in FY 2010.

Also, the project ended up involving more staff time than expected. Only one survey was completed with the project funds. The final survey will be completed with another grant.

9. List any publications or in-house reports resulting from this work.

N/A

Name, title, phone number, and e-mail address of person compiling this report:

Diane Vice, Wildlife Biologist III, 671-735-3990, dianevice@gmail.com

Final Performance Report

Guam Division of Aquatic and Wildlife Resources, Department of Agriculture
FY 2011

1. State: Guam

Grant number: T-6-R

Grant name: State Wildlife Grant

Project number and name: W-5: Locally Captured Geckos for MK Food Source

2. Report Period: October 1, 2008 to September 30, 2011

Report due date: June 30, 2011 (*Submitted June 15, 2011*)

3. Location of work: Guam

4. Costs:

Source	Budget	FY 2009	FY 2010	Total Expenditures
Federal:	\$19,887	\$9750	\$7410	\$17,160
State:				
Other:				
Total Federal:	\$19,887	\$9750	\$7410	\$17,160
Total match:				
Total project:	\$19,887	\$9750	\$7410	\$17,160

5. Objective:

To provide locally caught geckos as the main food source for the captive Micronesian kingfisher population.

6. If the work in this grant was part of a larger undertaking with other components and funding, present a brief overview of the larger activity and the role of this project.

The larger activity is to captive breed Guam Micronesian kingfishers in captivity to prevent the extinction of the species and to eventually reintroduce them back to Guam. Endangered Species Section 6 fund the majority of the species recovery in captivity on Guam. Also, there are 11 zoological facilities participating in the Micronesian Kingfisher Species Survival Plan. Each institution funds the husbandry efforts of maintaining and reproducing kingfishers at their respective facilities.

The Guam Micronesian kingfishers have extremely low reproductive success and a majority of chicks raised are hand-reared. This project will allow GDAWR staff to study the birds in a more natural environment on Guam, as opposed to an artificial zoo setting, to better understand why 66% of chicks disappear from the nest and how to prevent this from happening on both Guam and the US mainland, and eventually recover the species.

7. Describe how the objectives were met. See “Supplemental Information” for additional requirements and “Attachments” for specialized tables.

In FY 2009 one purchase order for local-caught geckos was completed for \$9750. In FY 2010 another purchase order was completed for \$7410 (19,000 grams).

8. Discuss differences between work anticipated in grant proposal and grant agreement, and that actually carried out with Federal Aid grant funds; include differences between expected and actual costs.

The difference in expected costs is due to the purchasing process and getting a better price per gram than originally expected.

9. List any publications or in-house reports resulting from this work.

N/A

Name, title, phone number, and e-mail address of person compiling this report:

Diane Vice, Wildlife Biologist III, 671-735-3990, dianevice@gmail.com
Suzanne Medina, Wildlife Biologist III, 671-735-3985, medinas@guam.net

Interim Annual Performance Report

Guam Division of Aquatic and Wildlife Resources, Department of Agriculture
FY 2011

1. State: Guam

Grant number: T-2-1-R-1

Grant name: State Wildlife Grant

Project number and name: Recovery of the Guam Micronesian Kingfisher, Job 1:
Captive Breeding of Guam Micronesian Kingfishers

2. Report Period: October 1, 2010 to September 30, 2011

Report due date: December 29, 2011

3. Location of work: Guam

4. Costs:

Source	FY 2009 Budget	FY 2010 Budget	FY 2009 Expenditures	FY 2010 Expenditures	FY 2011 Expenditures
Federal:	\$60,000	\$60,000	\$0	\$29,326.32	\$42,418.97
State:					
Other:					
Total Federal:	\$60,000	\$60,000	\$0	\$29,326.32	\$42,418.97
Total Project:	\$60,000	\$60,000	\$0	\$29,326.32	\$42,418.97

5. Objectives:

1. Captive breed sihek. Increase the amount of parent-reared sihek by supplemental feeding at the nest.
2. Feed sihek a diet consisting mainly of locally caught geckos, pinkies, crickets and mealworms.

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3. Maintain the existing sihek breeding and holding facility. Increase the number of cages if needed.
4. Prepare sihek for release by maintaining facilities that mimic Guam's environment and have the opportunity to capture live prey.
- 6. If the work in this grant was part of a larger undertaking with other components and funding, present a brief overview of the larger activity and the role of this project.**

The larger activity is to captive breed Guam Micronesian kingfishers to prevent the extinction of the species and to reintroduce to Guam. Endangered Species Section 6 fund the majority of the species recovery in captivity on Guam. Also, there are 15 zoological facilities participating in the Micronesian Kingfisher Species Survival Plan. Each institution funds their efforts in maintaining and reproducing kingfishers.

The Guam Micronesian kingfishers have extremely low reproductive success and a majority of chicks raised are hand-reared. This project will allow GDAWR staff to study the birds in a more natural environment on Guam, as opposed to an artificial zoo setting, to better understand why 66% of chicks disappear from the nest and how to prevent this from happening on both Guam and the US mainland, and eventually recover the species.

- 7. Describe how the objectives were met. See "Supplemental Information" for additional requirements and "Attachments" for specialized tables.**

Due to the difficulty in establishing FY 2010 accounts, the project was only active towards the end of the fiscal year. Approximately \$42,000 was spent in staff salaries and indirect costs. Accomplishments include: pairing two kingfishers that resulted in one parent-reared chick with supplemental feeding at the nest, and general maintenance around the holding and breeding pens such as replacing perches and bush-cutting. Sihek were fed a diet consisting of geckos and insects however none were purchased this fiscal year.

- 8. Discuss differences between work anticipated in grant proposal and grant agreement, and that actually carried out with Federal Aid grant funds; include differences between expected and actual costs.**

The only difference is that we had expected accounts to be established sooner which would have allowed more time to work on the project this fiscal year.

- 9. List any publications or in-house reports resulting from this work.**

N/A

Name, title, phone number, and e-mail address of person compiling this report:
Suzanne Medina, Wildlife Biologist, 671-735-3985, medinasuzanne@gmail.com

Interim Annual Performance Report

Guam Division of Aquatic and Wildlife Resources, Department of Agriculture
FY 2011

1. State: Guam

Grant number: T-2-1-R-1

Grant name: State Wildlife Grant

Project number and name: Recovery of the Guam Micronesian Kingfisher, Job 2:
Releasing Captive Bred Guam Micronesian Kingfishers on Guam and other Suitable Islands

2. Report Period: October 1, 2010 to September 30, 2011

Report due date: December 29, 2011

3. Location of work: Guam

4. Costs:

Source	FY 2009 Budget	FY 2010 Budget	FY 2009 Expenditures	FY 2010 Expenditures	FY 2011 Expenditures
Federal:	\$9,000	\$10,000	\$0	\$0	\$0
State:					
Other:					
Total Federal:	\$9,000	\$10,000	\$0	\$0	\$0
Total project:	\$9,000	\$10,000	\$0	\$0	\$0

5. Objectives:

1. Determine potential release sites on Guam and other suitable islands in FY 2011.
2. Create a release protocol for releasing sihek on Guam and other suitable islands in FY 2012.

6. If the work in this grant was part of a larger undertaking with other components and funding, present a brief overview of the larger activity and the role of this project.

The larger activity is to captive breed Guam Micronesian kingfishers in captivity to prevent the extinction of the species and to eventually reintroduce them back to Guam. Endangered Species Section 6 fund the majority of the species recovery in captivity on Guam. Also, there are 15 zoological facilities participating in the Micronesian Kingfisher Species Survival Plan. Each institution funds the husbandry efforts of maintaining and reproducing kingfishers at their respective facilities.

The Guam Micronesian kingfishers have extremely low reproductive success and a majority of chicks raised are hand-reared. This project will allow GDAWR staff to study the birds in a more natural environment on Guam, as opposed to an artificial zoo setting, to better understand why 66% of chicks disappear from the nest and how to prevent this from happening on both Guam and the US mainland, and eventually recover the species.

7. Describe how the objectives were met. See “Supplemental Information” for additional requirements and “Attachments” for specialized tables.

Discussions for releasing sihek on Guam, Cocos Island, or other island location occurred during meetings as well as when visitors from the Micronesian Kingfisher Species Survival Plan and the USFWS Micronesia Kingfisher Recovery Committee were present on Guam. Unfortunately, no potential release sites were agreed upon.

8. Discuss differences between work anticipated in grant proposal and grant agreement, and that actually carried out with Federal Aid grant funds; include differences between expected and actual costs.

It was anticipated that the USFWS Micronesian Kingfisher Recovery Committee would support the release of sihek in snake-controlled areas on Guam and/or Cocos Island. This was not the case, however, as some members want all sihek to be released on an island outside of the Marianas. In FY 2012, GDAWR intends to fulfill the objective to create a release protocol that will include Guam and Cocos Island.

9. List any publications or in-house reports resulting from this work.

N/A

Name, title, phone number, and e-mail address of person compiling this report:
Suzanne Medina, Wildlife Biologist, 671-735-3985, medinasuzanne@gmail.com

Interim Annual Performance Report

Guam Division of Aquatic and Wildlife Resources, Department of Agriculture
FY 2011

1. State: Guam

Grant number: T-7-C-1

Grant name: State Wildlife Grant

Project number and name: W-1: Guam Cycad Health Survey and Biological Control of the Cycad Aulacaspis Scale (CAS)

2. Report Period: October 1, 2010 to September 30, 2011

Report due date: December 29, 2011

3. Location of work: Guam

4. Costs:

Source	Budget	FY 2011	Total Expenditures
Federal:	\$18,000	\$0	\$0
State:			
Other:			
Total Federal:	\$18,000	\$0	\$0
Total Project:	\$18,000	\$0	\$0

5. Objectives:

1. Continue monitoring of cycad health on Guam.
2. Determine the causes of high cycad seedling mortality; and,
3. Introduce and establish additional biological control agents for CAS.

6. If the work in this grant was part of a larger undertaking with other components and funding, present a brief overview of the larger activity and the role of this project.

The project is a continuation of cycad preservation work that started in 2006 through the University of Guam.

7. Describe how the objectives were met. See “Supplemental Information” for additional requirements and “Attachments” for specialized tables.

The Objectives were not completed in FY 2011. An MOU was drafted by GDAWR in January 2011, signed by Guam Agriculture and UOG in February 2011, and signed by the Governor of Guam in June 14, 2011. In the final three months of the report period, UOG recruited Dr. Leyla Kaufman at the University of Hawaii as a collaborator. Dr. Kaufman has located a good field site for collecting parasitoids and has attempted on three occasions to get a lab colony established. The current plan is to continue attempts to establish a lab colony. Dr. Aubrey Moore will be in Honolulu during the last week of February 2012 and will hand carry wasps to Guam (whether from the established lab colony or field collected).

8. Discuss differences between work anticipated in grant proposal and grant agreement, and that actually carried out with Federal Aid grant funds; include differences between expected and actual costs.

No difference in costs; the MOU process is slow and inhibits progress.

9. List any publications or in-house reports resulting from this work.

N/A

Name, title, phone number, and e-mail address of person compiling this report:

Diane Vice, Wildlife Biologist III, 671-735-3990, dianevice@gmail.com based on project update provided by Dr. Aubrey Moore, Principle Investigator, aubreymoore@guam.net.

Interim Annual Performance Report

Guam Division of Aquatic and Wildlife Resources, Department of Agriculture
FY 2011

1. State: Guam

Grant number: T-7-C-1

Grant name: State Wildlife Grant

Project number and name: W-2: Implementation and Revision of Guam's
Comprehensive Wildlife Conservation Strategy

2. Report Period: October 1, 2010 to September 30, 2011

Report due date: December 29, 2011

3. Location of work: Guam

4. Costs:

Source	Budget	FY 2011	Total Expenditures
Federal:	\$111,000	\$18,704.97	\$18,704.97
State:			
Other:			
Total Federal:	\$111,000	\$18,704.97	\$18,704.97
Total project:	\$111,000	\$18,704.97	\$18,704.97

5. Objectives:

1. Coordinate CWCS project implementation and reporting during FY 2011.
2. Revise Guam's CWCS during FY 2011.

6. If the work in this grant was part of a larger undertaking with other components and funding, present a brief overview of the larger activity and the role of this project.

Guam receives annual appropriations under the State Wildlife Grant Program (SWGP) to implement conservation actions as prescribed within Guam's 2006 Comprehensive Wildlife Conservation Strategy (CWCS).

7. Describe how the objectives were met. See “Supplemental Information” for additional requirements and “Attachments” for specialized tables.

During FY 2011 the administration of grants included the purchasing and budget management of five SWGP grants (including about 10 individual projects); final reports for T-5 and T-6 were written and submitted in April 2011; proposals for two new grants for FY 2012 were written and submitted in June 2011; one MOU was completed between the UOG and Guam Agriculture; and, meetings with Federal Aid Specialists, cooperators and staff were held. The revision of CWCS was not conducted due to staffing constraints.

8. Discuss differences between work anticipated in grant proposal and grant agreement, and that actually carried out with Federal Aid grant funds; include differences between expected and actual costs.

9. List any publications or in-house reports resulting from this work.

N/A

Name, title, phone number, and e-mail address of person compiling this report:
Diane Vice, Wildlife Biologist III, 671-735-3990, dianevice@gmail.com

Interim Annual Performance Report

Guam Division of Aquatic and Wildlife Resources, Department of Agriculture
FY 2011

1. State: Guam

Grant number: T-8-D-1

Grant name: State Wildlife Grant

Project number and name: W-1: Cocos Island Native Species Protection

2. Report Period: October 1, 2010 to September 30, 2011

Report due date: December 29, 2011

3. Location of work: Guam

4. Costs:

Source	Budget	FY 2011	Total Expenditures
Federal:	\$105,000	\$62,100.57	\$62,100.57
State:			
Other:			
Total Federal:	\$105,000	\$62,100.57	\$62,100.57
Total project:	\$105,000	\$62,100.57	\$62,100.57

5. Objectives:

1. To protect Cocos Island over a twelve-month period from any incursions of unwanted species, including but not limited to, rodents, snakes and cats, by monitoring the island and its incoming cargo and vessels.
2. Remove predators and invasive species from Cocos Island that may pose a threat to the native species on Cocos Island; species to be removed include but are not limited to, monitor lizards, cats, rodents, snakes, dogs and chickens.

6. If the work in this grant was part of a larger undertaking with other components and funding, present a brief overview of the larger activity and the role of this project.

This project supports the Cocos Island Restoration Project. The restoration of Cocos Island is a large undertaking that involves multiple stakeholders, funding and projects that prepare and maintain the island's habitat for the federally endangered Guam rail. Management actions include the eradication of rodents, brown treesnake survey, native forest enhancement, release of captive-bred Guam rails, and continuous monitoring for incursions of snakes and rodents.

7. Describe how the objectives were met. See "Supplemental Information" for additional requirements and "Attachments" for specialized tables.

During the report period 15 brown treesnake traps were operated on Guam to reduce the likelihood of snakes getting to Cocos Island; 10 were located in the area surrounding the Cocos Resort parking area and five were located in a private property where a vessel that visits Cocos Island daily is stored. In addition, 12 rodent-tracking stations were checked twice a week for signs of rodent activity.

Predator control efforts focused on monitor lizard removals. One hundred and thirty monitors were removed using monofilament snare traps, PVC pipe traps, cage traps, and air rifles from Cocos Island. Gut contents of the removed monitor lizards were examined to assess the species' impact on the endemic fauna of Cocos Island. Important findings include; migratory sea birds, bird eggs, turtle remains, smaller lizards, and numerous crustaceans.

The removal efforts were effective in decreasing the sightings of monitors during regular management activities. In September of 2010, between six to seven monitor lizards were seen per hour; a year later, sightings are reduced to one monitor lizard per hour. Efforts were also made to eliminate introduced chickens from Cocos Island. Two roosters remain on the island, and while they pose no threat to increase in population, efforts will continue to remove them.

Table 1: Monitor Lizard Removal Results – October 1, 2010 to September 30, 2011

SVL Size Class	<30 cm	>29 + <40 cm	>40 cm	Total
Live trap	4	12	1	17
Pellet gun	60	26	4	90
Snake trap	15	0	0	15
Snare	1	1	0	2
Hand	0	1	0	1
Garbage can	1	2	2	5
Totals	81	42	7	130

8. Discuss differences between work anticipated in grant proposal and grant agreement, and that actually carried out with Federal Aid grant funds; include differences between expected and actual costs.

No difference in costs.

9. List any publications or in-house reports resulting from this work.

N/A

Name, title, phone number, and e-mail address of person compiling this report:

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Seamus Ehrhard, Wildlife Biologist II, 671-735-3996, seamuse@hawaii.edu

Interim Annual Performance Report

Guam Division of Aquatic and Wildlife Resources, Department of Agriculture
FY 2011

1. State: Guam

Grant number: T-8-D-1

Grant name: State Wildlife Grant

Project number and name: W-2: Reestablishing Island Swiftlets To Former Swiftlet Caves

2. Report Period: October 1, 2010 to September 30, 2011

Report due date: December 29, 2011

3. Location of work: Guam

4. Costs:

Source	Budget	FY 2011	Total Expenditures
Federal:	\$11,603	\$ 0	\$ 0
State:			
Other:			
Total Federal:	\$11,603	\$ 0	\$ 0
Total project:	\$11,603	\$ 0	\$ 0

5. Objectives:

1. In FY 2011, complete the required National Environmental Policy Act (NEPA) documents and initiate MOUs for translocation of swiftlets from Naval Ordnance Annex to northern Guam.
2. In FY 2011, amend GDAWR's Section 10(a)(1)(A) permit, TE-032209-8 to include swiftlet translocation.

6. If the work in this grant was part of a larger undertaking with other components and funding, present a brief overview of the larger activity and the role of this project.

N/A

7. Describe how the objectives were met. See “Supplemental Information” for additional requirements and “Attachments” for specialized tables.

During the report period a Cooperative Service Agreement Reimbursable between the Guam Department of Agriculture and the USDA/APHIS Wildlife Services was completed and signed by both parties in January 2011. When the Work Plan was submitted for processing of a work order, it was denied due to lack of fund in the correct object class. The movement of funds into the appropriate object class was completed in July 2011, however it was too late in the fiscal year for the work to be completed.

8. Discuss differences between work anticipated in grant proposal and grant agreement, and that actually carried out with Federal Aid grant funds; include differences between expected and actual costs.

The lack of timely movement of money between object classes prevented the Memorandum of Understanding from being completed during the report period. The money is now in the proper object class for FY 2012.

9. List any publications or in-house reports resulting from this work.

N/A

Name, title, phone number, and e-mail address of person compiling this report:

Diane Vice, Wildlife Biologist III, 671-735-3990, dianevice@gmail.com

GUAM
Fisheries Development Program
F-8-D-6, F-9-D-8, F-11-D-1 And F-15-E-1
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January 30, 2012

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Mangilao, Guam 96913
671-735-3955/6

Fisheries Development Program - F-8-D-6, F-9-D-8, F-11-D-3 And F-15-E-1

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6. If the work in this grant was part of a larger undertaking with other components and funding, present a brief overview of the larger activity and the role of this project.
N/A

7. Describe how the objectives were met. See “Supplemental Information” for additional requirements and “Attachments” for specialized tables.

The objective was met for the reporting period. A scope of work (attachment 1) to upkeep, maintain, and repair the three (3) fishing platforms on the reef flats of Ylig and Togcha Bays was sent to Department of Administration’s General Service Agency and a purchase order was secured and awarded to Aloka Maintenance on March 25, 2011 in the amount of \$13,350.00. The contract involved cleaning in the vicinity of the platforms and inspecting the platforms twice a month, which includes maintenance and/or painting with fiberglass coat marine paint to the foundation, rails, signs, ladders, benches, and rod holders. A meeting was held with Aloka’s general manager and owner on the 29th of March to review the scope of work and conduct the site visit.

Mr. Justin Aloka general manager and owner provided monthly reports to the Department from April 11, 2011 through September 17, 2011. The amount of fishing debris and other materials collected are summarized in Table 1. Shoreline and recreational activities included debris from fast food, beach-goers, sports/games, festivals, litter from streets / storm drains, etc. with a total of 2,042 pieces. Ocean and waterway activities included debris from recreational/commercial fishing and boat /vessel operations with a total of 242 pieces. Smoking – related and dumping activities consisted of cigarettes / cigarette filters, lighters, tips, tobacco packages/wrappers, appliances, batteries, building materials, car parts, drums and tires totaling 203 pieces. For medical/personal hygiene, this consisted of condoms, diapers, syringes, tampons/ tampon applicators totaling 12 pieces. Lastly, debris items of local concern for this period were 2-Butane canisters, 2-vehicle chairs, 1-barbecue fork and 1-electrical wire totaling 6-items.

Table 1. Fishing debris and other materials collected during FY11

<u>Months</u>	<u>Shoreline & Recreational Activities</u>	<u>Ocean / Waterway Activities</u>	<u>Smoking-Related / Dumping Activities</u>	<u>Medical/Personal Hygiene</u>	<u>Debris iItems of Local Concern</u>
April	409	30	58	6	2 Butane canisters
May	385	18	16	4	2 Vehicle chairs
June	470	43	60	0	1-electrical wire 1- Barbecue fork
July	400	53	48	0	0
August	307	84	19	2	0
September	71	14	2	0	0
Total:	<u>2042</u>	<u>242</u>	<u>203</u>	<u>12</u>	<u>6</u>

Table 1a are the dates of scheduled work-days for Ylig, Togcha-1 and Togcha-2 fishing platform services and maintenance. On May 13, 2011, department staff issued a temporary work suspension to Aloka because of a stranded deceased whale. Fishermen reported an increasing number of sharks within the vicinity of the channel. The suspension was lifted on May 24th and the contractor continued the job tasks on the 25th of May.

Table 1a. Work schedule for fishing platform services and maintenance

WORK LOG

(Site Work Dates Completed)

		YLIG SITE					
		Shore/Cleanup	FP INSPECTION	FP DEBRIS CHECK	FP DEBRIS AREA CK	Ladder-Nskid	Rail Paint
April	(1)	4-11-2011	4-11-2011	4-11-2011	4-11-2011	4-11-2011	4-17-2011
	(2)	4-24-2011	4-24-2011	4-24-2011	4-24-2011	4-24-2011	4-24-2011
May	(1)	5-2-2011	5-2-2011	5-2-2011	5-2-2011	Not applied	Not applied
	(2)	5-25-2011	5-25-2011	5-25-2011	5-25-2011	Not applied	Not applied
June	(1)	6-15-2011	6-15-2011	6-15-2011	6-15-2011	6-15-2011	6-15-2011
	(2)	6-30-2011	6-30-2011	6-30-2011	6-30-2011	6-30-2011	6-30-2011
July	(1)	7-6-2011	7-6-2011	7-6-2011	7-6-2011	7-06-2011	7-06-2011
	(2)	7-20-2011	7-20-2011	7-20-2011	7-20-2011	7-20-2011	7-20-2011
August	(1)	8-9-2011	8-9-2011	8-9-2011	8-9-2011	8-9-2011	8-9-2011
	(2)	8-23-2011	8-23-2011	8-23-2011	8-23-2011	8-23-2011	8-17-2011
September	(1)	9-2-2011	9-2-2011	9-2-2011	9-2-2011	9-2-2011	9-2-2011
	(2)	9-17-2011	9-17-2011	9-17-2011	9-17-2011	9-17-2011	9-17-2011

Photo attachments are taken during site visits to the three fishing platforms while conducting quality control inspections for this project.

8. Discuss differences between work anticipated in grant proposal and grant agreement and that actually carried out with Federal Aid grant funds; include differences between expected and actual costs.

Because of the transition to the new financial system, the grant was decreased by \$20,000 to ensure Sport Fish funds were available. The Department received the award letter on August 17, 2011. This reduced the amount of federal share to 28,085.00. Plans to proceed with this project will be based on available funding.

9. List any publications or in-house reports resulting from this work. N/A
Name, title, phone number, and e-mail address of person compiling this report

Shawn Wusstig, Fisheries Technician II (671)735-4037, shawnwusstig@yahoo.com

Edited by: Jay Gutierrez, Assistant Chief, (671) 735-3955/56, jaytgutierrez@yahoo.com

Attachment 1. Below is the scope of work proposal for contractors to follow to maintain the three fishing platforms located in Togcha/Ipan area, Guam.

Scope of Work
Proposal for contract to three Fishing Platforms for Services and Maintenance

From: Shawn Wusstig Department of Agriculture Tel: 735-4037 Fax: 734-6570

Subject: Request for Quotation

Project Site:

Ylig #1 GPS: 13°23'29.1" N / 144°46'30.7" E

Ipan Togcha #1 GPS: 13°21'55.8" / 144°46'20.0" E

Ipan Togcha #2 13°21'55.5" N / 144°46'21.9" E

Job Description:

1. Inspection, Maintenance and Repairs to (3) Fishing platforms total for loosens bolts, nuts, and missing epoxy to 2 X per month.

- A. Inspect *footing foundation* of platforms, tighten if needed and epoxy when needed and replace bolts and nuts if missing.
- B. Inspect and tighten bolts, nuts and screws on the *rails surrounding platforms, ladder, benches, and signs*.
- C. Apply *non skid coat paint on ladders*, 1X per month
- D. Apply marine coat (yellow) *paint by brush for fiberglass parts* 3 feet above water line to (3) platforms. Only on parts above waterline to minimize any spillage.

2. Removal of fishing debris (trash) to (3) platforms 2 X per month.

- A. Remove all trash to include paper, monofilament (fishing line) plastic wastes, aluminum cans, batteries and metal debris located *on the platforms* (3)
- B. Removal of all lines tied *to platforms*, rope, monofilament (fishing lines), strings, and tuna cords and chains etc.

- C. Removal of debris *below platforms* (3) deck, and *surrounding areas 10 feet surrounding platforms, including channel in front* for small debris weighing 50lbs or less. Includes, drift nets, tuna cords, metal debris, trash, batteries and cans.
- 3. Removal of trash, debris, metal items, batteries, plastics, lines to shore access to (3) Platforms 2 X per month**
- A. Removal of all trash, debris, *floating objects between shore and platforms, shores in front of platforms* (3)
- B. Removal of *non-biodegradable items* such as batteries, monofilament lines, tuna cords, chains, rope, aluminum cans, metal items on shore accessing platforms (3).
- 4. Quantifying debris and items collected above, below platforms (3) including 10 feet surrounding platforms, and shore access to platforms using NOAA forms 2 X per month**
- A. Debris collected at the platforms *is to be sorted* in a manner to quantify such items; Plastics, batteries, Metals, Aluminum cans, Fishing Sinkers, Glass, bottles, Monofilament lines, tuna cords, ECT. Are to be separated and indicated on the NOAA coastal form provided by DAWR.
- B. Debris collected *prior to disposal* should be separated and all recyclable items such as aluminum and car batteries are to be recycled, *metal, glass and other non biodegradable items are to be disposed of properly to EPA specifications at solid waste sites* and a copy of receipt to be given to DAWR accompanying the NOAA data sheet upon completion. The contractor may keep the money from recycling.
- 5. Handling of debris and Quality control of debris collected 2 X per month to fishing platforms (3)**
- A. All items collected during assigned job tasks, is to be brought to DAWR Fisheries office accompanying the NOAA data sheet indicating amount of items such as metal items, plastics, glass ECT. And site of each platform to be indicated on each sheet (separate) to each platform site.
- B. Tools utilized by contractor are supplied by the contractor including trash bags, and vehicles used to transport materials from platform sites to DAWR and to dumpsite.
- C. Dumpsite deposal of debris is paid by the contractor and a copy of receipt to be provided to DAWR fisheries office as proof of proper disposal.
- D. The use of heavy equipment such as back hoes, jackhammers and diggers are not allowed on the shore without proper permits
- E. The contractor will use floatation devices such as kayaks to transport any materials and supplies (paints and tools) to and from the platforms to the shore is at the responsibility of the contractor to minimize any spillage

- F. Liability of any damages to reefs, marine animals, and plants are at the responsibility of the contractor.
- G. Contractor is liable for any damage to marine life.
- H. DAWR reserves the right to inspect sites at any time to ensure compliance with contract specifications.

Photo attachment 1. Site visit with contractor April 2011



Photo Attachment 2. Paint touch ups on fishing platform – F-8-D-6.



Annual Project Performance Report
Guam Division of Aquatics and Wildlife Resources
FY 2011

1. State: Guam

Grant number: F-9-D-8

Grant name: Guam Sport Fish Investigations

Project number and name: F-9-D-8. Maintenance and Redeployment of DAWR FADs and SWMs.

2. Report Period: October 1, 2010 to September 30, 2011

Report due date: December 31, 2011 Extended to January 31, 2012

3. Location of work: Guam: Island-wide

4. Costs:

Source	Budgeted	Actual <u>X</u> or Estimated <u>__</u>
Federal : _____	335,317	22,102.42
State	-0-	
Other: _____	-0-	

Total Federal	335,317	22,102.42
Total match	-0-	-0-
Total project:	335,317	22,102.42

5. Objectives:

- a. To maintain, preserve, and replace (14) fish aggregating devices (FADs) located between 3.5 and 12 miles off the island of Guam, in a one-year period. Procure 7-line set's that will consist of the chain, line, fastening hardware, buoy and light as a unit to streamline and avoid procurement delays and secure a contract with a vendor to perform the FAD deployments. (Please see attachment # 1)
- b. To maintain, preserve, and replace 34 Shallow-Water-Mooring buoys (SWMs) located in 30-60 ft. of water off the coast of Guam. Continue to collaborate with the nonprofit group The Guam Marine Awareness Foundation agreed to reinstall the SWMS at no cost to Government agreement with the Department of Agriculture Division of Aquatic and Wildlife Resources providing materials and equipment. Improvements to design of the SWMS will be studied and an accurate inventory of systems will take

place. Perform studies to identify possible new SWM locations. (Please see attachment # 2)

6. If the work in this grant was part of a larger undertaking with other components and funding, present a brief overview of the larger activity and the role of this project.
N/A

7. Describe how the objectives were met.

5a: This fiscal year, the grant was reduced \$75,000.00 in preparation of the change to the USFWS-Financial Budget Management System (FBMS). The revised amount reduced the number of FAD Systems that could be built and deployed from initial plans of procuring 14 FAD Line sets to 7 sets and 5 deployments each. Currently, contracts and Purchase Orders are being processed for 7 FAD Line Sets, 14 Anchors, and 5 deployments with 2 errant buoy recovery services. No deployments, line purchases, or anchors were made this reporting period due to procurement discrepancies with Guam General Service Agency (GSA) and the Bureau of Budget and Management Resources (BBMR) and personnel shortages. Currently, 7 FAD's of 14 are on line; Number 2, Ledge and NOAA on the NW side of the island and Agat, Facpi #1, Facpi #2 and 9 Mile to the SW of island. Local fisherman and the USCG have reported that the Number 1 and Number 3 FADs are not on station and may have detached in the past few weeks. The lack of a contract to retrieve errant buoys and the division boat being inoperative to perform an assessment have caused some concern with the USCG because the errant FADs may be hazard to navigation. Assurances have been made with the USCG that these circumstances are isolated. All 5 FAD's procured are expected to be deployed as early as March 2012.

Fisheries Technician II Jamie Bass presented Guam's FAD program at the 2011 FAD Symposium in Papeete , Tahiti. The symposium was sponsored by the Secretariat of the Pacific Community. The purpose of his attendance was to gain knowledge on advancements in the field of FAD and research. The meeting also provided a unique opportunity to interact with professionals in FAD industry.

5b: The Division of Aquatic and Wildlife Resources (DAWR) is responsible for the maintenance and redeployment of 34 Shallow Water Moorings (SWM) sites located on the northern and leeward Guam (attachment #2). Although DAWR is responsible for all aspects of the SWM program, DAWR signed an agreement with the Guam Marine Awareness Foundation (GMAF) to replace offline SWMS with components provided by DAWR. Equipment such as lines and floats were delivered to GMAF in June FY'11 but GMAF have not been able to deploy any of the SWMS in fy'11 and even FY'10. In addition, DAWR is researching materials on SWM systems to increase resilience to the elements. The improvements would help with longevity of the systems in the field and provide better service to recreational fishers. Currently only 6 sites located on the south side of the island are online; these sites are Cocos #1, Cocos #2, Bile Bay, Cetti Bay, Sella Bay and Pete's Reef. Please refer to SWMS map attached. These same sites were replaced with new systems in June and July FY'11 by DAWR staff due to their poor condition. DAWR will be cancelling the agreement with GMAF next fiscal year due to non-performance with the

SWMs. All components will be retrieved from GMAS as well. A contract with a vendor will be obtained next fiscal year to install the remaining offline buoys. Furthermore, plans to locate other anchoring sites are forthcoming and, as an alternative, DAWR can deploy more SWMS as soon as the division boat is operational.

8. Discuss differences between work anticipated in grant proposal and grant agreement and that actually carried out with Federal Aid grant funds; include differences between expected and actual costs. Discussed above.

9. List any publications or in-house reports resulting from this work.

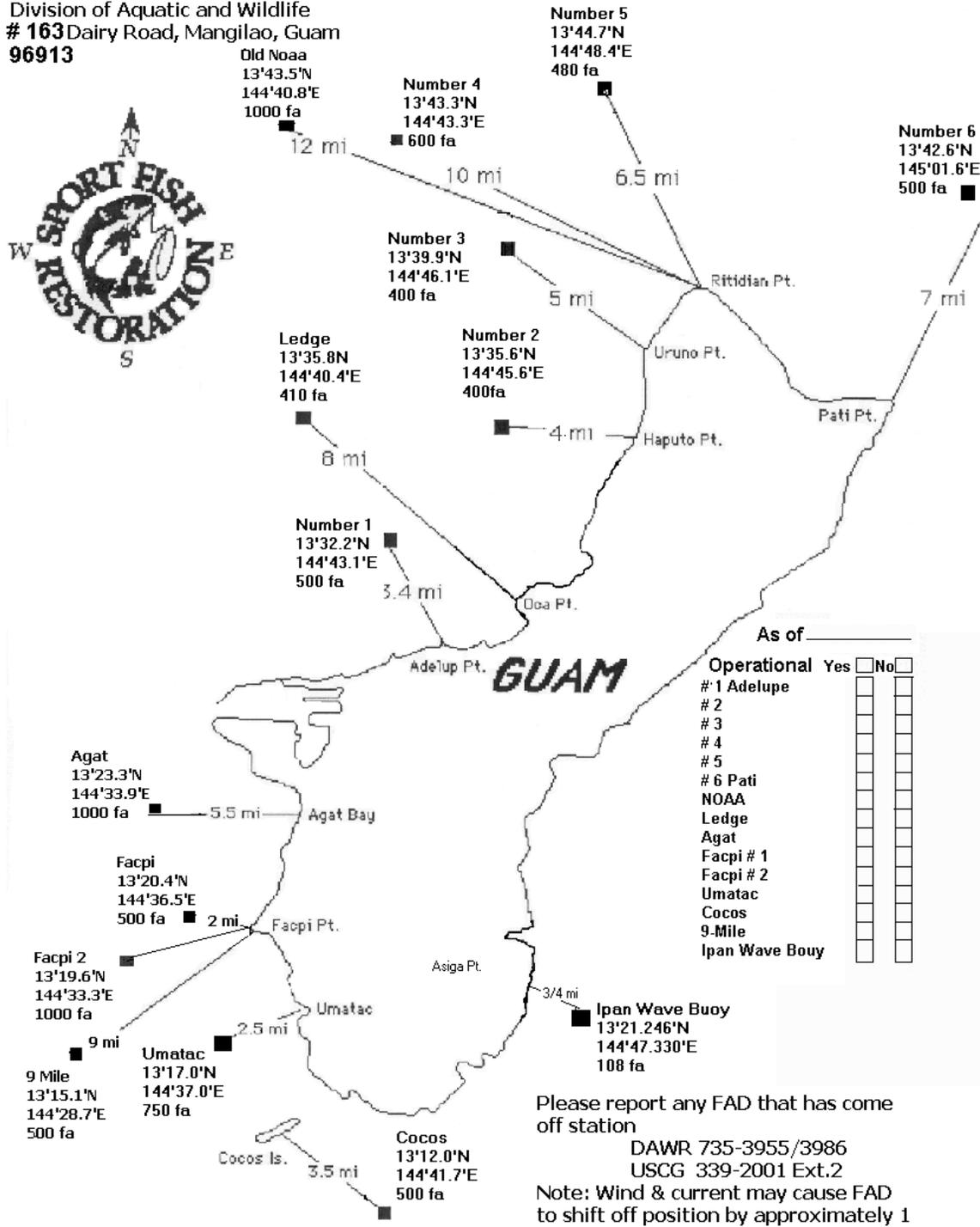
Name, title, phone number, and e-mail address of person compiling this report:

Jamie D. Bass, Fisheries Technician II (671) 735-3958, jddbass@hotmail.com.

Edited by: Jay T. Gutierrez, Assistant Chief, (671) 735-3955/56, jaytgutierrez@yahoo.com

Attachment # 1: Location of FADs on Guam

Department of Agriculture
 Division of Aquatic and Wildlife
 # 163 Dairy Road, Mangilao, Guam
 96913

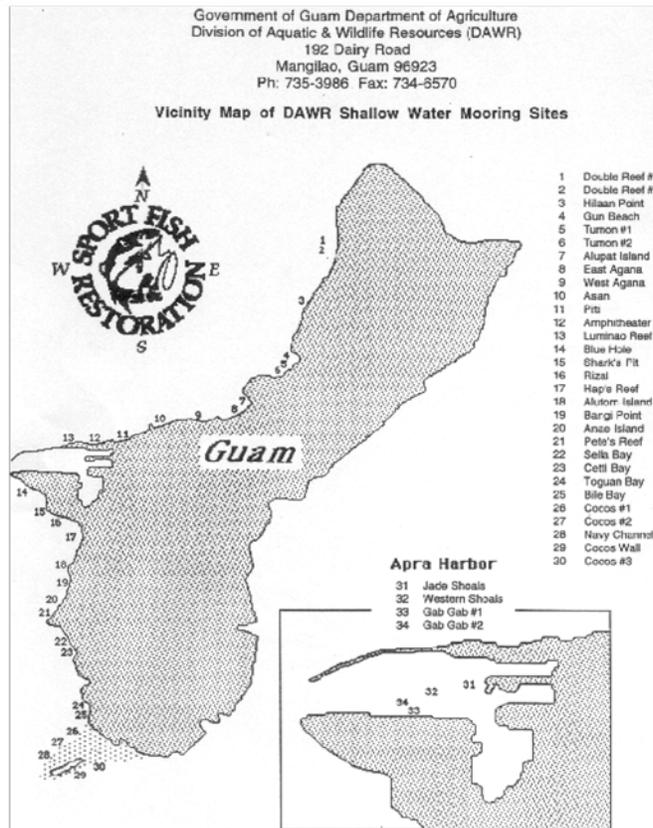


As of _____

	Operational	Yes	No
# 1 Adelupe	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
# 2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
# 3	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
# 4	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
# 5	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
# 6 Pati	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
NOAA	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ledge	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Agat	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Facpi # 1	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Facpi # 2	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Umatac	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Cocos	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
9-Mile	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Ipan Wave Bouy	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Please report any FAD that has come off station
 DAWR 735-3955/3986
 USCG 339-2001 Ext.2
 Note: Wind & current may cause FAD to shift off position by approximately 1 mile.
DO NOT TIE TO FAD BUOY

Attachment 2. Location of Shallow-Water Mooring Sites around Guam, MI.



Annual Project Performance Report

Guam Division of Aquatic and Wildlife Resources
FY 2011

1. State: Territory of Guam

Grant number: F-11-D-1

Grant name: Guam Sport Fish Investigations

Project number and name: F-11-D-1. Masso Reservoir Restoration

2. Report Period: October 1, 2010 to September 30, 2011

Report due date: December 29, 2011, Extended to January 30, 2012,

3. Location of work: Masso Reservoir

4. Costs:

Source	Budgeted	Actual __or Estimated_X__
Federal :_____	\$259,254.00	\$259,200.00
State		
Other:_____		

Total Federal	\$259,254.00	\$259,200.00
Total match		
Total project:	\$259,254.00	\$259,200.00

5. Objectives:

1. To have a contract in place by March 2007 to conduct a wetland delineation of the Masso Reservoir. (Completed)
2. To obtain permits and approvals from the U.S. Army Corps of Engineers and the Guam Environmental Protection Agency, which is dependent on the wetland delineation by June 2008. (Completed)
3. The grant will be amended when the permits are obtained.
4. Project given to DPW for bid.

6. If the work in this grant was part of a larger undertaking with other components and funding, present a brief overview of the larger activity and the role of this project.
N/A

7. Describe how the objectives were met.

Dredging began in January 2010. An estimated 15,000 cubic yards (cy) of material was dredged from the reservoir. Two sediment traps were to be installed in the Masso River feeding in to the reservoir. During the dredging, an unknown drainage port was uncovered in the bottom of the reservoir. The drainage had to be repaired before the reservoir could refill. The contract award was increased to reflect this additional work. The estimated date of completion for the Masso Restoraton Project was September 30, 2010. Dredging of the Masso Reservoir, and installation of the sediment traps were all substantially completed by September 30, 2010.

The reservoir was filled, and the fishing platform was installed by September 2, 2011. Heavy rainfall caused severe erosion at the Masso site. Therefore the reservoir remains closed to the public until the erosion issues are dealt with. Although outside of the reporting reporting period, on October 24, fisheries staff discovered parts of the fishing platform had been stolen. A police report was filed regarding the incident. Suspects in the theft were arrested on November 22, 2011.

During 2011, 197 *Kuhlia rupestris*, 63 shrimp, 4 eels, and a sleeper goby were relocated in to the Masso reservoir. Ultimately, 500 *Kuhlia* will to be released into the reservoir, and monitoring of the fishing activity will continue to assess if the stocking efforts are adequate to meet user demand.

8. Discuss differences between work anticipated in grant proposal and grant agreement, and that actually carried out with Federal Aid grant funds; include differences between expected and actual costs. N/A

9. List any publications or in-house reports resulting from this work. None

Name, title, phone number, and e-mail address of person compiling this report: This report was prepared by R. Brent Tibbatts. Fisheries Biologist II, Telephone number 7353987. E-mail- brent.tibbatts@gmail.com
Edited by Jay Gutierrez, Assistant Chief, Telephone number 735-3955/56, E-mail jaytgutierrez@yahoo.com

Annual Project Performance Report
Guam Division of Aquatic and Wildlife Resources (GDAWR)
FY 2011

1. State: Territory of Guam

Grant number: F-15-E-1

Grant name: Guam Sport Fish Investigations

Project number and name: F-15-E-1. Installation and Maintenance of Cultural Educational Signs along Guam's shores

2. Report Period: October 1, 2010 to September 30, 2011

Report due date: December 29, 2011, Extended to January 30, 2012

3. Location of work: Guam

4. Costs: Please identify sources of federal funds and match and indicate amounts budgeted and spent for each. Indicate if match is in-kind. Indicate in table whether costs are "Actual" or "Estimated"

Source	Budgeted	Actual <u>X</u> or Estimated
Federal : Sport Fish Restoration	\$ 14,92.89	\$ 116.53
State	-0-	-0-
Other: _____	-0-	-0-

Total Federal	\$ 14,92.89	\$ 116.53
Total match	-0-	
Total project:	\$ 14,92.89	\$ 116.53

5. Objectives:

- A. To design artworks, frames, footings and text needed in order to fabricate cultural educational signs (10) ten total. **(Complete)**
- B. Identify sites along Guam's coast for the installation of the signs to promote cultural fishing practices. **(Complete)**
- C. To adequately trim vegetation to ensure the signs are visible to members of the public and to conduct routine maintenance and inspections to the footings, bolts, nuts, frames and replace parts on as needed basis to the cultural educational signs (10) ten.

6. If the work in this grant was part of a larger undertaking with other components and funding, present a brief overview of the larger activity and the role of this project.

N/A

7. Describe how the objectives were met. See “Supplemental Information” for additional requirements and “Attachments” for specialized tables.

Objective 5a in the grant agreement, the department staff completed the scope of work and obtained a contract with Guampedia Foundation to design the artworks and text needed in order to fabricate and install ten (10) cultural educational signs promoting cultural fishing practices on Guam. The Department had secured a contract through the Guam Services Agency (GSA) and a purchase order (# P106A06221) was issued on August 9, 2010 in the sum of \$5,070.00 (Attachment 1). The completed 10 signs consist of five individual aluminum plates printed back to back on anti graffiti film in full color (Figure 1 and 2) totaling to fifty individual back to back signs. The scope entitles the contractor to design the layout, text, and images for approval and review, and to print ten large signs back-to-back full color at two feet height by four feet width, and forty individual two feet by two feet individual aluminum sheets. Image and text will be back-to-back in full color on anti graffiti film and placed on the aluminum sheets. .

The layout with the text information and artwork design was reviewed and approved by Dr. Lawrence J. Cunningham, author of Ancient Chamorro Society, and Mr. Anthony Ramirez of the Guam Museum. Guampedia Foundation as part of the scope of work provided the department copyright of the layout for future use on September 13, 2010. The signs were delivered to the department on October 10, 2010.

The department had completed the scope of work for the footing design (Figure 3) and received quotations on October 4, 2011 for the sum of \$10,000.00 (Attachment 2). The frame will be fabricated with galvanize pipes and welded, to include rust proof paint over the frame to protect the frame from the elements. The footing for the sign frames will consist of a one-foot rod through the two inch galvanize frame at a depth of two feet. The foundation will be poured with marine grade concrete cement and the nuts and bolts used to secure the signs will be stainless steel and is provided by the contractor. The department anticipates the installation to take place early next fiscal year.

Objective 5b in the grant agreement was accomplished and letters were sent to the Department of Parks and Recreation (DPR) Guam State Historical Preservation Office (SHPO) and the Guam Coastal Zone Management Office to review the proposed sites for installation on July 16, 2010. The locations for the installation of all (10) ten educational cultural signs will be placed above the high tide water line, above the vegetation in parks and hotel property areas along Guam’s coast. Proposed sites locations for the installation of the cultural educational are as follows:

- 1) Asan Beach Park -prior to war in the pacific by pavilions GPS N 13.28.309 / E 144.42.709;
- 2) East Hagatna bay – GPS N13.28.748 / E144.45.020;
- 3) Adelupe, GPS N13.28.660 / E144.43.599;
- 4) Tanguisson beach park GPS N13.32.530 / E 144.48.424;

- 5) Tagachan beach park GPS N13.24.183 / E144.46.685;
- 6) Ipan public beach GPS N13.21.531 / E144.46.122;
- 7) Talafofo bay GPS N13.20.426 /E144.45.589;
- 8) Inarajan bay GPS N13.16.426 /E 144.44.782;
- 9) Merizo Pier GPS N13.15.984 / E 144.39.730;
- 10) Nimitz beach Agat GPS N13.21.818 / E144.38.858.

Objective 5c was not completed because the signs have not been installed for any vegetation to be cleared.

8. Discuss differences between work anticipated in grant proposal and grant agreement and that actually carried out with Federal Aid grant funds; include differences between expected and actual costs.

Objective 5b installation portion of the objective was not completed for the grant period. A letter was sent to the DPR on March 29, 2011 (Attachment 3) requesting permission to install the proposed sites, which was accompanied with a site map and GPS coordinates Photo Attachments 1- 3). Department of Parks and Recreation responded in writing dated May 6, 2011 requesting an additional letter from the department to review our findings of effects for each location (Attachment 4). Due to the sensitivity of the Historical archives, the department filled out a request for assistance and service on May 18, 2011 which allowed a Historical Preservation staff to conduct site inspections with the department staff. Site inspections were completed by May 22, 2011. The letter to DPR requesting to review our finding was sent on June 6, 2011 (Attachment 5). The department determined a finding of “No Historic Properties Affected” based on the inspections of both department and DPR staff. On June 17, 2011 DPR sent a letter concurring with the department’s determination (Attachment 6).

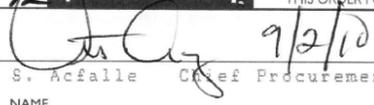
9. List any publications or in-house reports resulting from this work.

N/A

Name, title, phone number, and e-mail address of person compiling this report

Shawn Wusstig, Fisheries Technician II (671) 735-4037, shawnwusstig@yahoo.com

Attachment 1. Guampedia Foundation's purchase order to design layout

		<p align="center">PURCHASE ORDER GENERAL SERVICES AGENCY DEPARTMENT OF ADMINISTRATION GOVERNMENT OF GUAM 148 Route 1 Marine Drive Piti, Guam 96925</p>		<p>TRAN CODE 6221</p>			
				<p>THIS PURCHASE ORDER NUMBER No. P106A06221</p> <p>MUST APPEAR ON ALL INVOICES, PACKING SLIPS, PACKAGES, B/L, CORRESPONDENCE ETC.</p>			
F.O.B.		* AIR FREIGHT TEL. CONTACT		SHIP VIA:			
				DATE 8/09/2010	JOB ORDER NO. 162309131230		
		PREPAID-SHOW SHIPPING CHARGES AS SEPARATE ITEM ON INVOICE.		OBJ CL 230			
VENDOR	<p>TO: GUAMPEDIA FOUNDATION INC. GUAMPEDIA UOG STATION MANGILAO, GU 96923</p> <p>Telephone: 671 734-0217 Fax: 671 734-0217</p>		SHIP TO	<p>CONSIGNEE, DESTINATION & MARKING DEPARTMENT OF AGRICULTURE 192 DAIRY ROAD MANGILAO, GU 96913-0000</p> <p>MARINE PRESERVE AREAS EDUC SIGN</p>			
	<p>VENDOR G0097822</p>						
AUTHORITY 3111(c)	** INVITATION NO.	** CONTRACT NO.	TIME FOR DELIVERY SEE BELOW	EXPIRING	DISCOUNT TERMS:		
ITEM	ARTICLES OF SERVICES	QTY.	UNIT	UNIT PRICE	AMOUNT	DOCUMENT NUMBER	FAC
1	TO COVER COSTS FOR DIGITAL LAYOUTS, DESIGN, IMAGES, TEXT, PRINTING AND PLACING ON ALUMINUM SHEETS 10 EA. 2 FT. HIGH X 4 FT. WIDE AND 40 EA. 2 FT. HIGH X 2 FT. WIDE SIGNS IN FULL COLOR WITH ANTI GRAFFITI FILM AND PLACED BACK TO BACK. SEE ATTACH SCOPE OF WORK. POC:ALAN VAN AKEN 735-3983 NOTE: THE GOVERNMENT OF GUAM WILL NOT BE RESPONSIBLE FOR 'UNAUTHORIZED' PURCHASES OR SERVICES. Note: Amounts due this Purchase Order may be off set for monies due the Government of Guam inclusive of but not limited to taxes, fees, and returned checks other damages, penalties, and Attorney's fees, after failure to pay accordingly. To be coordinated between the requesting agency and vendor. ALL LATE DELIVERIES AND ACCEPTANCES ARE SUBJECT TO THE LIQUIDATED DAMAGES CLAUSE IN SECTION 5101(9)(a) OF THE GAR.	1	LOT	5070.00	5070.00	Q101623059	
<p>SPECIAL INSTRUCTIONS TO VENDOR: B. SEND CERTIFIED ORIGINAL AND THREE (3) COPIES OF INVOICE TO DIVISION OF ACCOUNTS, DEPARTMENT OF ADMINISTRATION; GOVERNMENT OF GUAM, P.O. BOX 884, AGANA, GUAM 96910. C. PAYMENT UPON RECEIPT OF MERCHANDISE IN GUAM IN GOOD CONDITION. D. THIS ORDER SUBJECT TO CONDITIONS ON REVERSE SIDE. E. **THIS ORDER IS SUBJECT TO THE SPECIAL PROVISIONS, AND BID GENERAL TERMS AND CONDITIONS SPECIFIED ON THIS BID. F. * ON ALL AIR SHIPMENTS HAVE AIR FREIGHT COMPANY CALL THIS NUMBER UPON ARRIVAL OF GOODS IN GUAM.</p>					5070.00	<p>A. DO NOT FILL THIS ORDER IF YOUR TOTAL COST EXCEEDS THIS TOTAL.</p> <p>INSERT CHANGES AND RETURN THIS ORDER FOR AMENDMENT.</p>	
<p>CONTRACTOR: PLEASE SUPPLY PROMPTLY THE ABOVE ARTICLES OR SERVICES. ALL CORRESPONDENCE PERTAINING TO THIS ORDER INCLUDING INVOICES, SHIPPING DOCUMENTS AND PACKAGES MUST BEAR THE PURCHASE ORDER NUMBER SHOWN ABOVE. SEE REVERSE SIDE FOR PURCHASE ORDER TERMS AND CONDITIONS. PAGE</p>			<p>ADVANCE PAYMENT AUTHORIZATION</p> <p>PAYMENT ENCLOSED <input checked="" type="checkbox"/></p>	<p>SIGNATURE:  9/2/10</p> <p>NAME: Claudia S. Acfalle TITLE: Chief Procurement Officer</p>			

Control No.

ORIGINAL/VENDOR'S COPY

Figure 1. Layout of the cultural fishing sign – Front view



Guam Cultural Fishing Practices





Funding provided by Sport Fish Restoration



Courtesy of the Guam Public Library System

Fishing was the main source of sustenance for Chamorros for centuries. It was a communal activity performed by both men and women.

Men typically fished off shore and women within the reef. Salt-water fishing was reserved for upper caste clans, the chamorro. The lower caste, manachang, were limited to fresh water fishing in streams and ponds.



For more information visit 



Courtesy of the Guam Public Library System

Lagua' Net Fishing

There are several nets used for fishing depending on the type of catch and the area being fished.

The lagua' pula, similar to a seine or dragnet, consisted of three connected nets with wooden poles woven into the ends. This net was used to trap fish and bring them closer to shore where they could then be collected or scooped up.



Talaya Throw Net

A familiar sight along Guam's shores is that of the fisherman waiting patiently for a school of fish to get close enough for him to cast his talaya (a cast net or throw net). The talaya is used to catch smaller fish such as mañahak (juvenile rabbitfish) or t'iao (goatfish).

It takes a skilled fisherman to spin and throw the almost perfectly circular net. The Japanese or the Spanish possibly introduced this net-throwing technique. The word "talaya" is of Spanish origin.



Village Fishing

In the annual "atulai run" in Inarajan, fishing was a communal event that manifested the Chamorro value of *inafa' maolek* (making it good for everyone) and reliance on each other.

The night before, men set out their fishnet. The next morning, it was pulled to shore where men, women and children collected fish and prepared the catch for distribution.

Inafa' maolek Making good for all



In village fishing, once the catch is pulled towards the shore the fish is collected and laid out to properly distribute to families and individuals. If a family was not there to participate in the catch, someone was responsible for ensuring that the family received a share. Fish was also given to people who were just watching and not part of the actual activity.

This practice is in the spirit of *inafa' maolek*, which is a central tenet of Chamorro culture. *Inafa' maolek* considers the importance of the well-being and benefit of the entire community over individual needs.

Figure 2. Layout of the cultural fishing sign – Back view

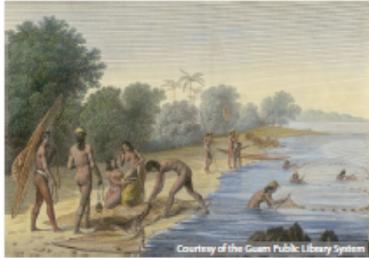


Government of Guam
Department of Parks and Recreation
11 Governor Michael Coe

Guam Cultural Fishing Practices



Director Paul C. Dapin
Deputy Director Joseph S. Torres



Courtesy of the Guam Public Library System

Fishing was the main source of sustenance for Chamorros for centuries. It was a communal activity performed by both men and women.

Men typically fished off shore and women within the reef. Salt-water fishing was reserved for upper caste clans, the chamorri. The lower caste, manachang, were limited to fresh water fishing in streams and ponds.



Funding provided by Sport Fish Restoration

For more information visit 



Courtesy of the Guam Public Library System

Sakman Flying Proa

The flying proa was an essential fishing tool for Chamorros. Western visitors were in awe of the speed and agility of the sea craft and at the skill of Chamorro sailors.

There were several types of proa. The largest proa was the sakman, fitted with a triangular sail, used for off-shore fishing and the smallest was the galaide' used for reef fishing.

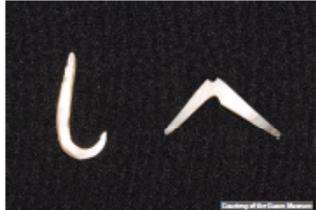


Courtesy of the Guam Public Library System

Poio Chumming Device

The poio or acho' achuman was a chumming device used by Chamorros until as late as the 20th century to catch achuman, a type of mackerel. This "fish training" device was unique to the region. It's successful use required patience and time.

The top half was a hollow coconut shell and the bottom half stone. The two parts were held together by a cord. The poio was filled with mashed coconut and lowered into the ocean. For several weeks fishermen returned daily to the site, pulling the poio a little closer to the surface. Eventually the fish, trained to come to the surface. Eventually the fish, trained to come to the poio for food, were easily caught at the surface with a net.



Courtesy of the Guam Public Library System

Haguet Fishhook

Chamorros traditionally used fishhooks common to the Micronesian area. The J-shaped fish hooks and V-shaped or L-shaped gorges were made of natural resources including turtle shell, seashell, fish bone and human bone. Fishhooks were later made of metal.



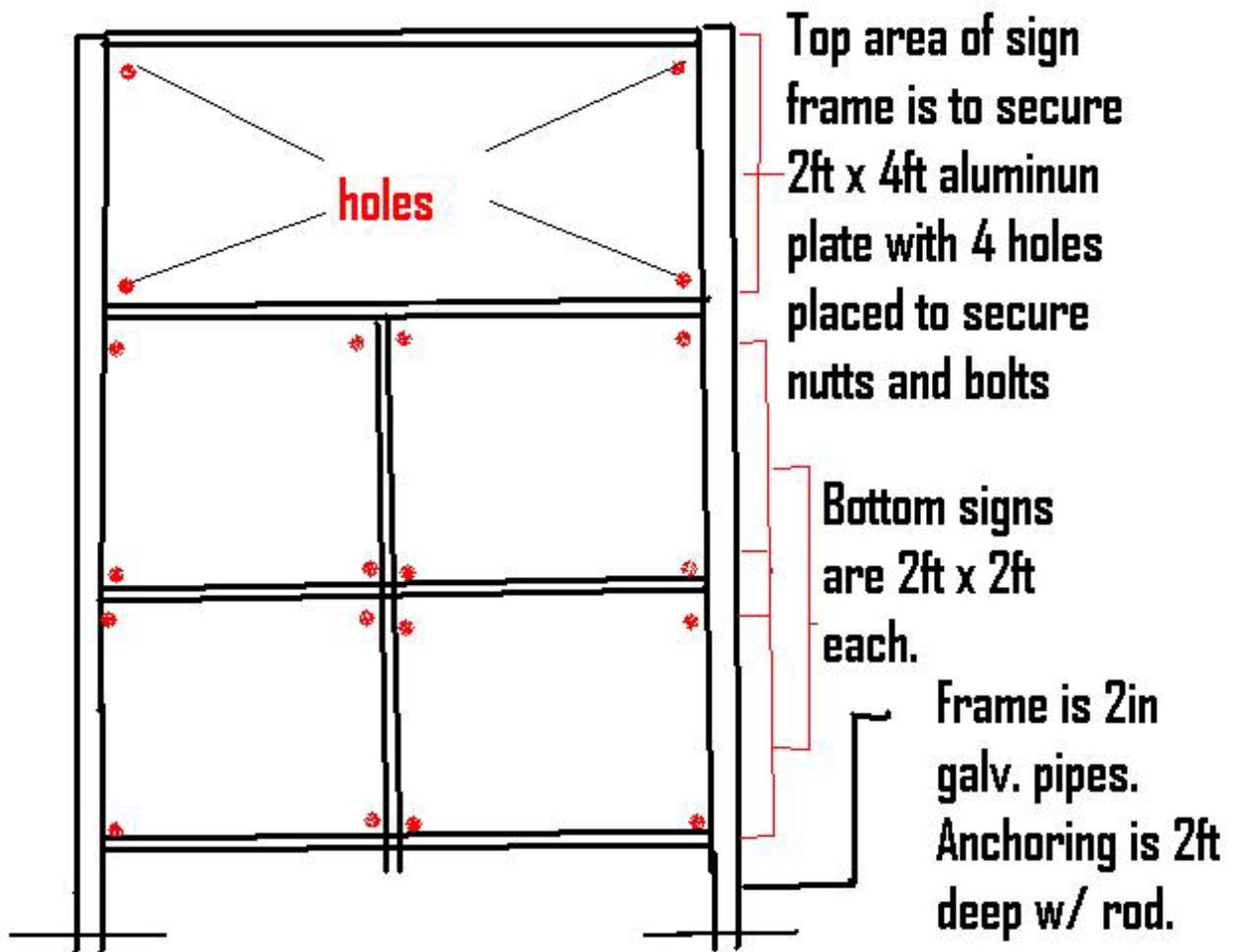
Courtesy of the Guam Public Library System

Ka'tokcha' Spear Fishing

Another technique ancient Chamorros used was spear fishing. There were three techniques: ka'tokcha' was above water where the fisherman would stand in shallow water or on rocks and spear fish; etokcha' was an underwater free dive without the aid of face masks or fins; and, peskan sumulo' was fishing where the fisherman used a torch to guide him and also to attract fish. Fishermen would use spears with two or more prongs called faga.

Figure 3. Layout of the cultural fishing practices frame

Specs for Cultural education signs Department of Agriculture



Attachment 2. Quote from D & R Maintenance

10/04/2011 10:38 6717895251

TALOFOFO_MAYOR

#0855 P.001 /003

From: D & R Maintenance
256 Ernest P. Santos St.
Talofofo, Guam 96915
Business License #200801915
Vendor # D0097329

To: Department of Agriculture

Attn: Shawn Wusstig

Quotations to fabricate and install a total of ten cultural education sign frames to include fastening the sign plates to the frame by nuts and bolts.

Design: The frame will be fabricated with galvanize pipes and weld, to include rust proof paint over the frame to protect the frame from the elements. The footing for the sign frames will consist of a one foot rod through the two inch galvanize frame at a depth of two feet. The foundation will poured with marine grade concrete cement and the nuts and bolts used to secure the signs will be stainless steel and is provided by the contractor. The locations for the installation of all (10) ten educational cultural signs will be placed above the high tide water line, above the vegetation in parks and hotel property areas along Guam's coast. Sites will be determined by the department staff. The use of materials, equipments and transportation for sign transport to and from locations are the responsibility of the contractor.

Qty = 10 Unit Price - \$1,000.00 each *THIS PRICE GOOD FOR 6 MONTHS*
Total Price - \$10,000.00 *from DATE Signed*

Upon condition that one half (\$5,000.00) of payment will be paid in advance with purchase order.

The party making the foregoing bid is genuine and that said bidder agrees, that they are fully aware and is in compliance with Title 5 G.C.A Chapter 5 - 5801 and 5802. Wage Determination, and that the attached is the most recent issued by U.S. D.O.L. for the positions required to implement the required service as per the following specification. Therefore, under penalty of perjury, I certify that the facts stated above are true.

Darrell L. Tice
Signature

9-1-11
Date

Attachment 3. Department's letter requesting permission to install the cultural sign at the proposed sites



Edward J.B. Calvo
Governor
Raymond S. Tenorio
Lt. Governor

Department of Agriculture Dipattamenton Agrikottura

163 Dairy Road, Maugilao, Guam 96913

Director's Office	734-3942/43; Fax 734-6569
Agricultural Dev. Services	734-3946/47; Fax 734-8096
Animal Health	734-3940
Aquatic & Wildlife Resources	735-3955/56; Fax 734-6570
Forestry & Soil Resources	735-3949/50; Fax 734-0111
Plant Nursery	734-3949
Plant Inspection Facility	472-1426; 475-1427; Fax 477-9487



Mariquita F. Taitague
Director

March 29, 2011

Memorandum

To: Director, Department of Parks and Recreation

From: Director, Department of Agriculture

Subject: **Installation and Maintenance of Ten (10) Cultural Educational Fishing Practice Signs Along Guam Shorelines**

Per the attached Guam (State) Historic Preservation Officer letter of August 19, 2010, your permission is requested to install the subject signs at locations identified in the attached map and photographs reflecting the proposed GPS coordinates. Permission is pending from the Superintendent, War in the Pacific National Park for the proposed locations in the National Park (2 locations). Specifications for the proposed signs are also attached for your information.

Your continued support and assistance for this federally funded culturally sensitive project is appreciated.

MARIQUITA F. TAITAGUE

Attachment(s):

Photo Attachment 2

5) Tagachang beach park
GPS N13.24.183 / E144.46.685
By parking area in between swimming
advisory sign and parking entrance



6) Ipan Public Beach
GPS N13.21.531 / E144.46.122
By parking area under pine trees and
adjacent signs



7) Talofoto Bay
GPS N13.20.426 / E144.45.589
In front of parking area and rock wall
By old sign foundation



8) Inarajan Bay
GPS N13.16.426 / E 144.44.782
Across church facing the bay by swimming
advisory sign



Photo Attachment 3

9) Merizo Pier
GPS N13.15.984 / E 144.39.730
By entrance to Pier walkway and adjacent signs



10) Nimitz Beach Agat
GPS N13.21.818 / E144.38.858
By entrance to walkway



Attachment 4. DPR's letter requesting an additional letter to review the department's findings of effects for each location



Eddie Baza Calvo
Governor

Ray Tenorio
Lt. Governor

Department of Parks and Recreation
Government of Guam
490 Chalan Palasyo
Agana Heights, Guam 96910
Director's Office: (671) 475-6296/7
Facsimile: (671) 477-0997
Parks Division: (671) 475-6288/9
Guam Historic Resources Division: (671) 475-6294/5
Facsimile: (671) 477-2822



Peter S. Calvo
Acting Director

In reply refer to:
RC11-7265

May 6, 2011

Memorandum

To: Director, Department of Agriculture

From: Director, Department of Parks and Recreation

Subject: Section 106 Review: Installation and Maintenance of Ten (10) Cultural Educational Fishing Practice Signs Along Guam's Shoreline.

We received your March 29, 2011 memorandum requesting our concurrence on BSP's September 3, 2010 "finding of no adverse environmental impacts" relative to the installation of 10 cultural education signs along the shores of Asan Memorial Beach Park, East Hagåtña, Adelup, Tanguisson Beach Park, Tagáchang Beach Park, Ipan Beach Park, Talofof Bay, Inarajan Bay, Merizo Pier, and Nimitz Beach. BSP's determination of "no adverse environmental impacts" is consistent with their regulatory requirements, but not with Section 106 of the National Historic Preservation Act.

For us to concur pursuant 36CFR Part 800, please submit a letter requesting us to review your findings of effects for each of the 10 location to include the area of potential effects. Additionally, the regulations provide for public participation in the Section 106 process.

If you need assistance on references to historic sites near these locations and a listing of individuals and organizations please contact William Hernandez, Historic Preservation Specialist, at 475-6294/6295 to help you on this. Please feel free to visit our website at www.historicguam.org for links to additional information at historicguam.org.

P.S. Calvo

Peter S. Calvo
Acting

Lynda Bordallo Aguin
Lynda Bordallo Aguin
State Historic Preservation Officer

Cc: BSP

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Attachment 5. Letter to DPR requesting to review the department's finding of "No Historic Properties Affected".



Edward J.B. Calvo
Governor

Raymond S. Tenorio
Lt. Governor

Department of Agriculture Dipattamenton Agrikottura

163 Dairy Road, Mangilao, Guam 96913

Director's Office	734-3942/43; Fax 734-6569
Agricultural Dev. Services	734-3946/47; Fax 734-8096
Animal Health	734-3940
Aquatic & Wildlife Resources	735-3955/56; Fax 734-6570
Forestry & Soil Resources	735-3949/50; Fax 734-0111
Plant Nursery	734-3949
Plant Inspection Facility	472-1426; 475-1427; Fax 477-9487



Mariquita F. Taitague
Director

Manuel Q. Cruz
Deputy Director

June 06, 2011

Memorandum

To: Director, Department of Parks and Recreation
Attention: Ms. Lynda Bordallo Aguon, State Historic Preservation Officer

From: Director, Department of Agriculture

Subject: **Request Section 106 Review: Installation and Maintenance of Ten (10) Cultural Educational Fishing Practice Signs Along Guam's Shoreline**

The Department of Agriculture, Division of Aquatic and Wildlife Resources (DAWR), requests your review of our proposed project to install ten signs in designated locations around the island of Guam, pursuant to Section 106 of the National Preservation Act (NHPA). We have reviewed the proposed project scope and have determined that it is an undertaking as defined in 36 CFR 800.16(y).

Description: The project proposed to install ten (10) Cultural Educational Fishing Practice Signs measuring four (4) feet by six (6) feet and will be anchored at a depth of 24 inches. The signs are going to be installed (see attached photos and GPS coordinates) in Asan Memorial Beach Park, East Hagatna (Paseo), Adelup, Tanguisson Beach Park, Tagachang Beach Park, Ipan Public Beach, Talofof Bay, Inarajan Bay, Merizo Pier, and Nimitz Beach Park. The location of the installation is in a disturbed area and consists of overburden as well as backfill. However, any post review discoveries requirements by the State Historic Preservation Office (SHPO) shall be complied with.

Therefore, in consideration with the above information, DAWR has determined a finding of "No Historic Properties Affected" for the propose project. We ask for your concurrence with this determination. Thank you for your review of our submittal. Please contact Mr. Shawn Wusstig at 735-4037, or Mr. Celestino F. Aguon, at 735-3955/56 should you have any questions. Thank you for your assistance of this request.


MARIQUITA F. TAITAGUE

Attachment(s):

Attachment 6. DPR letter concurring with the department's determination of "No Historic Properties Affected".



Eddie Baza Calvo
Governor

Ray Tenorio
Li. Governor

Department of Parks and Recreation
Government of Guam
490 Chalan Palasyo
Agana Heights, Guam 96910
Director's Office: (671) 475-6296/7
Facsimile: (671) 477-0997
Parks Division: (671) 475-6288/9
Guam Historic Resources Division: (671) 475-6294/5
Facsimile: (671) 477-2822



Peter S. Calvo
Acting Director

In reply refer to:
RC2010-7265

June 17, 2011

Memorandum

To: Director, Department of Agriculture
From: Director, Department of Parks and Recreation
Subject: Section 106 Review: Installation and Maintenance of Ten (10) Cultural Educational Fishing Signs along Guam's Shoreline

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Fisheries
6/28/2011

We reviewed your request for the above undertaking and have the following comments.

We concur with your determination of "No Historic Property Affected" on your proposed signs installation project, which includes Asan Memorial Beach, East Hagåtña (Paseo), Adelup, Tanguisson Beach Park, Tagachang Beach Park, Ipan Public Beach, Talofof Bay, Inarajan Bay, Merizo Pier, and Nimitz Beach Park. However, if any inadvertent discovery of cultural deposit occurs during your project implementation, please immediately cease work in the area and inform our office for further instructions.

If you have any questions, please contact our office at 475-6294/6295.

Peter S. Calvo
Acting

Lynda Bordallo Agudin
State Historic Preservation Officer

GUAM
Boating Access Fisheries Program
F-6-B-6, F-20-B-1, And F-21-B-1
ANNUAL PERFORMANCE REPORTS

FY 2011

January 30, 2012

Division of Aquatic and Wildlife Resources,
Department of Agriculture
163 Dairy Road
Mangilao, Guam 96913
671-735-3955/6

**Guam Fisheries Boating Access Program FY2011;
F-6-B-6, F-20-B-1, And F-21-B-1 Annual Performance Reports**

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Project Number And Name: F-21-B-1. Repair And Maintenance Of The Boat Ramp, Docks
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Annual Project Performance Report

Guam Division of Aquatic and Wildlife Resources
FY 2011

1. State: Territory of Guam

Grant number: F-6-B-6

Grant name: Guam Sport Fish Investigations

Project number and name: F-6-B-6. Repair and Maintenance of the Merizo Boat Ramp and Pier

2. Report Period: October 1, 2010 to September 30, 2011

Report due date: December 29, 2011, Extended to January 30, 2012

3. Location of work: Village of Merizo

4. Costs:

Source	Budgeted	Actual <u>X</u> Estimated _____
Federal : _____	\$121,606.00	\$7827.30
State	-0-	-0-
Other: _____	-0-	-0-

Total Federal	\$121,606.00	\$7827.30
Total match	-0-	- 0 -
Total project:	\$121,606.00	\$7827.30

5. Objectives:

1. Have a contract in place to replace the Merizo boat ramp's damaged walkway rubber bumpers and wooden supports for the bumpers, repair the Merizo Pier's damaged concrete cross beams supporting the damaged pier bumpers, and replace the missing upper and lower bumper system on the eastern side of the pier by November 2010.
2. Replace the signage crediting Sport Fish Restoration for the Construction of the Merizo Pier to include crediting Sport Fish Restoration for the construction of the current parking lot/double boat ramp/washdown facility.

3. Conduct at least two (2) clean-up days by fisheries staff to remove trash and fishing gear that may have entered the waters immediately around the Merizo Pier due to recreational and subsistence fishing activity.
 4. Have a contract in place to waterblast the one (1) public boat ramp at the Merizo Boat Ramp by November 2010.
 5. Have a contract in place to fix the damaged lighting and wiring at the Merizo Pier by December 2010.
6. **If the work in this grant was part of a larger undertaking with other components and funding, present a brief overview of the larger activity and the role of this project.** N/A

7. Describe how the objectives were met.

The Merizo Pier is a heavily used recreational and subsistence fishing area. The facility boasts a double ramp, lightings, and a locale adjacent to the channel north of the Cocos which provides fishermen the opportunity to fish for resident food fish species as well as pulse fisheries. Upkeep of the facility ensures fishing opportunities for the public, including persons with disabilities.

The contract to repair the damages on the pier and replace the bumpers around the boat ramp walkways was awarded to Hubtec International Company for \$94,500 at the beginning of the FY2010. However, significant delays with this project occurred at the Attorney's General office and the Governor's Office for contract review. The Governor of Guam signed the contract signed early FY2011.

Although the contract was signed early FY2011, the Department of Public Works delayed issuing the "Notice to Proceed" to Hubtec despite the contract having been signed by the Governor. Complications with Hubtec on a major highway contract resulted with the Department of Public-Works delaying other contracts awarded to Hubtec, including the Merizo Pier contract. Despite numerous meetings with the engineering section and a meeting with Federal Aid officials and the Deputy Director of the Department of Public Works in early 2011, the contract was not resolved or moved forward during FY2011. Public Works is well aware that this contract affects the safety of fishers at the facility. Agriculture's Director and DAWR administration is currently working with Public Works to resolve the contract, by either awarding the project to the next awardee or giving Hubtec the Notice to Proceed with stringent requirements given to ensure that all work is done to Public Works' specification.

One (1) clean up day around the boat ramp and pier facility was accomplished during FY11. In addition, the Merizo Pier was added to the Guam Coastal Cleanup's list of sites cleaned by local divers. One clean up day was done on June 2011.

The contract to waterblast the boat ramp was awarded to Aloka's Home Improvement

beginning in April 2011. Work done by Aloka's was inspected and found to be done according to the Scope of Work. This project is well received by the boating public since this removes algal growth on the boat ramp providing adequate traction to vehicles retrieving their boats. This prevents boaters trailering their boats from sliding into the ocean and being submerged.

8. Discuss differences between work anticipated in grant proposal and grant agreement, and that actually carried out with Federal Aid grant funds; include differences between expected and actual costs.

The complications with the contract being awarded to Hubtec International placed the Merizo Pier contract on hold. In addition, Public Works did not include the rewiring of the lights on the pier to the Hubtec contract. Public Works has been contacted about whether the existing contract with Hubtec can be modified to include this job.

The sign crediting federal aid was to include the current Merizo Pier work. However, the contract to update the sign was placed on hold until the Merizo Pier work is completed and added to the new sign.

9. List any publications or in-house reports resulting from this work.

Name, title, phone number, and e-mail address of person compiling this report: This report was prepared by Thomas Flores, Jr., Acting Fisheries Supervisor, (671) 735-4033, thomasfloresjr@yahoo.com.

Edited by Jay Gutierrez, Assistant Chief, (671) 735-3955/56, Email jaytgutierrez@yahoo.com

Annual Project Performance Report
 Guam Division of Aquatic and Wildlife Resources
 FY 2011

1. State: Territory of Guam

Grant number: F-20-B-1

Grant name: Guam Sport Fish Investigations

Project number and name: F-20-B-1. Repair and Maintenance of the Agat Marina Boat Ramp Facility

2. Report Period: October 1, 2010 to September 30, 2011

Report due date: December 29, 2011, Extended to January 30, 2012

3. Location of work: Village of Agat

4. Costs:

Source	Budgeted	Actual <u>X</u> or Estimated <u>___</u>
Federal : _____	\$98,606.00	\$76,664.04
State	-0-	-0-
Other: _____	-0-	-0-

Total Federal	\$98,606.00	\$76,664.04
Total match	-0-	- 0 -
Total project:	\$98,606.00	\$76,664.04

5. Objectives:

- a. Have a contract in place to repair the damaged walkway at the northern side of the public boat ramp at the Agat Marina by November 2010.
- b. Remove any of the existing bumpers at both walkways at the public boat ramp at the Agat Marina and replace the missing bumpers with new rubber bumpers by November 2010.

- c. Have a contract in place to waterblast the one (1) public boat ramp at the Agat Marina by November 2010.
- d. Meet with the appropriate Port Authority staff to first determine the feasibility, and if feasible, develop a Scope of Work to remove appropriated sections of the existing damaged concrete beam and metal winch which is used by sport fishermen to offload large pelagics, such as Pacific blue marlins, directly into their vehicles from their boats. Then, obtain a contract to design and build a new winch system somewhere appropriate in the approximate area which will be available to the general

6. If the work in this grant was part of a larger undertaking with other components and funding, present a brief overview of the larger activity and the role of this project.
N/A

7. Describe how the objectives were met.

The Agat Marina is a marina providing recreational boaters and fishermen closer access to the southern banks and to Apra Harbor. The facility has a double boat ramp with fixed walkways, lighting, and a winch to offload large pelagics.

The contract to fix the damaged walkway was awarded to EVM Construction for \$48,800, and the Notice to Proceed was given on August 23, 2010. However, several weeks later Agriculture was informed that there were additional damages done to the piling on the damaged walkway, damage that was overlooked by the Department of Public Works and Port Authority of Guam. A site visit was conducted on October 7, 2011, and the walkway was immediately condemned since the walkway was in danger of collapsing. An additional \$37,925 was the estimated cost for the piling work in addition to the original award of \$48,000. The total cost for the repair of the walkway increased to \$86,725.

Both Public Works and Port Authority engineers indicated that an Army Corp permit was in place, and since the grant had enough money to cover the cost, all agencies agreed on a modified Scope of Work on October 12, 2011, and the contractor was given the Notice to Proceed on December 8, 2010. The work to repair the entire walkway including the piling was completed on February 18, 2011.

During the period, Agriculture requested for a copy of the Army Corp of Engineers permit. However, it was determined that a permit was not issued. However, the entire project was paid to the contractor with Sport Fish funding. Furthermore, Agriculture did not complete a Section 7 review for the modified in-water Scope of Work resulting in the in-water portion of the work ineligible to be paid with Sport Fish funds.

Due to the miscommunication with this project and the Port Authority's concentration on the grant objectives for the Agana Boat Basin, which were put as a priority, the Port Authority only provided given an estimated cost for the repair of the fish boom and replacement of the damaged wooden bumpers on the southern walkway of the boat ramp.

These projects were not bid out due to the increased workload and minimal staff at the Port Authority. However, with the completion of the northern walkway, the Port's engineering office staff has assured Agriculture that both the fish boom and the repair of the wooden bumpers of the other walkway will be pursued during FY2012 should funding be available. A priority would be to replace the damaged wooden bumpers over replacement of the fish boom.

The objective to waterblast the Agat boat ramp was issued April 2011 to Aloka's Home Improvement and Construction Company. The waterblasting contract needed the F6B6, F20B, and F21B grants to be in place prior to the project being bid out. The F20B grant was the last grant that was put in place in order to get the waterblasting contract bid out and awarded, in April 2011.

8. Discuss differences between work anticipated in grant proposal and grant agreement, and that actually carried out with Federal Aid grant funds; include differences between expected and actual costs.

The non-issuance of an Army Corp of Engineers and Section 7 permits severely complicated this grant. Although safety was a glaring issue, lack of the permits made the in-water piling work ineligible to be paid with Sport Fish funds. However, the entire project was funded with the Sport Fish funds. Although the waterblasting project will remain as an objective, available funding may result in the objectives to repair the fish boom and the wooden bumpers of the other walkway to be either deleted or one objective may be able to be funded during FY2012.

9. List any publications or in-house reports resulting from this work.

Name, title, phone number, and e-mail address of person compiling this report: This report was prepared by Thomas Flores, Jr., Acting Fisheries Supervisor, (671) 735-4033, thomasfloresjr@yahoo.com.

Edited by Jay Gutierrez, Assistant Chief, (671) 735-3955/56, jaytgutierrez@yahoo.com

Annual Project Performance Report

Guam Division of Aquatic and Wildlife Resources
FY 2011

1. State: Territory of Guam

Grant number: F-21-B-1

Grant name: Guam Sport Fish Investigations

Project number and name: F-21-B-1. Repair and Maintenance of the Boat Ramp, Docks A, B, C and pilings at the Agana Boat Basin

2. Report Period: October 1, 2010 to September 30, 2011

Report due date: December 29, 2011, Extended to January 30, 2012

3. Location of work: Village of Agana

4. Costs:

Source	Budgeted	Actual <u> X </u> or Estimated <u> </u>
Federal : _____	\$744,106.00	\$219,163.99
State	-0-	-0-
Other: _____	-0-	-0-

Total Federal	\$744,106.00	\$219,163.99
Total match	-0-	- 0 -
Total project:	\$744,106.00	\$219,163.99

5. Objectives:

Job 1: Repair of Dock A at the Agana Boat Basin

1. Issue a contract to replace the Damaged Dock A Agana Boat Basin walkway with a composite wood lumber by January 2010. (\$250,088.00)

Job 2: Repair of Dock B at the Agana Boat Basin

1. Issue a contract to replace the damaged Dock B Agana Boat Basin walkway with composite wood lumber by May 2010. (\$180,000)

Job 3: Repair of Dock C at the Agana Boat Basin

1. Issue a contract to replace the damaged Dock C Agana Boat Basin walkway with composite wood lumber by November 2009. (\$150,000)

Job 4: Extend the Pilings at the Agana Boat Basin

1. Explore the option to replace existing pilings that may not be able to support the piling extensions, and then submit a Port-approved Scope of Work to allow for these pilings to either be replaced or stabilized. Status of the pilings should be completed by November 2009.
2. Conduct a feasibility study to determine if any of the pilings at the Agana Boat Basin are capable of supporting a five (5) foot extension composed of an overlapping metal pole filled with concrete.
3. Issue a contract to extend pilings at the Agana Boat Basin by May 2010, if supported by engineering standards. (\$75,000.00)

Job 5: Waterblast the two (2) boat ramp at the Agana Boat Basin

1. Have a contract in place to waterblast the two (2) public boat ramps at the Agana Boat Basin by November 2009. (\$7,000.00)

6. If the work in this grant was part of a larger undertaking with other components and funding, present a brief overview of the larger activity and the role of this project.
N/A

7. Describe how the objectives were met.

The Agana Boat Basin is the heaviest used boat ramp facility for recreational boaters and fishermen on Guam. The facility boasts two double ramps, lightings, security cameras, and access to fuel and a business that buys fish. Commercial dive boats, and parasail operations also heavily use this facility.

The Port Authority of Guam is responsible for maintaining the Agana Boat Basin. Historically, use of Federal Aid funds was used for waterblasting, minor repair work to the boat ramps, removing large debris in the water next to the boat ramps, and providing gravel to even out the parking facility in the grassy area adjacent to the rinse down facility. However, since the facility is used by berthed boats participating in eligible fishing activity for Federal Aid funding, a cost-sharing agreement between the Port Authority of Guam and the Department of Agriculture was developed. Activities such as waterblasting are paid for 100% by Agriculture, while other eligible activities that result in use by berthed boats are cost-shared, with Agriculture paying 82.5% of the cost.

Dock A

The contract for the Dock A repair work was awarded by the Port to Hubtec for \$253,000. The first Notice to Proceed (NTP) was given during FY2010, June 14, 2010. On February 8, 2011, Hubtec acquired the Army Corp of Engineers permit. Once this was obtained

Hubtec was given a Notice to Proceed for the construction phase, and contracted Blue Water Marine for \$175,000 to complete the Work. On July 6, 2011, the Port Authority conducted a final inspection with final concerns given to Hubtec. These concerns were minor construction oversights, such as replacement of several screws, bolts, and cleats as per specifications and completion of painting on the steel pilings. On September 24, 2011, Hubtec requested for the final payment for the contract via the Port Authority.

Dock B

The bidding packet for the Dock B repair work was still being completed at the beginning of FY2011. The bidding packet was completed with a pre-conference meeting held at the Port Authority on June 22, 2011. Hubtec International was awarded the bid, and a Notice to Proceed was issued August 2011 in order for Hubtec to obtain the permits from the Army Corp, Guam Coastal Management, and Public Works, in addition to providing the design drawing for Dock B. The NTP required Hubtec to complete this phase in 45 days. By the end of FY2011, Hubtec had not completed the required work within the 45 days. Currently, the Port Authority is in communication with Hubtec regarding the NTP. Should Hubtec not comply, the Port has communicated that it may terminate this contract with Hubtec. Agriculture is in communication with Port to ensure that Dock B work is completed by the end of 2012.

Dock C

The complications with the Dock A and Dock B contracts have resulted in the Port putting a temporary hold on the Dock C and Pilings contract. Currently, the Port is aware that the money for these projects expires September 30, 2012. Their staff has not yet completed the Scope of Work and bidding package for this work. With the resolution of the Dock B job, the Dock C and pilings work should be awarded fairly quickly.

The waterblasting contract for the Agana Boat Basin was awarded to Aloka Home Improvement Company April 2011. This project is well-received by boaters since this project removes algal growth that has resulted in several vehicle retrieving their boats not having adequate traction and sliding into the marina.

8. Discuss differences between work anticipated in grant proposal and grant agreement, and that actually carried out with Federal Aid grant funds; include differences between expected and actual costs.

The delays with this grant have resulted from work being awarded to Hubtec International. By the beginning of FY2012, the Port should resolve all issues regarding its procurement challenges with Hubtec and award the Notice to Proceed 45-day requirement for Dock B as well as finalize engineering specifications for Dock C and Pilings work in order to begin putting out Dock C and Pilings work out for bid.

9. List any publications or in-house reports resulting from this work.

Name, title, phone number, and e-mail address of person compiling this report: This report was prepared by Thomas Flores, Jr., Acting Fisheries Supervisor, (671) 735-4033, thomasfloresjr@yahoo.com.

Edited by Jay T. Gutierrez, Assistant Chief, (671) 735-3955/56, jaytgutierrez@yahoo.com

GUAM

Cooperative Sport Fish Investigations

F-14-R Grants

ANNUAL PERFORMANCE REPORTS

FY 2011

January 30, 2012

Division of Aquatic and Wildlife Resources,
Department of Agriculture
163 Dairy Road
Mangilao, Guam 96913
671-735-3955/6

Annual Performance Reports
Cooperative Sport Fish Investigations
F-14-R Grants

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Annual Project Performance Report
Guam Division of Aquatic and Wildlife Resources (GDAWR)
FY 2011

1. State: Territory of Guam

Grant number: F-14-R-1 Job 2

Grant name: Guam Sport Fish Investigations

Project number and name: F-14-R-1 Job 2. Project 1. Management of Guam's Marine Fisheries Resources. Job 2: Assessing patterns of movement and life history traits of the orangespine unicornfish (*Naso lituratus*) and bluespine unicornfish (*N. unicornis*) in relation to marine preserves on Guam

2. Report Period: October 1, 2010 to September 30, 2011

Report due date: December 29, 2011, Extended to January 30, 2012

3. Location of work: Guam

4. Costs: Please identify sources of federal funds and match and indicate amounts budgeted and spent for each. Indicate if match is in-kind. Indicate in table whether costs are "Actual" or "Estimated"

Source	Budgeted	Actual <u>X</u> or Estimated <u> </u>
Federal : Sport Fish Restoration	\$184 502	\$126 661
State	-0-	- 0 -
Other: _____	-0-	- 0 -

Total Federal	\$184 502	\$126 661
Total match	-0-	-0-
Total project:	\$184 502	\$126 661

5. Objectives:

1. To quantify movement patterns and residency times and home range size of individually tagged *N. unicornis* over a 1 yr period by using a remote acoustic tagging method which includes deploying an array of receivers along the marine preserve boundary (April 2008 – May 2009).

2. To establish if there are any spatial differences in the age structure of populations of *N. lituratus* and *N. unicornis* around Guam, and to estimate sex-specific growth curves (March 2008-April 2009) by otolith analysis.
3. To determine a gonadosomatic index for gonad samples collected on a monthly basis (in conjunction with the otolith study) over a 1 year period (March 2008-April 2009). Establishing the frequency and timing of spawning is often the first step in a population assessment of an exploited reef fish species.
4. To determine whether *N. unicornis* and *N. lituratus* are gonochoristic (separate sexes) or hermaphroditic (sex-change) (January 2009 – July 2009).
5. Develop a multi-dimensional simulation model based on a physical hydrographic model to track the dispersal potential of larval *Naso* cohorts. This model will incorporate both larval characteristics and adult spawning strategies, such that propagules are released at the time of spawning and from locations where spawning is known to take place (September 2009-January 2010)
6. Track the fate of larval cohorts released from the various marine preserves around Guam during peaks in spawning to determine if any export to non-fished sites is taking place (February – March 2010)
7. Based on the outcomes of the model, make recommendations to the local fisheries agency as to how “connected” the Guam stocks of *Naso* are, both at a local and regional scale and provide the agency with various management options (e.g. ban capture of target species during peak spawning season if adult stock from Guam are providing a large proportion of new recruits to the island) (May – August 2010).

6. If the work in this grant was part of a larger undertaking with other components and funding, present a brief overview of the larger activity and the role of this project.

N/A

7. Describe how the objectives were met.

Objective 1:

The acoustic array was deployed in 2008, with the results reported in an MSc thesis completed by Alyssa Marshall in March 2010. A manuscript describing those results has been published in the international journal *Coral Reefs* which is available upon request.

Objective 2:

All otoliths of both species have been ground and read. These data were validated, and age and growth models fitted by Justin Mills, Research Associate at the UOG Marine Lab, who was employed for several months in 2011 on this grant. Age-based yield models will then be used as the basis for making management recommendations.

Objective 3:

This section is complete – the results will be included in the final report.

Objective 4:

This section is complete – the results will be included in the final report.

Objective 5:

This section is complete – the results will be included in the final report.

Objective 6,7:

With the building of the simulation model completed, simulations are currently being run to determine the fate of larval dispersed from various sites around Guam. Objective 7 will be included in the final report.

8. Discuss differences between work anticipated in grant proposal and grant agreement, and that actually carried out with Federal Aid grant funds; include differences between expected and actual costs.

N/A

9. List any publications or in-house reports resulting from this work.

Alyssa Marshall, Justin S. Mills, Jennifer McIlwain, Kevin L. Rhodes (2011) *Passive acoustic tracking reveals highly variable home range and movement patterns among unicornfish in a marine reserve*. Coral Reefs DOI 10.1007/s00338-011-0770-2

Alyssa Marshall and Jennifer McIlwain (2012) Population estimates of *Naso lituratus* and *Naso unicornis* and distribution patterns of acanthurids around Guam. UOG Marine Lab Technical Report.

Name, title, phone number, and e-mail address of person compiling this report:

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Annual Project Performance Report
 Guam Division of Aquatic and Wildlife Resources (GDAWR)
 FY 2011

1. State: Territory of Guam

Grant number: F-14-R-1

Grant name: Guam Cooperative Sport Fish Investigations

Project number and name: F-14-R-1. Project 2. Guam Sport Fish Aquatic Education Job 1. Professional, Interactive, Portable Educational Displays.

2. Report Period: October 1, 2010 to September 30, 2011

Report due date: January 30, 2012

3. Location of work: Guam Island-wide

4. Costs: Please identify sources of federal funds and match and indicate amounts budgeted and spent for each. Indicate if match is in-kind. Indicate in table whether costs are “Actual” or “Estimated”

Source	Budgeted	Actual ___ or Estimated__
Federal : _____	\$70,000	-0-
State		
Other: _____		

Total Federal	\$70,000	-0-
Total match		
Total project:	\$70,000	-0-

5. Objectives:

1. Establish a Memorandum of Understanding with the Department of Agriculture and the Bureau of Statistics and Plans (BSAP) to sub-grant the project to BSAP by December 2008. (Completed)
2. Contract a services to a professional by February 2009 to:
 - a. Create a variety of displays including a 3-dimensional model of Guam’s coral reef ecosystem.
 - b. Create crafted messages pertaining to the importance of Guam’s cultural fishing traditions, and the relationship with the island’s coral reefs as habitats.

3. Consolidate all resource information in an accessible location that can easily be obtained by everyone by September 2009.

6. If the work in this grant was part of a larger undertaking with other components and funding, present a brief overview of the larger activity and the role of this project.
N/A

7. Describe how the objectives were met. See “Supplemental Information” for additional requirements and “Attachments” for specialized tables.

GCMP staff had sent out a quotation request for banners type displays from vendors but the F-14-R-1 account has not been set up with the Bureau of Budget and Management Research (BBMR).

The original intent of the educational displays was to be housed in a local children's science discovery center. The children's center is having a difficult time finding a facility to be housed and does not have the ability to accommodate these educational displays. We therefore had to create these displays so it could be portable. The project was to produce two different types of displays. The first type of display will be static and feature an overview of the history of fishing on Guam describing traditional practices and methods. The second display will be interactive and will reinforce the information from the static display. We also intend to use replicas of fishing implements and a model of a fishing canoe.

There has not been any invoices or any cost incurred through this MOU. Invoices will be submitted and reported in the next reporting period.

8. Discuss differences between work anticipated in grant proposal and grant agreement, and that actually carried out with Federal Aid grant funds; include differences between expected and actual costs. (See #7)

9. List any publications or in-house reports resulting from this work.

N/A

Name, title, phone number, and e-mail address of person compiling this report:

Evangeline D. Lujan, Administrator, Guam Coastal Management Program, (671) 475-9672, vangelujan@yahoo.com

Edited by: Jay T. Gutierrez, Assistant Chief, Division of Aquatic and Wildlife Resources (DAWR), (671) 735-3980, jaytgutierrez@yahoo.com

Annual Project Performance Report
Guam Division of Aquatic and Wildlife Resources (GDAWR)
FY 2011 under no-cost extension

1. State: Territory of Guam

Grant number: F-14-R-2 [54-R-720586-R-5]

Grant name: Guam Sport Fish Investigations

Project number and name: F-14-R-2 [54-R-720586-R-5]. Project 1. Management of Guam's Marine Fisheries Resources. Job 2 Characterization of Mangrove Snapper Spawning Aggregations and Sites in Selected Outer Estuarine Bays of Guam, Phase II

2. Report Period: October 1, 2010 to September 30, 2011

Report due date: January 30, 2012 (interim report for no-cost extension)

3. Location of work: Island of Guam

4. Costs: (To be completed by UOGML Administrative Officer and submitted separately)

Source	Budgeted	Actual <u>X</u> or Estimated _____
Federal : _____	\$38,781	\$13,868.74
State	- 0 -	- 0 -
Other: _____	- 0 -	- 0 -

Total Federal	\$38,781	\$13,868.74
Total match	- 0 -	- 0 -
Total project:	\$38,781	\$13,868.74

Note: Financial reporting will be sent as soon as the Marine Laboratory's administrative assistant returns from personal leave.

5. Objectives:

- A. Tag, release, and attempt to observe adult mangrove snappers from three different river systems on a single spawning aggregation site or on multiple sites.
- B. Quantify the temporal and spatial distribution of fishes on one or more spawning aggregation sites relative to the location of the respective rivers and estuaries that adults may utilize; determine the relative abundance of fishes in spawning aggregations determine the estimated density of fishes in aggregations.

- C. Determine and quantify the reproductive behavior of this species on spawning aggregation sites.
- D. This objective will be met after the site(s) has (have) been identified. We will utilize the ArcGIS program to incorporate GPS data on the location of the site estimated from the modified protocol.

5b. Modified Objectives

A. Tag (Vemco acoustic tags plus Floy tags), release, and attempt to observe adult fishes of the following species: mangrove snappers (*Lutjanus argentimaculatus*, Lutjanidae), titan triggerfish (*Balistoides viridescens*, Balistidae), yellowmargin triggerfish (*Pseudobalistes flavimarginatus*, Balistidae), giant trevally (*Caranx ignobilis*, Carangidae), and longnose emperor (*Lethrinus olivaceus*, Lethrinidae). Other important species may be added as replacements depending upon capture success rates of the target species.

B. Quantify the temporal and spatial distribution of fishes on one or more spawning aggregation sites using GPS survey methods coupled with an existing and expanded (southeast coast) acoustic telemetry array and visual or photographic/videographic/fish finder (GPS fathometer) surveys; to determine catchment areas and migration pathways of fishes, and their relative abundance and density in spawning aggregations.

C. Determine and quantify the reproductive behavior of these species on spawning aggregation sites using visual and photographic/videographic methods.

D. Map locations of spawning aggregation sites of each species utilizing ArcGIS to incorporate GPS data on the location of the site determined from GPS surveys.

6. If the work in this grant was part of a larger undertaking with other components and funding, present a brief overview of the larger activity and the role of this project.
N/A

7. Describe how the objectives were met. See “Supplemental Information” for additional requirements and “Attachments” for specialized tables.

Note: This project was terminated under the old system of project awards and replaced with a stand-alone award that applied through 2009; a no-cost extension request was granted until September 30, 2012. REPLIES ARE TO MODIFIED OBJECTIVES.

Objective A: As reported previously, in addition to collecting smaller mangrove snappers in the Pago, Ylig, and Talofofu rivers, we identified adult habitats along the western coast of southern Guam, between Cetti Bay and Cocos Island and began to attempt tagging in this area. I had shifted the focus from capturing and tagging (Floy tags) fishes to capturing and

tagging large adults with bioacoustic tags and Floy tags. The acoustic tags are 13mm in size and were intended originally for use with groupers. Because large groupers continue to be difficult to find consistently, I have opted to use a subset of these tags on mangrove snappers instead. Unfortunately, fishes collected to date have still been too small to allow for the use of these tags. Nevertheless, to detect mangrove snappers and other species on both southwestern (Orote Point to Cocos Lagoon) and southeastern (Cocos Lagoon to Pago Bay) Guam, I added additional hydrophone/receivers to the existing array. Receivers installed on the southwestern coast have been doing double duty as they have already been recording data from groupers tagged in this area (see F14R-1 report; this project continues as a stand-alone project). The receivers installed on the southeastern coast are also doing double duty by tracking mangrove snappers but also additional species (groupers and large trevallies) that we attempted to collect and tag between Cocos Lagoon and Pago Bay. These collections have been unsuccessful because of the closing of the boat ramp on the Ylig River, thus denying access to much of the coastline, and our inability to collect, by hook and line or traps, fish capable of carrying these tags in the Cocos Lagoon area. I continue to expect that mangrove snappers will migrate to one or more spawning aggregation sites between June-September. We are arranging to collect fish with a local fisherman we've identified as skilled at catching mangrove snappers, and will commence fishing activity again in December of 2011 in southwestern Guam (mainly in Cetti Bay, where sizeable snappers have been observed). If we are successful, and fish are tagged, their signatures may be detected by the passive tracking array in place and we will be able, as the spawning season commences, to track movements of tagged snappers out of Cetti Bay and along the coast, presumably to a spawning aggregation site. Scans with a newly-acquired sidescan/downscan GPS fathometer/sonar will allow us to detect aggregating fishes whose own sonar signatures may be matched to those we obtain from pinging tagged fishes at depth before they are released. If aggregations are detected, we will then survey the site with the fathometer/sonar system and determine its physical and geospatial characteristics. If the site is within safe-diving limits, we will survey it by scuba and record aggregation sizes, depth distribution, and behavior.

We have tagged eight triggerfishes (7 *Balistoides viridescens* and 1 *Pseudobalistes flavimarginatus*) from Orote Point (mouth of Apra Harbor), where a transient spawning aggregation site has been found, and are collecting bioacoustic data from them. These powerful fishes are not easily captured and frequently break our lines on coral; we have managed to collect them at night when they are asleep, however, but this is also a difficult task where they sleep (see below). In addition, we have been conducting nearly weekly surveys to characterize use of this site. These triggerfishes are important as alpha-level predators within their family, their use in artisanal/subsistence and sport fisheries, and their vulnerability to overfishing and local extinction because of relatively low abundances wherever they are found (Donaldson, unpublished data). They make good proxies for other species, especially mangrove snappers, which we have been unable to capture in sufficient numbers or sizes because they are instructive of behavior and the use of traditional spawning aggregation sites.

Objective B: No spawning aggregation sites for snappers have been identified yet but data collection continues. We have identified a spawning aggregation site for the triggerfish

Balistoides viridescens at Orote Point and have conducted near-weekly surveys during or near new, full and quarter moon phases to determine aggregation size, inferred sex ratios, location within the site, recruitment of large juveniles to the site during aggregation periods, and physical factors. We will soon use a newly acquired sidescan/downscan GPS fathometer/sonar to characterize physical features at this site correlate these with GPS-referenced data on individuals observed at the site. The site has a core area that appears to be where most of the triggerfish nests are located. Observations of habitat use at night and early morning have indicated that the triggerfishes refuge (sleep) in hole in the spur and groove zone, and may feed there, but as daylight progresses they move out onto the bench and slope. The spur and groove zone can be accessed for collecting only during relatively calm periods; weekly visual surveys in this area during daylight is subject also to wave action but is generally easier than trying to collect them when the surf becomes rougher. Visual surveys during new and full moon periods have indicated also the presence of snappers (*Lutjanus bohar* and *L. argentimaculatus*) in small aggregations at this site; these fishes tend to move downslope below 30m and have been difficult to observe, however. We will continue to try and capture and tag some of them, and will continue to record their presence during surveys.

Objective C: No spawning aggregation sites of snappers have been identified yet and so no reproductive behavior has been observed. With respect to triggerfishes, we have been recording behavior on the site during morning, late afternoon, and nighttime periods but have yet to see spawning of these fishes. The triggerfish do not dig nests at this site but rather appear to use fissures in the pavement that males defend as courtship time approaches. We suspect that courtship takes place at one of these fissures after a female chooses a male, and that the eggs are laid and fertilized there. We have little data on male defense of the “nest” during morning hours but suspect that nest defense occurs only prior to and immediately after courtship and spawning. We will place low-light video cameras at nest sites and attempt to document spawning and nest defense.

Objective D: No snapper spawning aggregation sites have been identified yet. Results should include GIS bathymetric mapping of the spawning aggregation site(s). For triggerfishes, we will commence mapping the Orote Point site soon with a newly-acquired sidescan/downscan GPS fathometer/sonar unit. Data will be processed in Surfer and ArcGIS.

8. Discuss differences between work anticipated in grant proposal and grant agreement, and that actually carried out with Federal Aid grant funds; include differences between expected and actual costs. As stated above, this phase of the study includes the use of bioacoustic telemetry and a wider range of tagging sites in an attempt to solve the problem of poor returns for fish tagged with conventional Floy tags alone. The use of bioacoustic telemetry is fortuitous and done at no additional cost to the project. Additional species have been added to the list and the objectives have been modified to reflect this in FY2011 (modified objectives are also on file with GDAWR and the US Fish and Wildlife Service). This list has not changed

9. List any publications or in-house reports resulting from this work.

A manuscript describing the temporal pattern of triggerfish spawning aggregation formation at Orote Point is in preparation.

Name, title, phone number, and e-mail address of person compiling this report:

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Edited by: Jay T. Gutierrez, Assistant Chief, Division of Aquatic and Wildlife Resources (DAWR), (671) 735-3980, jaytgutierrez@yahoo.com

Annual Project Performance Report

Guam Division of Aquatic and Wildlife Resources
 FY 2011 with no-cost extension

1. State: Territory of Guam

Grant number: F-14-R-4 [54-S-720594-R-5]

Grant name: Management of Guam’s Marine Fisheries Resources

Project number and name: F-14-R-4 [54-S-720594-R-5]. Project 1. Management of Guam’s Marine Fisheries Resources. Determination of reef fish spawning aggregation sites on Guam II: northern and eastern coast surveys

2. Report Period: October 1, 2010 to September 30, 2011

Report due date: January 30, 2012; interim report for a two-year project

3. Location of work: Island of Guam

4. Costs:

Source	Budgeted	Actual <u> X </u> or Estimated <u> </u>
Federal : _____	\$91,077.00	\$1,849.73
State	- 0 -	- 0 -
Other: _____	- 0 -	- 0 -

Total Federal	\$91,077.00	\$1,849.73
Total match	- 0 -	- 0 -
Total project:	\$91,077.00	\$1,849.73

5. Objectives:

- A. To identify resident spawning aggregations sites of parrotfishes and large wrasses along the western coast of Guam by conducting monthly observations during relevant moon phases (new or full) with annual repetition. (Transient spawning aggregation triggerfishes (Balistidae) have been added to this objective because of their ease of detection with manta tows and timed-GPS scuba dive surveys.) Thus, the coastline would be surveyed at least twice over a nearly two-year period.

- B. To characterize and map resident spawning aggregation sites in relation to temporal and spatial factors by assessing the species aggregating, determining the number of male individuals establishing temporary mating territories, describing the habitat type and water depth, describing the temporal factors (i.e., moon phase, tidal state) that contribute toward aggregation formation, and confirming spawning events.
- C. To deploy an array of underwater acoustic receivers along the eastern coast of Guam in order to track the movement of adult spawning fishes bearing coded acoustic tags.
- D. To tag (coded acoustic tags) adult groupers (mainly *Epinephelus merra* but also other species of *Epinephelus* captured opportunistically), mangrove snapper (*L. argentimacultus* added to this study at no extra cost), and large spawning aggregation triggerfishes (*Balistoides viridescens* and *Pseudobalistes flavimarginatus*) collected by hook and line from the inshore waters of the coast of Guam in order to transmit movement patterns of spawning adults to specific spawning aggregation sites.
- E. To characterize transient spawning aggregation sites in relation to temporal and spatial factors by assessing the species aggregating, determining the number of males individuals establishing temporary mating territories, describing the habitat types and water depth, describing the temporal factors (i.e., moon phase, tidal state) that contribute toward aggregation formation, and confirming spawning.
- F. To correlate species-specific movement of both kinds of species with season, lunar phase, water depth, and geographic features (i.e. benthic structure) to determine the location of spawning aggregations, and the physical attributes that relate to the spatial and temporal patterns of aggregation formation.
- G. To produce GIS maps of resident and transient spawning aggregation sites along the western coast of Guam that incorporate aggregation parameters for use in developing and implementing management strategies for the management and conservation of spawning aggregations and sites.

6. If the work in this grant was part of a larger undertaking with other components and funding, present a brief overview of the larger activity and the role of this project.

N/A

7. Describe how the objectives were met. See “Supplemental Information” for additional requirements and “Attachments” for specialized tables.

Objective A Outcome: Loss of the boat launching ramp on the Ylig River because of bridge reconstruction activities has closed much of the coast north of Ipan to our boats. Manta tows and some collecting attempts for tagging were made again from the southern tip of Cocos Island north to just south of Talafofo Bay. Again, we did not discover any additional

parrotfish resident spawning aggregations sites along this leg. We did collect a little data on triggerfishes and the humphead wrasse (*Cheilinus undulatus*) but these were sightings of single individuals and not aggregations) in this area and identified a potential spawning aggregation site for *Balistoides vireescens* on the Cocos Barrier Reef at a depth of approximately 15m. We will be mapping this site in February, 2012 using a newly-acquired sidescan/downscan GPS fathometer/sonar. Manta tows have been suspended until Spring 2012 on central eastern, northeastern and northern exposures because of seasonally-heavy seas. Surveys will continue in the Cocos Island area, where we will investigate a reported spawning aggregation site for the triggerfish *Pseudobalistes flavimarginatus*. We will also continue to attempt the collection of fishes for tagging from this area. In Spring 2012, in addition to renewing manta tows (these were hampered this past summer because of repeated boat breakdowns- two of our boats are over 40-years old and a third is not seaworthy in heavier seas), we will attempt to install some receivers in the Ritidian area, and collect and tag target species that may use the cut there to move out to potential spawning aggregation sites off Ritidian Point that we expect will be utilized by late spring. We will map this area if we are successful in tracking fishes to this site. We require calmer weather to complete these north coast tasks, however. Two new students will join the project in January and will assist with the completion of these tasks.

Objective B Outcome: We are still collecting data to meet this objective.

Objective C Outcome: Deployment of receivers was limited to the Cocos Island area because of a) increased costs of acoustic telemetry receivers, and b) the loss of the boat launch ramp at the Ylig River. We still intend to concentrate receiver deployments near the mouths of rivers and bays in order to be able to detect mangrove snappers in addition to groupers and trevallys (if sufficiently-sized individuals can be captured).

Objective D Outcome: We've had poor success in capturing suitably-size individuals of the target species along the coastline of southeastern Guam. We shall continue with this task in line with other tasks to be performed in the area.

Objective E Outcome: We are still collecting data to meet this objective.

Objective F Outcome: We are still collecting data to meet this objective.

Objective G Outcome: We are still collecting data to meet this objective.

8. Discuss differences between work anticipated in grant proposal and grant agreement, and that actually carried out with Federal Aid grant funds; include differences between expected and actual costs. We added the mangrove snapper, *Lutjanus argentimaculatus*, two triggerfishes (*Balistoides viridescens* and *Pseudobalistes flavimarginatus* Balistidae), and trevallys (*Caranx* spp., Carangidae) to the acoustic tagging study in order to augment data collection in a related project for mangrove snappers, for which returns of fish with standard Floy tags have been poor, and to extend data collection to other important species, such as the latter. The objectives were modified for FY2011 and

are on file with GDAWR and the US Fish and Wildlife Service, and the responses given here address them (the modification involved additions in the species targeted).

9. List any publications or in-house reports resulting from this work.

Manuscript in preparation:

Donaldson, T.J., K.A. Chop and Z.R. Foltz. Distribution and characterization of resident spawning aggregation sites of the parrotfishes *Chlorurus sordidus* and *Scarus schlegeli* (Labridae: Scarinae). (We are adding additional species to this manuscript and will expand the paper accordingly.)

Name, title, phone number, and e-mail address of person compiling this report:

Dr. Terry Donaldson, University of Guam Marine Laboratory, (671) 735-2187, donaldsn@uguam.uog.edu

Edited by: Jay T. Gutierrez, Assistant Chief, Division of Aquatic and Wildlife Resources (DAWR), (671) 735-3980, jaytgutierrez@yahoo.com

Annual Project Performance Report
Guam Division of Aquatic and Wildlife Resources (GDAWR)
FY 2011

1. State: Territory of Guam

Grant number: F-14-R-5

Grant name: Guam Sport Fish Investigations

Project number and name: F-14-R-5. Connectivity of reef fish populations within the Mariana Islands and the Greater Micronesia Region

2. Report Period: October 1, 2010 to September 30, 2011

Report due date: January 30, 2012

3. Location of work: Guam and Micronesia

4. Costs:

Category	Current Billing	Previous Billing	Total Billing	Budget	Balance
Salary (0170)	\$72,618.68	\$106,376.00	\$178,994.68	\$174,583.00	-\$4,411.68
Benefits (0901)	\$6,369.59	\$8,124.30	\$14,493.89	\$13,780.00	-\$713.89
Travel	\$8,385.31	\$44,282.14	\$52,667.45	\$53,645.00	\$977.55
Comm (3231)	\$18.08	\$379.80	\$397.88	\$700.00	\$302.12
Contractual	\$0.00	\$7,000.00	\$7,000.00	\$7,000.00	\$0.00
Printing	\$0.00	\$622.98	\$622.98	\$623.00	\$0.02
Contr Misc (3239)	\$0.00	\$25,390.12	\$25,390.12	\$28,508.85	\$3,118.73
Supplies (4240)	\$312.40	\$4,733.98	\$5,046.38	\$6,512.60	\$1,466.22
Misc Supplies (4249)	\$415.20	\$3,151.26	\$3,566.46	\$3,152.00	-\$414.46
Equipment (5250)	\$1,423.15	\$2,905.43	\$4,328.58	\$4,329.00	\$0.42
Total	\$89,542.41	\$202,966.01	\$292,508.42	\$292,833.45	\$325.03

5. Objectives:

1. Complete the submission for publication process for the genetics component of the project.

2. Continue with model simulations to further refine the model output.
3. Continue with grinding, reading and interpretation of otoliths from adult fish – the otoliths from the adult fish have proven very difficult to interpret.
4. Continue with collation of the final report for submission by March 31st 2012.

6. If the work in this grant was part of a larger undertaking with other components and funding, present a brief overview of the larger activity and the role of this project.

N/A

7. Describe how the objectives were met.

Objective 1. A scientific manuscript has already been submitted to the international peer reviewed journal *Ecology and Evolution* and is currently undergoing review. The manuscript title and abstract is included under item 9.

Objective 2.

The bio-physical model has been run many times to build a more robust picture of how larval connectivity and dispersal around Guam is affected by the interactions of larval behavior with varying oceanographic conditions.

Objective 3.

The adult otoliths have been used to try and obtain an estimate of the age structure of local and regional populations of *Siganus spinus*. Unfortunately these otoliths are proving very difficult to interpret as the annual banding that identifies yearly growth cycles in adult reef fish is poorly conceived in these otoliths and hence estimates of age structure will have to be interpreted cautiously. These results will nevertheless be included in the final submission.

Objective 4.

Work is ongoing in collating all the various strands of information from this study to produce a coherent narrative on the population dynamics of *Siganus spinus* in the local region. The report is expected to be ready for submission by March 31st 2012.

8. Discuss differences between work anticipated in grant proposal and grant agreement, and that actually carried out with Federal Aid grant funds; include differences between expected and actual costs. N/A

9. List any publications or in-house reports resulting from this work.

Submitted to *Ecology and Evolution* in December 2011

Evidence of stable genetic structure across a remote island archipelago through self-recruitment in a widely dispersed coral reef fish.

Abstract

Understanding and quantifying patterns of connectivity between populations is essential for the effective management and conservation of marine ecosystems. Species that are widely dispersed are thought to be more resilient to disturbances, including overfishing. This resilience is a function of high connectivity between populations, with regular recruitment of outside individuals and their genes. From a contemporary management perspective however, it is necessary to distinguish between (1) levels of gene flow that maintain population heterogeneity and demographic singularity of populations and (2) levels of gene flow that are high enough to maintain genetic heterogeneity but too low for maintaining a single population structure. In this study we used microsatellite markers to assess the population genetic structure of the scribbled rabbitfish *Siganus spinus* along a 5000 km transect in the western Pacific. This species is a culturally important food fish in the Mariana Archipelago and subject to high fishing pressure. Our primary hypothesis was to test whether the populations resident in the southern Marianas island chain were genetically distinct and hence should be managed as a discrete stock. We also seek to explain what bio-physical mechanisms are at work to enforce such structure on a ubiquitous reef fish. In addition to spatial sampling of adults, newly settled individuals (< 2 weeks old) were sampled on Guam over four separate recruitment events to assess the temporal stability of the observed spatial patterns, and levels of self-recruitment. We found significant genetic structure in *S. spinus* populations across the region, with bayesian analyses revealing three genetically homogenous clusters: the Southern Mariana Islands (Guam and Saipan), East Micronesia (Chuuk, Pohnpei and Majuro), and the West Pacific (Philippines, Palau, Yap and PNG); with the Southern Mariana Islands being more strongly differentiated from the rest of the clusters. Analyses of the temporal samples from Guam indicated the southern Mariana cluster was stable in time, with no genetic differentiation between life-history stages (adults versus recruits), or between samples collected across the four separate recruitment events spanning 11 months. Additional comparison of the Guam recruit samples with the adult populations from both the East Micronesia and West Pacific clusters confirmed these patterns. Subsequent assignment tests indicated four recruits could be determined as self-recruiting from the Southern Mariana Islands population. Our results confirm the relative isolation of the southern Marianas island population and highlight how local processes can act to isolate populations that – by virtue of their broadscale distribution – have been subject to traditionally high gene flows. Our results add to a growing consensus that self-recruitment is a highly significant influence on the population dynamics of tropical reef fish.

Name, title, phone number, and e-mail address of person compiling this report:

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Final Project Performance Report

Guam Division of Aquatic and Wildlife Resources (GDAWR)
FY 2011

1. State: Territory of Guam

Grant number: F-14-R-6

Grant name: Guam Sport Fish Investigations

Project number and name: F-14-R-6. Field Guide "Marine Plants of Guam"

2. Report Period: October 30, 2010 to September 30, 2011

Report due date: January 30, 2012

3. Location of work: Guam, Island-Wide

4. Costs: Please identify sources of federal funds and match and indicate amounts budgeted and spent for each. Indicate if match is in-kind. Indicate in table whether costs are "Actual" or "Estimated"

Source	Budgeted	Spent	Actual/Estimated
Total Federal (Sport Fish Restoration)	\$17,500	\$12,646	Actual
Total match (in-kind; 10% FTE Tom Schils)	\$7,694	\$7,694	Actual
Total project:	\$25,194	\$20,340	Actual

5. Objectives

The goal of this project is to produce a field guide of the marine plants of Guam and the Mariana Islands to assist field workers and local monitoring programs in the identification of marine macroalgae and seagrasses. The guide will include an identification key, concise species descriptions, habit pictures, distribution and species richness maps. Field work (*i.e.*, collecting and photographing marine plants) was an important component of the project. More specifically, the following objectives were set:

- A. Conduct field work: habit, habitat, and ecological observations on marine plants; specimen collection; *in situ* photography; documenting species distributions in Guam.
- B. Database development: entry of morphological and ecological descriptions; adding information on voucher specimens.
- C. Conduct literature study and local inquiries on the traditional use of marine plants in Guam.
- D. Determine morphological-anatomical identification in the laboratory using microscopy, and establish a voucher collection: herbarium sheets, wet samples preserved in formalin, and dried specimens in silica gel for molecular identification.

- E. Produce global distribution maps for the species covered by the field guide. Prepare global species richness maps for the genera and families included in the field guide.
- F. Take microphotographs of diagnostic features where needed.
- G. Export database report and automate generation of page layout.

6. If the work in this grant was part of a larger undertaking with other components and funding, present a brief overview of the larger activity and the role of this project.

NA

7. Describe how the objectives were met. See “Supplemental Information” for additional requirements and “Attachments” for specialized tables.

Most objectives have been completed. Through research surveys and contract work we have increased the number of specimens in the voucher collection and the amount of habit pictures. Research assistant, Joost den Haan, has done a thorough literature review and entered descriptions of about 200 taxa in the database. At the same time have been digitizing label information of all marine plants in the GUAM herbarium. We also georeferenced the herbarium specimens in order to prepare maps of species distributions in Guam. In addition, we have also compiled a database of species distributions in the world to provide global distribution maps of the taxa included in the field guide. The global distribution maps of the 200 species and the species richness maps of the relevant genera and families (Fig. 1) are ready.

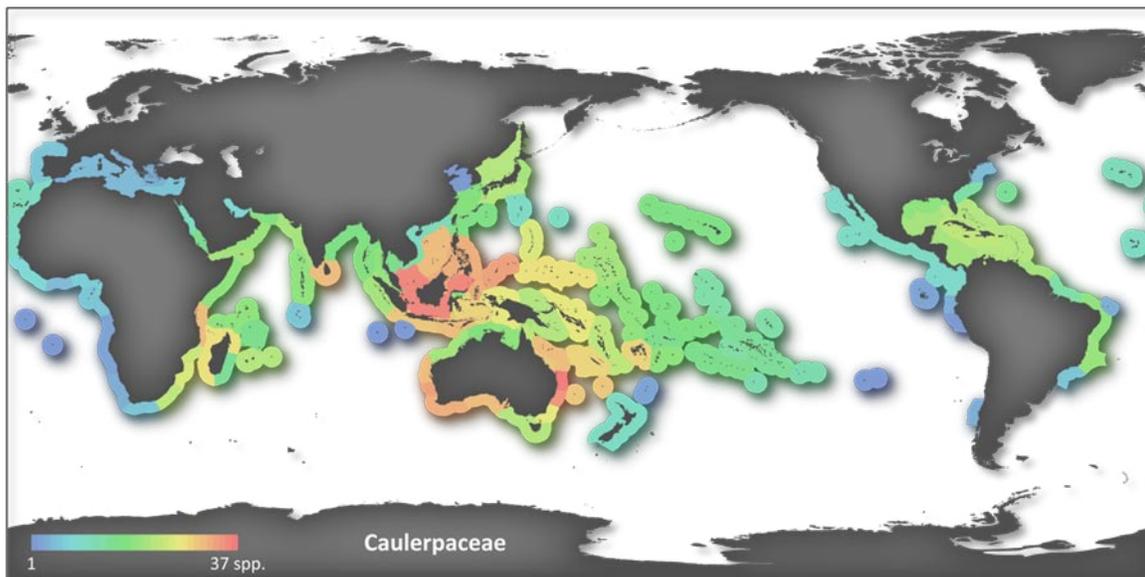


Fig. 1. Example of a global species richness map of the family Caulerpaceae that will be used in the field guide.

8. Discuss differences between work anticipated in grant proposal and grant agreement, and that actually carried out with Federal Aid grant funds; include differences between expected and actual costs.

The database, habitus pictures of algae, and distribution maps are ready for use. At this stage, the actual production of the field guide is on hold because (i) new information from DNA barcoding reveals that the traditional morphospecies concept is in need of revision and (ii) all current work on the project is an in-kind contribution of the PI. At this stage we're amassing gene sequence data on the algal flora of Guam and comparing this to regional barcode data. Preliminary analyses show that cryptic diversity is rampant in algae and consequently a considerable number of new species are comprised in the current morphospecies complexes. Earlier this year we described a new species of *Rhipilia* that is very abundant on Guam, which has historically been misidentified as a *Chlorodesmis* species due to the morphological similarity between both taxa. The distinct entity of the alga was detected based on DNA barcodes. Fortunately, a thorough morphological examination of the species revealed a diagnostic set of features that positively groups it among other *Rhipilia* species and differentiate it from known *Rhipilia* and *Chlorodesmis* species. This paper is currently accepted and we expect it to be published in the first half of 2012. Based on this information the publication of the field guide is delayed until we have a better understanding of the species diversity and uniqueness of the Guamanian algal flora. We expect to have more barcodes available by mid-2012 and we plan to finish the writing of the field guide in the latter half of 2012. Therefore, I request an extension of the remaining funds into FY 2012.

9. List any publications or in-house reports resulting from this work.

Verbruggen H. & Schils T. *Rhipiliacoppejansii*, a new coral reef-associated species from Guam (Bryopsidales, Chlorophyta). *Journal of Phycology*: in press.

Schils T. 2011. DNA barcoding as a tool for macroalgal diversity studies and invasive species risk assessments: a case study from the western Pacific. *Book of Abstracts. Fourth International Barcode of Life Conference, Adelaide, Australia, November 30 – December 3, 2011*

Both documents are included as attachments.

Name, title, phone number, and e-mail address of person compiling this report:

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**Rhipilia copejansii, a new coral reef-associated species
from Guam (Bryopsidales, Chlorophyta)**

Journal:	<i>Journal of Phycology</i>
Manuscript ID:	JPY-11-230-ART.R1
Manuscript Type:	Regular Article
Date Submitted by the Author:	n/a
Complete List of Authors:	Verbruggen, Heroen; Ghent University, Phycology Research Group and Center for Molecular Phylogenetics and Evolution Schils, Tom; University of Guam Marine Laboratory
Keywords:	Bryopsidales, Chlorodesmis, DNA barcodes, morphology, rbcL, Rhipilia, taxonomy, tufA
Category:	Phylogenetics and Taxonomy

Rhipilia coppejansii, a new coral reef-associated species from Guam (Bryopsidales,
Chlorophyta)¹

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³ Both authors contributed equally to this study.

Running title: *Rhipilia coppejansii* sp. nov.

Abstract: The new species *Rhipilia coppejansii* is described from Guam. This species, which has the external appearance of a *Chlorodesmis* species, features tenacula upon microscopical examination, a diagnostic character of *Rhipilia*. This unique morphology, along with the *tufA* and *rbcL* data presented here, set this species apart from others in the respective genera.

Phylogenetic analyses show that the taxon is nested within the Rhipiliaceae. We discuss the diversity and possible adaptation of morphological types in the Udoteaceae and Rhipiliaceae.

Keywords: Bryopsidales, *Chlorodesmis*, DNA barcodes, morphology, *rbcL*, *Rhipilia*, taxonomy, *tufA*

Introduction

The Bryopsidales is an order of green seaweeds primarily found in tropical marine ecosystems. Its representatives are acellular, that is, they lack cross-walls and construct complex thalli from a single giant tubular cell (Vroom and Smith 2003b, Cocquyt et al. 2010). In most species, this cell is branched and, depending on the arrangement of the branches, species can have various levels of anatomical complexity. The tubular branches are called siphons, and the Bryopsidales are commonly known as siphonous algae. Despite their bizarre anatomy, siphonous algae are among the most common and ecologically dominant groups of seaweeds found in tropical marine habitats (Hillis-Colinvaux 1986, Vroom and Smith 2003a). Besides the calcified, reef-forming genera *Halimeda* and *Udotea*, they also comprise several non-calcified taxa, some of which are also dominant (e.g. *Caulerpa*) but the majority of which are less conspicuous inhabitants of the reef slope. The focus of this paper will be on the Udoteaceae and the Rhipiliaceae, two related bryopsidalean families (Verbruggen et al. 2009a).

The species of the Udoteaceae cover a wide spectrum of morphologies and the great majority of them are calcified. Members of the genus *Udotea* have multiaxial stipes and fan- or funnel-

shaped blades (Littler and Littler 1990b). *Rhipidosiphon* is structurally similar but has a much simpler uniaxial stipe and a single-layered blade (Littler and Littler 1990a, Coppejans et al. 2011). *Penicillus* and *Rhipocephalus* both consist of a stipe subtending a cap. Whereas in *Penicillus* the cap has a brush-like structure, that of *Rhipocephalus* consists of numerous imbricated blades along a central stalk (Littler and Littler 2000). In addition to these rather complex thallus architectures, the Udoteaceae also contain the genus *Chlorodesmis*. As its name suggests (chloro = green, desma = bundle), individuals consist of a simple tuft of branched green siphons. This feature, as well as the fact that the genus is non-calcified, sets *Chlorodesmis* apart from the more complex genera. Many genera of the Udoteaceae, including *Chlorodesmis*, are abundant in shallow coral reefs and lagoons (Littler and Littler 2000).

The Rhipiliaceae are much less conspicuous and abundant. They consist of three genera of non-calcified taxa that have rather small thalli and mainly occur in deeper parts of the coral reef slope. *Rhipilia* species generally form bladelets that consists of a fan of longitudinally oriented siphons interconnected by small side branches that form tenacula and adhere to adjacent siphons, creating a meshwork that forms the blade (Millar and Kraft 2001).

Rhipiliopsis species also form bladelets, but adjacent siphons adhere to one another by means of lateral adhesion papillae instead of side branches (Kraft 1986). *Rhipiliella* is morphologically similar to *Rhipiliopsis* but has deciduous blades along a stalk (Kraft 1986).

During recent collection campaigns in the Piti bomb holes reef in Guam (western Pacific), an entity with a fascinating morphology was discovered. In its general appearance and ecology, it resembles the udoteacean genus *Chlorodesmis*, as it forms green tufts at the base of coral colonies. However, upon microscopical examination, tenacula reminiscent of the Rhipiliaceae were observed in the plants. The goal of this study is to provide a detailed morphological description of this entity, and evaluate its taxonomic status and phylogenetic affinities with DNA sequence analyses.

Material and methods

Morphological examination

Freshly collected specimens were observed using Nikon AZ-100 and 80i microscopes and images were taken with Nikon DS-Fi1 digital cameras. Series of images were stacked to achieve sharpness across the object plane. Crystals were examined using differential interference contrast microscopy.

Molecular phylogenetics

DNA was extracted from three specimens of the entity in question (GH0003055 = PITI044, GH0011082 = G.451, GH0011084 = G.453) as well as two samples of *Rhipilia pusilla* from South Australia (A88532, G.091), two samples of *R. orientalis* from Australia (AD-A88500, AD-A88388), two samples of *R. nigrescens* from Australia (H.0847, H.0864) and a sample of *Chlorodesmis* from Guam (GH0003035 = IPAN0014). The plastid genes *tufA* and *rbcL* were amplified and sequenced following previously described procedures (Verbruggen et al. 2009a) and the new sequences were submitted to Genbank (accessions to be added). After preliminary analyses had shown the various sequences of the Guam entity to cluster closely together, a single *tufA* sequence and a single *rbcL* sequence were retained to represent the entity in further analyses. The other species were also represented by a single sequence per species. The sequences were then added to the alignments of a previously published dataset (Verbruggen et al. 2009b). The *tufA* and *rbcL* alignments were analyzed separately and collectively using maximum likelihood (ML) and Bayesian inference (BI). The Bayesian Information Criterion was used to select a suitable partitioning strategy and model of sequence evolution. This procedure was carried out with Partitioned Model Tester 1.01 (Verbruggen 2010), and resulted in a 3-partition strategy (first, second and third codon positions across genes) with uncoupled GTR+ Γ_4 models for each partition. ML trees were

inferred from 100 randomized MP trees with RAxML 7.2.6 (Stamatakis 2006) and confidence was assessed with 500 bootstrap replicates. Bayesian inference used MrBayes 3.1.2 (Ronquist and Huelsenbeck 2003). Two independent runs, each consisting of 4 incrementally heated chains and using default priors were run for 2 million generations. Convergence was assessed and a suitable burn-in of 0.2 million generations determined with Tracer (Rambaut and Drummond 2009). All alignments and the files used for analysis are available from the first author's website (<http://www.phycoweb.net>) and TreeBase (<http://www.treebase.org>).

Results and Discussion

Morphological observations

The dark green thallus of the entity from Guam consists of densely and irregularly aggregated siphons growing in tufts and reaches up to 8 cm in height (Fig. 1). Thalli do not have stipes and were attached to limestone substrates by means of rhizoids (5–22 μm diam.) that develop proximally from the siphons (Fig. 2) and contain chloroplasts. Annular constrictions have not been observed at the proximal end of the siphons, but slight irregular inflations can be observed in a region where a multitude of rhizoids are initiated.

Siphons are loose but sparsely interconnected by means of tenacula. Four types of tenacular attachments were observed within a single thallus: (i) hook-shaped tenacula (Fig. 3A), (ii) tapering and bent siphon tips (Fig. 3B), (iii) discoid tenacula (Fig. 3C), and (iv) tenacula with 2–4 fingers (prongs, Figs 3D–H). Tenacula have been observed on primary siphons and lateral branches. Siphons are cylindrical and measure 50–105 μm in diameter ($78 \pm 13 \mu\text{m}$). Branching is variable (Fig. 4A), with irregular branching (lateral branches; Fig. 4B) as well as dichotomous ramifications (Fig. 4C) and trifurcations (Fig. 2A) occurring in the same thallus. The distance between successive ramifications varies from a few μm to over a cm. Siphons are inflated just below the ramifications (90–130 μm diam.) and strongly constricted above (18–36 μm in diam.; Fig 4C). The constrictions lack annulations of cell wall thickenings (Fig. 5A). Siphon constrictions that were not associated with any type of branching were

occasionally observed in the [studied specimens](#). Crystals corresponding to type 1b crystalline cell inclusions as defined by Leliaert & Coppejans (2004) were found. In contrast to the broad hexagonal and diamond shaped type 1b crystals depicted by Leliaert & Coppejans (2004), *R. coppejansii* has [prism-shaped](#) crystals with a regular hexagonal base ([Fig. 5B, arrowheads](#)). The [Udoteaceae and Rhipiliaceae families are](#) heteroplastic, and both chloroplasts and amyloplasts were seen in the investigated specimens. Amyloplasts (4–7 µm diam.) were especially abundant in the region surrounding the constrictions (Fig. 5C). Chloroplasts were numerous throughout the thallus (Fig. 5D) and two shapes were discerned: whereas parietal chloroplasts were generally subspherical in shape (1.5–4 µm diam., Fig. 5F), central chloroplasts were elongate-ovoid to spindle-shaped (2–6 µm long, Fig. 5E) [and moved throughout the thallus via cytoplasmic streaming](#).

DNA observations

Molecular phylogenetic analysis of the final DNA sequence alignment, which consisted of 39 taxa and 2175 characters (*rbcL* = 1320, *tufA* = 855), yielded the ML tree in Fig. 6A. The entity from Guam, indicated in the black box, is firmly recovered in the Rhipiliaceae, nested in a strongly supported clade with *R. tomentosa* and *R. nigrescens*. [As was shown in previous studies \(Verbruggen *et al.* 2009a, 2009b\), the genus *Rhipilia* is non-monophyletic, with *Rhipiliopsis profunda* and *Pseudochlorodesmis* strain HV1204 branching from within a group of *Rhipilia* species.](#) The two *Chlorodesmis* strains included in the analysis were recovered in the Udoteaceae (grey box). The overall structure of the tree corresponds to that presented in Verbruggen *et al.* (2009b) from which the dataset was taken. While the earliest divergences and most divergences within families are relatively well-resolved, the relationships among the five families of core Halimedineae remains poorly resolved. However, this does not constitute a problem for the interpretation of the position of the focal taxa of this paper. A UPGMA analysis of the *rbcL* sequences of multiple specimens per species of the entity from Guam along with sequences of the closely related *R. nigrescens* and *R. orientalis* (Fig. 6B) shows clear divergence between the three entities even though genetic distances between them are

small (0.6–0.8% for *rbcL*, 1.1–1.4% for *tufA*). These results confirm the higher interspecific divergence of *tufA* sequences as compared to *rbcL* sequences (Saunders and Kucera 2010), making it the better candidate for DNA barcoding in the Bryopsidales.

Taxonomic treatment

It follows from the morphological and molecular results that the entity from Guam should be described as a new species in the genus *Rhipilia*.

Rhipilia coppejansii Schils et Verbruggen, sp. nov.

Latin diagnosis: A speciebus in genere *Chlorodesmis* tenaculis dispersis et typi-II crystallis in cellulis differt. A speciebus in genere *Rhipilia* habitu et thalli statura simili *Chlorodesmis* generi differt. A speciebus in familia *Rhipiliaceae* et in familia *Udoteaceae* sequentiis geneticis *tufA* differt.

English diagnosis: Differs from species of the genus *Chlorodesmis* in having dispersed tenacula and type 2 crystalline cell inclusions. Differs from other *Rhipilia* species in its *Chlorodesmis*-like habit and thallus size. The *tufA* DNA barcode of the species is distinct from those of other species in the *Rhipiliaceae* and *Udoteaceae* and is available for comparison on Genbank.

Holotype: GH0011082 = G.451; Jun 14, 2009; coll. T. Schils; 3 m depth; Piti Bomb Holes, Guam (13.472118°N, 144.703204°E). Deposited in GENT.

Isotype: GH0011084 = G.453. Deposited in GUAM.

Paratypes: GH0011434 deposited in US. GH0011435 deposited in BISH. GH0011436 deposited in AD. GH0011438 deposited in GUAM. Paratype collection information: Oct 20, 2010; coll. T. Schils; 3 m depth; Piti Bomb Holes, Guam (13.472118°N, 144.703204°E).

Etymology: Named in honor of our former PhD supervisor Eric Coppejans, an inspiring mentor with a keen interest in coral reef-associated algae and Bryopsidales in particular. He has published extensively on green algae, including a paper describing a new species of *Rhipilia* (Coppejans and Prud'homme van Reine 1989, Coppejans and Prud'homme van Reine 1990).

Distribution: So far only known from Guam. Besides the type locality, the species has also been recorded during monitoring surveys in Apra Harbor (13.447638°N, 144.627361°E; 4 m depth) (Schils et al. 2011).

Habitat: The new species is locally abundant in between "fingers" of the corals *Porites cylindrica* and *P. rus* at shallow depths on sheltered reefs (2 to 5 m depth). The network of rhizoids forms a mat over coral rubble and living coral colonies. *Rhipilia coppejansii* appears to cope well with high turbidity levels as suspended fine sediment is regularly observed at the type locality and the alga not only grows among coral but also on limestone substrate covered by fine silt deposits.

Comparison to other taxa

The only other *Rhipilia* species with a filamentous tuft-like morphology is *Rhipilia pusilla* from Kangaroo Island, southern Australia (Womersley 1955, Ducker 1966). *Rhipilia coppejansii* differs from *R. pusilla* in having larger thalli (1.5 versus 8 cm high), thicker siphons, longer tenacular siphons, tenacula that do not only occur near the thallus base, consistent presence of constrictions at ramifications, the lack of cell-wall thickenings at constrictions, and the absence of cell-wall undulations of siphons. The species also have distinctive *tufA* and *rbcL* sequences (Fig. 6A, *R. pusilla* is indicated with arrowhead). Finally, they differ in their known distribution range (tropical versus temperate; western Pacific versus southern Australia) and habitat (shallow coral reef systems versus tide pools). It is interesting to note that *Rhipilia pusilla* was initially described as *Chlorodesmis pusilla* based on its filamentous, tuft-like habit (Womersley 1955) and it was subsequently transferred to *Rhipilia*

based on the presence of tenacula (Ducker 1966). This transfer is supported by the position of *R. pusilla* in our molecular phylogeny.

As it is possible that the new *Rhipilia* species has previously been misidentified as *Chlorodesmis*, a common genus of coral reef algae, we will also provide some comparison with *Chlorodesmis* species from the region. Three species of *Chlorodesmis* have been reported for Guam: *C. caespitosa*, *C. fastigiata*, and *C. hildebrandtii* (Lobban and Tsuda 2003). A fourth species, *C. dotyi*, is known from Micronesia but has thus far only been reported for Mokil Atoll (Pohnpei). As mentioned previously, the tenacula of *R. coppejansii* are a diagnostic feature that readily distinguishes the species from all currently accepted *Chlorodesmis* species. Furthermore, unlike many *Chlorodesmis* species, the filaments are perfectly cylindrical and not torulose towards the base. The siphon diameter of *R. coppejansii* is larger than that of *C. haterumana* but smaller than the size ranges listed for most other *Chlorodesmis* species (Ducker 1969, Yoshida 1998) although it does fall within the size range of *C. dotyi* and *C. fastigiata* siphons (Trono 1971). Besides these features, the acicular crystalline cell inclusions of crystal-containing *Chlorodesmis caespitosa*, *C. fastigiata*, and *C. haterumana* (Ducker et al. 1965) correspond to type 2 crystals *sensu* Leliaert & Coppejans (2004), whereas those of *R. coppejansii* are of type 1b. The symmetrical constrictions above siphon forkings of *R. coppejansii* differ from the asymmetrical constrictions in *C. fastigiata* and *C. papenfussii* (Ducker 1969, Coppejans et al. 2001). *Rhipilia coppejansii* also lacks the characteristic bulbous or elongate stipe of *C. baculifera* and *C. papenfussii* (Ducker 1969).

Morphological diversity and adaptation

The recovery of a *Chlorodesmis*-like morphology in the Rhipiliaceae warrants a brief discussion of morphological diversity across the Halimedineae. It was previously shown that *Pseudochlorodesmis*, a genus of diminutive species consisting of a siphon that branches only a few times (if at all), consists of a para- or polyphyletic assemblage of early-branching lineages (Verbruggen et al. 2009b), which can also be seen in Fig. 6A. One strain (*P.*

abbreviata) is sister to the Caulerpaceae, a second species (*P. furcellata*) is sister to the clade comprising Halimedaceae, Pseudocodiaceae and Udoteaceae, and the third strain (HV1204) is recovered within the Rhipiliaceae. The exact position of some of the strains (e.g. *P. furcellata*) differs somewhat from the previous analysis, probably as a consequence of different models of sequence evolution and taxon sampling used in this study, but their early-branching nature is confirmed. The fact that the *Pseudochlorodesmis* strains branch off early in the core Halimedineae may be indicative that such simple siphons represent the ancestral morphology of the group, although our current knowledge is too fragmentary to draw sound conclusions on the matter.

The currently recognized families of the core Halimedineae (Caulerpaceae, Rhipiliaceae, Halimedaceae, Pseudocodiaceae, Udoteaceae) largely consist of species with more complex thalli (Gepp and Gepp 1911, Vroom et al. 1998, Littler and Littler 2000, Verbruggen et al. 2009a). Within at least two of these families with more complex morphologies, the Udoteaceae and Rhipiliaceae, reductions to simpler morphologies have occurred independently.

The Udoteaceae comprise the widest range of morphological types, including the simple stalked blades of the genus *Rhipidosiphon*, the more complex stalked blades of *Flabellia* and *Udotea* several of which are corticated, the brush-like morphology of the genus *Penicillus*, the stalked caps of *Rhipocephalus* consisting of layered blades, resembling an artichoke, and the remarkably simpler tufts of siphons typical of *Chlorodesmis*. A study of the evolution of morphological types in the Udoteaceae overturned the traditional notion that simple morphologies like that of *Chlorodesmis* were primitive, instead showing that the earliest-branching lineages featured relatively complex corticated blades and that the simple *Chlorodesmis* morphologies evolved from more complex forms by reduction or neoteny (Kooistra 2002). Interestingly, this study also showed that this reduction to a simple form did not occur just once but at least two times independently, as *Chlorodesmis caespitosa* was recovered within a clade of *Penicillus* species while *Chlorodesmis fastigiata* was shown to be

nested in a lineage with diverse morphologies (*Udotea*, *Rhipocephalus* and *Penicillus*). The two *Chlorodesmis fastigiata* sequences included in this study do form a single clade, sister to *Rhipidosiphon javensis*, but our taxon sampling in the Udoteaceae in general and *Chlorodesmis* in particular is insufficient to make meaningful contributions to this topic.

As for the Rhipiliaceae, at first sight one would think that they are a fairly homogeneous assemblage consisting of blade-like thalli built up by interlinked siphons. However, the recent discoveries, including the *Chlorodesmis*-like morphology described here and the *Pseudochlorodesmis* specimen recently recovered within the Rhipiliaceae (Verbruggen et al. 2009b) falsify this notion. Although it is difficult to come to general conclusions about whether simpler morphologies are primitive or derived based on the limited set of taxa in our analysis, we suspect that at least in case of *R. coppejansii*, the simple morphology is derived, as it is nested within more typical *Rhipilia* forms (*R. tomentosa*, *R. nigrescens*, *R. orientalis*). It is worth noting that within the Rhipiliaceae, a few species have also evolved more complex thalli. Unlike the typical bladelets, *R. fungiformis*, *R. geppii* and *R. tomentosa* have developed thick, sponge-like thalli (Littler and Littler 2000, Millar and Kraft 2001). *Rhipilia penicilloides* is another exception that forms spongy stalks bearing brush-like heads (N'Yeurt and Keats 1997), not unlike the udoteacean genus *Penicillus* but non-calcified.

It is plausible that the divergent morphology of *R. coppejansii* among *Rhipilia* species reflects an adaptive trait. Typically, *Rhipilia* species occur in relatively deep habitats (> 5m), with their fan-shaped or peltate thalli oriented perpendicular to the incoming light. The integrity of the blade and maintenance of its orientation are facilitated by the ample tenacula that increase the rigidity of these species' thalli. The shallow-water species *R. pusilla* has a tuft-like morphology with few tenacula, increasing the flexibility of its thallus and reducing drag in wave-swept environments. The other tuft-like species *R. coppejansii* mostly grows in between or underneath dense coral formations. In this habitat, the flexibility conveyed by the loose siphons permits growth in small spaces and orienting the siphons towards the light. We want to note that the adaptive scenarios formulated here are solely based on correlations between

field conditions and morphological observations. While such correlations can lead to the formulation of interesting hypotheses, they need to be subjected to ecological experimentation and biophysical modeling before robust conclusions can be drawn.

Based on the diversity of secondary metabolites in the Udoteaceae that serve as feeding deterrents (Amsler 2008) and the observation that *R. coppejansii* grows in great abundance at a marine protected area near a fish feeding station, it is to be expected that the alga contains natural products similar to the cytotoxic compounds that have been isolated for *Chlorodesmis* species and other Bryopsidales (Wells and Barrow 1979, Paul and Fenical 1985).

Acknowledgements

We thank Sofie D'hondt for generating the sequence data. We are very grateful to Kyatt Dixon, Fred Gurgel and John Huisman for providing the *Rhipilia pusilla*, *R. nigrescens* and *R. orientalis* specimens used in this study. Funding was provided by the Research Foundation – Flanders (grant G.0142.05 and postdoctoral fellowship to HV), the US Fish and Wildlife Service through the Guam Division of Aquatic and Wildlife Resources (grant F-1R-15), and the NOAA Coral Reef Conservation Grant Program through the Guam Coastal Management Program (grant CRIGU08-67). We thank the reviewers of our manuscript (Daryl Lam and Peter Vroom) for their constructive comments and associate editor Fabio Rindi for handling our manuscript and helping with the Latin diagnosis.

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Table 1. Author names of species cited in text, following Guiry & Guiry (2011).

species	author
<i>Chlorodesmis baculifera</i>	(J. Agardh) Ducker
<i>Chlorodesmis caespitosa</i>	J. Agardh
<i>Chlorodesmis dotyi</i>	Trono
<i>Chlorodesmis fastigiata</i>	(C. Agardh) Ducker
<i>Chlorodesmis haterumana</i>	Tanaka & Itono
<i>Chlorodesmis hildebrandtii</i>	A. Gepp & E.S. Gepp
<i>Chlorodesmis papenfussii</i>	Ducker
<i>Chlorodesmis pusilla</i> ^a	Womersley
<i>Chlorodesmis sinensis</i>	C.K. Tseng & M.L. Dong
<i>Pseudochlorodesmis abbreviata</i>	(Gilbert) Abbott & Huisman
<i>Pseudochlorodesmis furcellata</i>	(Zanardini) Børgesen
<i>Rhipidosiphon javensis</i>	Montagne
<i>Rhipilia coppejansii</i>	Schils & Verbruggen
<i>Rhipilia fungiformis</i>	A.B. Joly & Ugadim
<i>Rhipilia geppii</i>	W.R. Taylor
<i>Rhipilia nigrescens</i>	Coppejans & Prud'homme van Reine
<i>Rhipilia orientalis</i>	A. Gepp & E.S. Gepp
<i>Rhipilia penicilloides</i>	A.D.R. N'Yeurt & D.W. Keats
<i>Rhipilia pusilla</i>	(Womersley) Ducker
<i>Rhipilia tomentosa</i>	Kützing

^a Now known as *Rhipilia pusilla* (Womersley) Ducker

Fig 1. Habit of *Rhipilia coppejansii*. **(A)** Upright growth of *R. coppejansii* in between branches of the coral *Porites cylindrica*. **(B)** *In situ* close-up of the alga, showing the predominant dichotomous branching pattern. **(C)** *R. coppejansii* hanging underneath plates of the coral *Porites rus*. **(D)** Complete thallus displaying the rhizoidal mass from which the upright siphons develop.

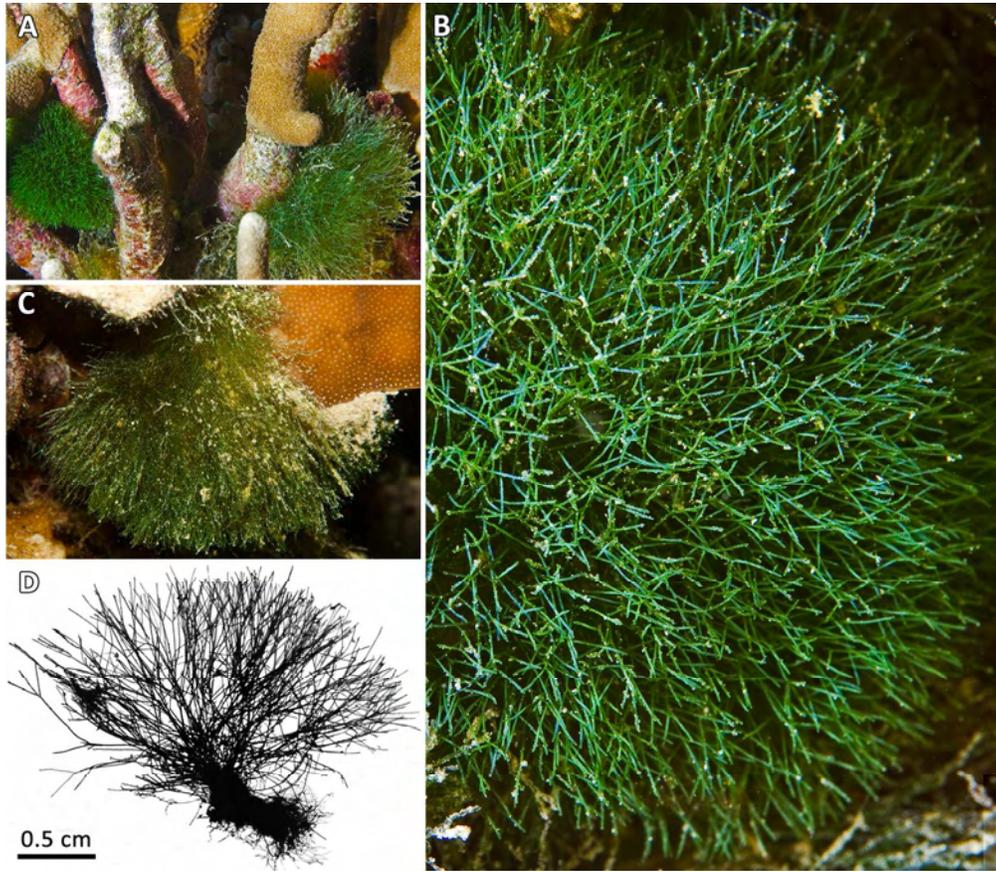
Fig. 2. Basal part of *Rhipilia coppejansii* showing rhizoids.

Fig. 3. Tenacula of *Rhipilia coppejansii*. **(A)** Hook-shaped tenaculum. **(B)** Modified branch tip. **(C)** Disc-like tenaculum connecting two siphons. **(D)** Two-pronged tenaculum on lateral branch. **(E)** Two-pronged tenaculum and unmodified siphon tip connecting siphons. **(F)** Two-pronged tenaculum laterally initiated from a siphon. **(G)** Two-pronged tenaculum on a stunted branch of a [trifurcation](#). **(H)** Three-pronged tenaculum.

Fig 4. Branching pattern of *Rhipilia coppejansii*. **(A)** Di- and tritochomous branching. **(B)** Dichotomous branching and lateral branch development, showing subdichotomous inflated siphons. **(C)** Dichotomous branching displaying subdichotomous inflated siphons and supradichotomous constrictions.

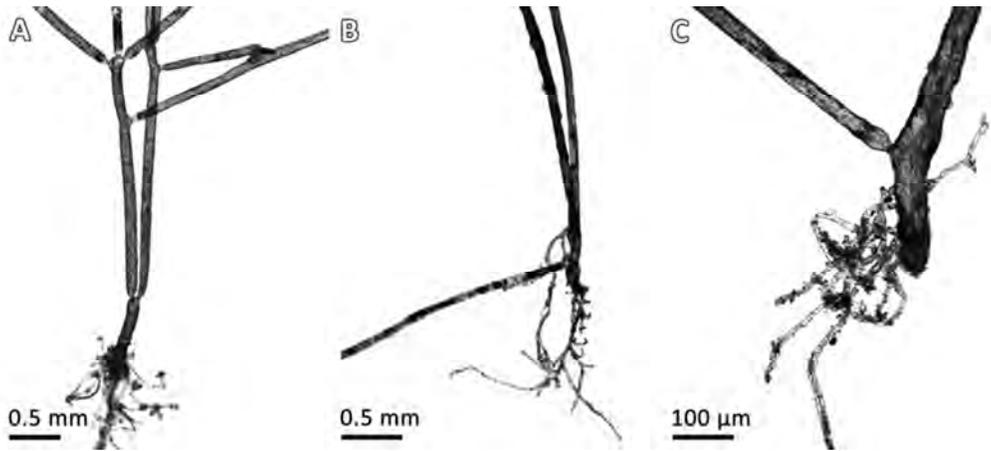
Fig 5. Anatomical features of *Rhipilia coppejansii*. **(A)** Close-up of a constriction displaying the absence of cell wall thickenings. **(B)** Siphon with regular hexagonal crystals (arrowheads). **(C)** Aggregation of amyloplasts (white) near cell constrictions. **(D)** Siphons contain large numbers of chloroplasts that mask amyloplasts and crystalline cell inclusions. **(E)** Elongated to spindle-shaped chloroplasts dispersed throughout the siphons. **(F)** Subspherical parietal chloroplasts.

Fig. 6. Molecular phylogenies. **(A)** Maximum likelihood tree of 39 Halimedineae taxa showing the position of *Rhipilia coppejansii*, the entity from Guam, within the Rhipiliaceae. **(B)** UPGMA dendrogram of *rbcL* haplotype distances, showing the distinctness between the closely related species *R. orientalis*, *R. nigrescens* and *R. coppejansii*.



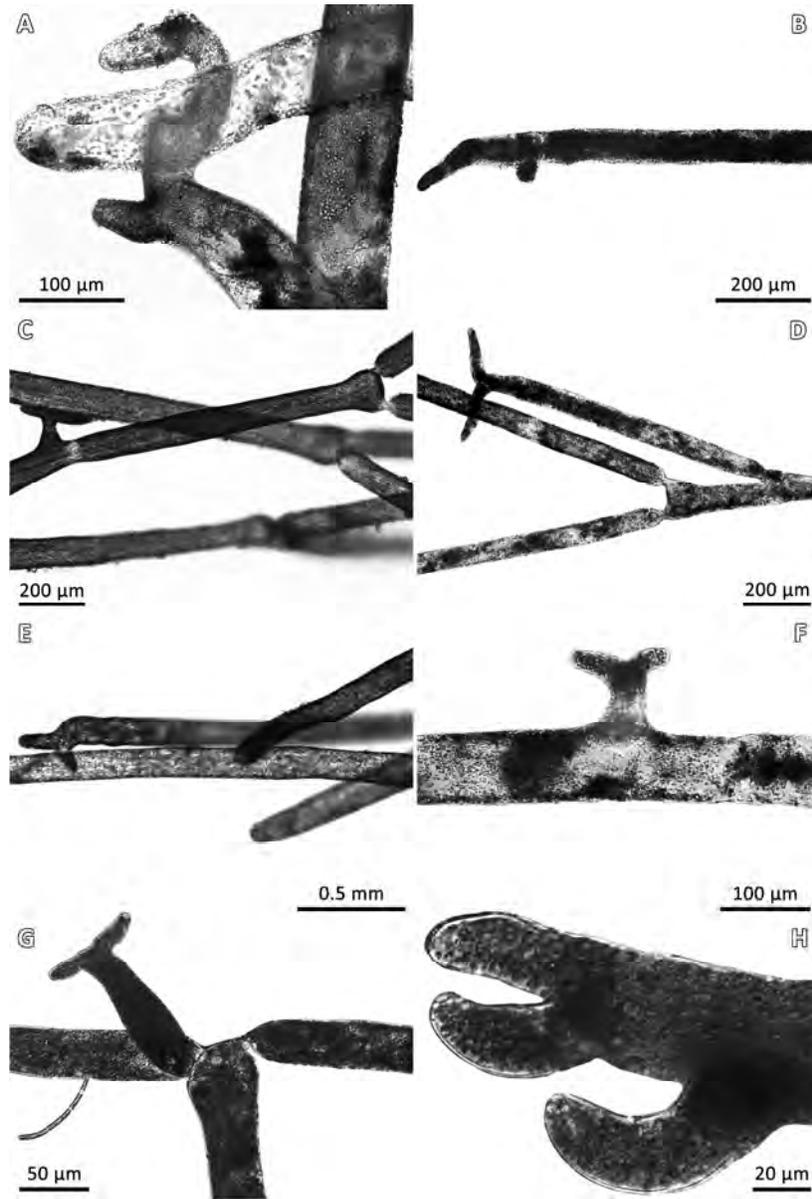
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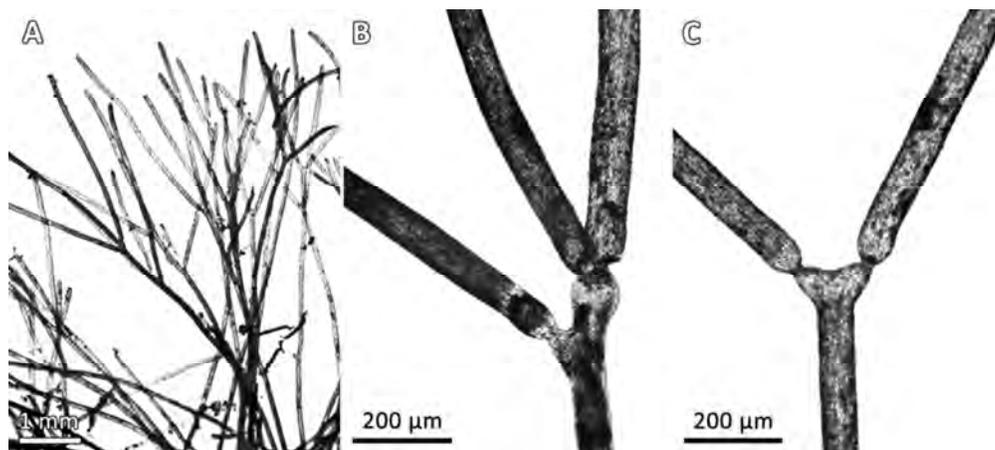


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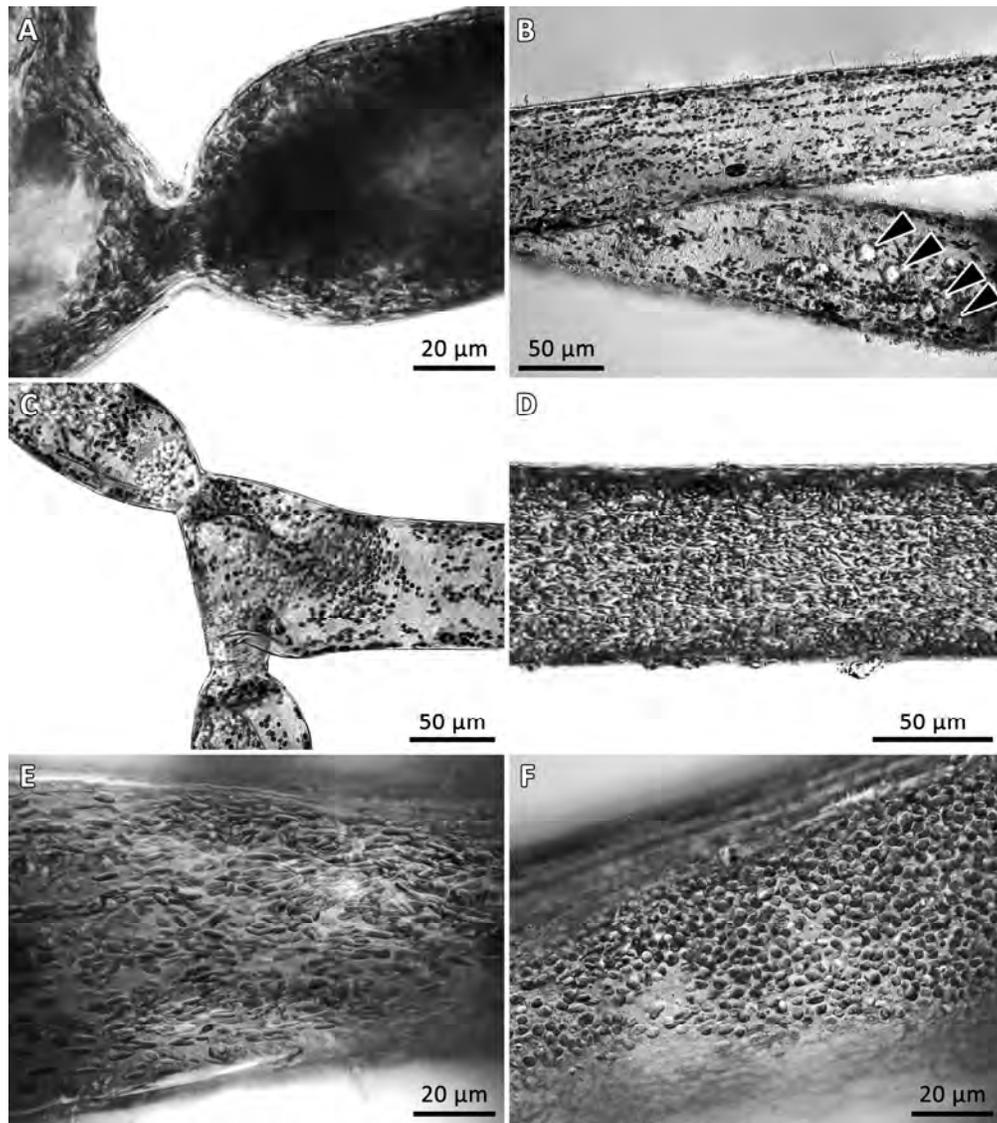


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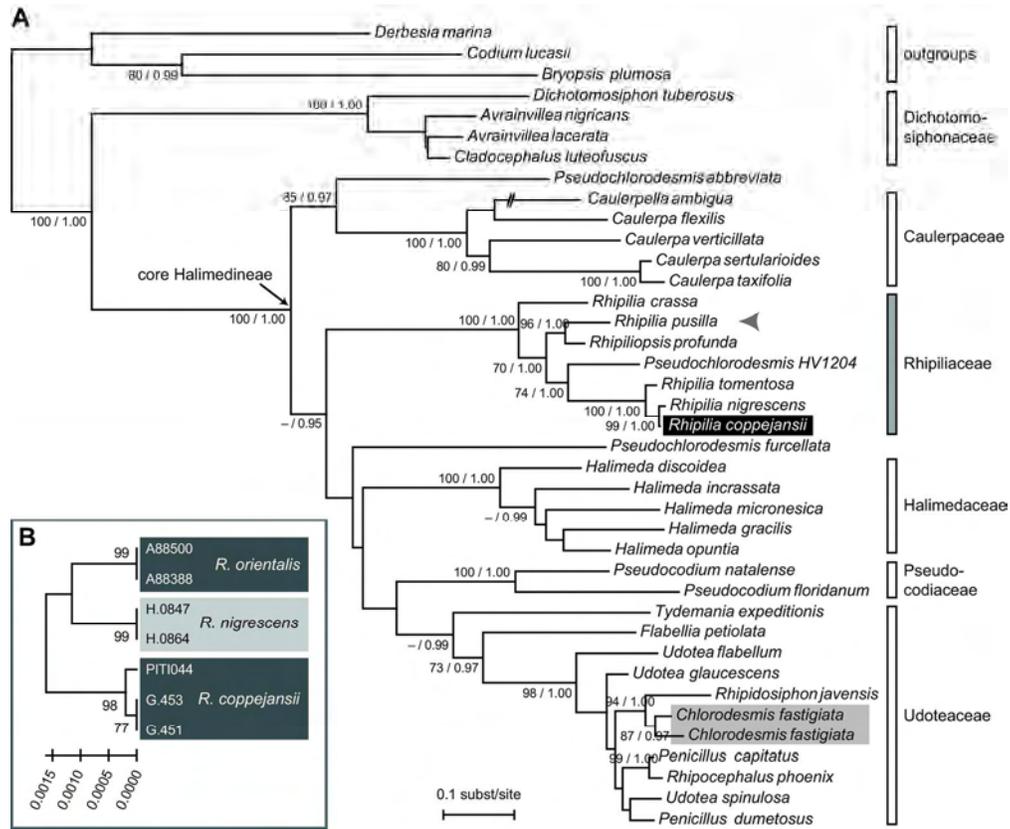
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DNA BARCODING AS A TOOL FOR MACROALGAL DIVERSITY STUDIES AND INVASIVE SPECIES RISK ASSESSMENTS: A CASE STUDY FROM THE WESTERN PACIFIC

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The majority of documented introductions of non-native marine macroalgae have occurred in the past half century. These introductions were not restricted to a few well-known alien invaders; instead most new introductions involved algae with no previous invasive history that often spread rapidly following their initial introduction. This study assesses the macroalgal diversity and the risk of alien introductions for two western Pacific islands. In light of the relocation of US marines from Okinawa (Japan) to Guam (Mariana Islands), an increase in vessel traffic between both islands is anticipated over the next years and alien introductions are of great concern. First, we report on a floristic comparison based on a morphospecies concept using published species inventories. The South Kuroshio marine ecoregion, which includes Okinawa, contains 745 species of marine macroalgae, whereas 484 species are known for the Mariana Islands. Of these, 329 and 196 algae of respectively the South Kuroshio and the Mariana Islands ecoregions belong to genera with documented invasive representatives (hereafter referred to as potential invasive species). The number of potential invasive species that is restricted to one of both ecoregions is about two and a half times higher for the South Kuroshio ecoregion compared to the Mariana Islands (225 versus 92 species). In a second approach, we aim to compare the floristic diversity between Okinawa and Guam using DNA barcodes. A standardized sampling strategy was adopted to obtain complete algal collections of 20 sites in Okinawa and Guam. Differences between the morphospecies and the barcode methods in their ability to measure biodiversity, estimate biogeographic affinities, and calculate invasion risks will be presented.

Keywords: Algae, Marine Barcoding



**DNA barcoding as a tool for macroalgal diversity studies
& invasive species risk assessments:
a case study from the Western Pacific**

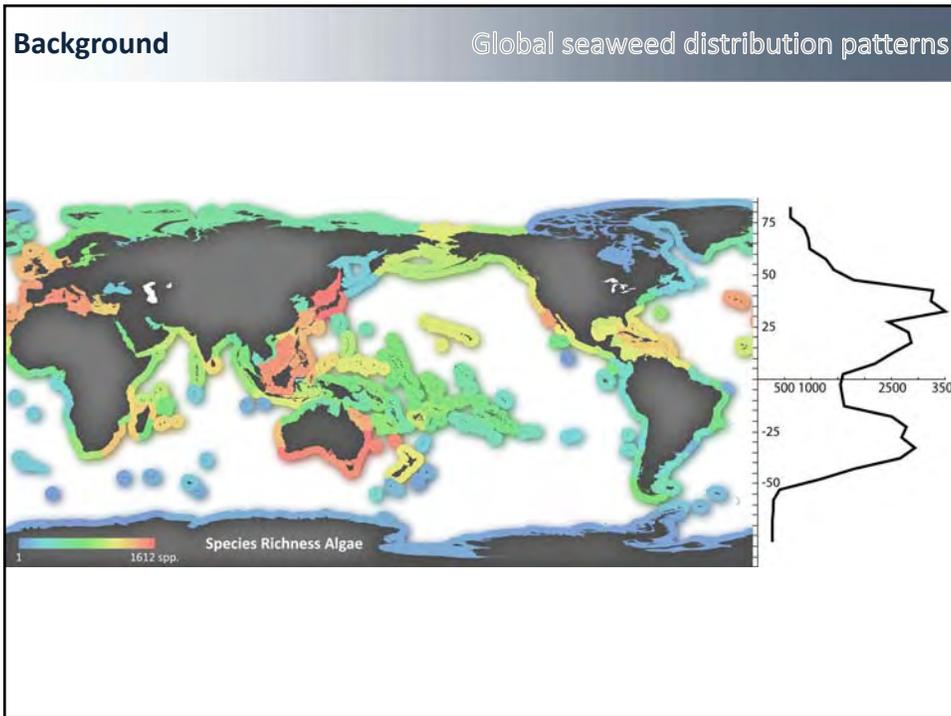


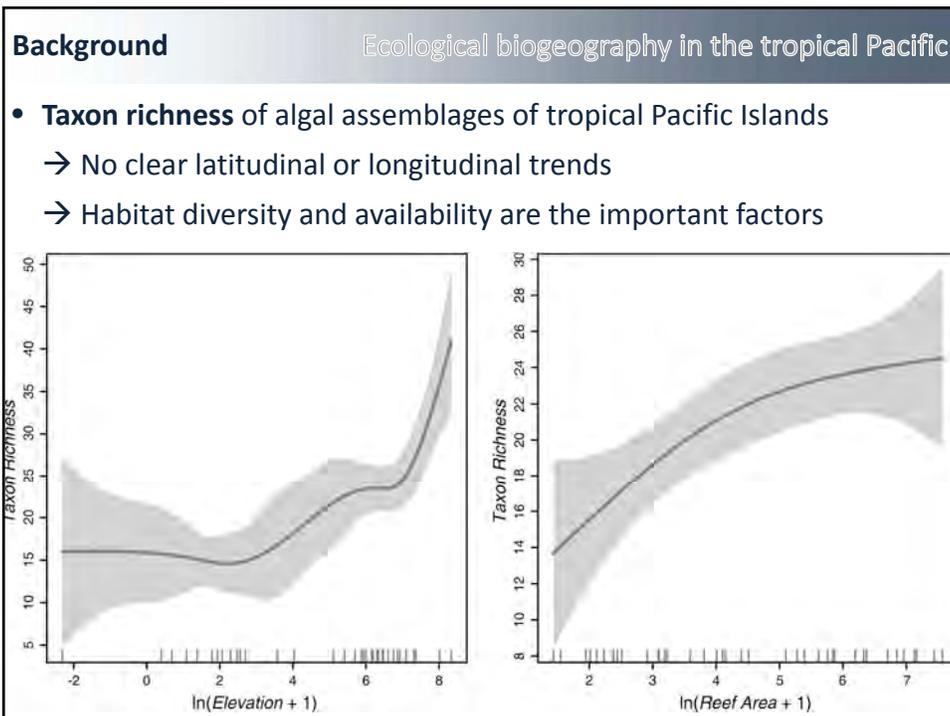
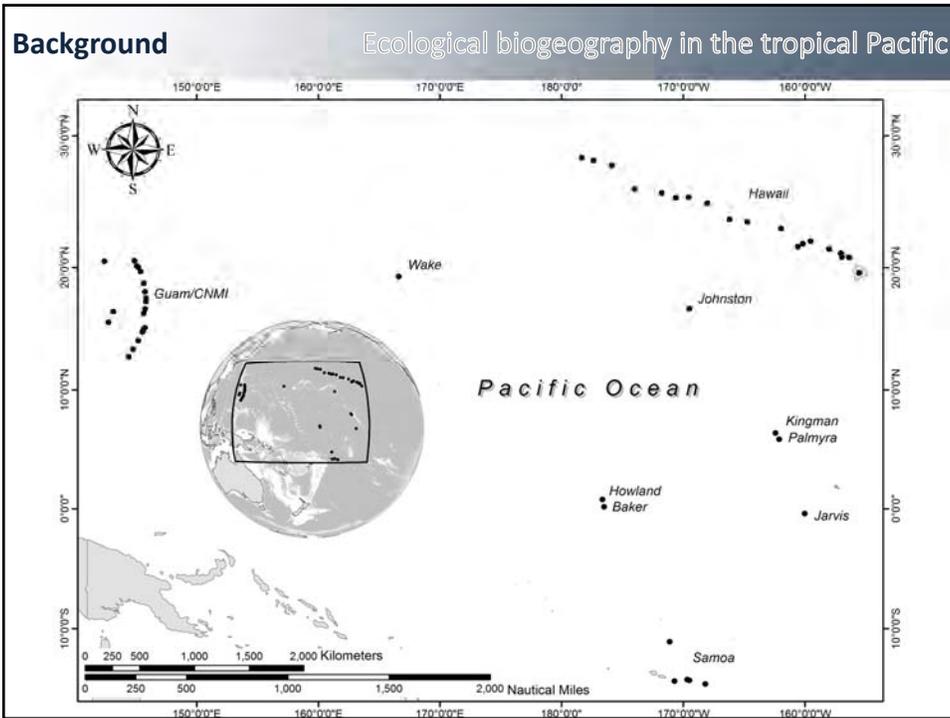
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Phycology
Marine Laboratory

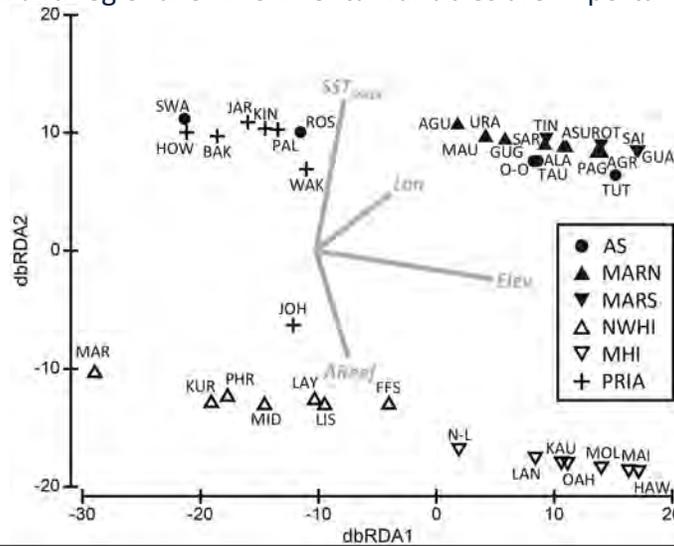




Background

Ecological biogeography in the tropical Pacific

- **Taxon composition** of algal assemblages of tropical Pacific Islands
→ Local and regional environmental variables are important



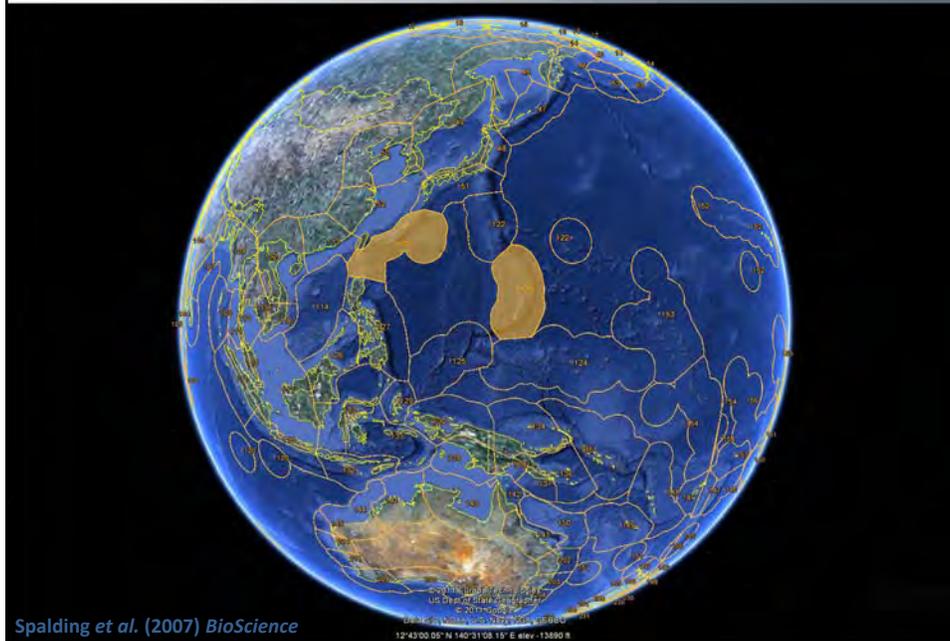
Fundamental research questions

Tropical Pacific

- Does the barcoding of macroalgal floras reveal new insights in global biodiversity patterns?
- Are macroalgae short distance dispersers (Kinlan & Gaines, 2003)?
- Do tropical macroalgae have larger distribution ranges (and dispersal capacities) than those of temperate and polar regions?
- Is the geographic partitioning of macroalgal assemblages obscured by
 - Employing ecological sampling methods?
 - Using algal genera as surrogates of species (practical tradeoff)?
 - Using a morphospecies concept?
- Is the amount of cryptic diversity in tropical marine macroalgae comparable to that of other marine groups?

DNA barcoding study

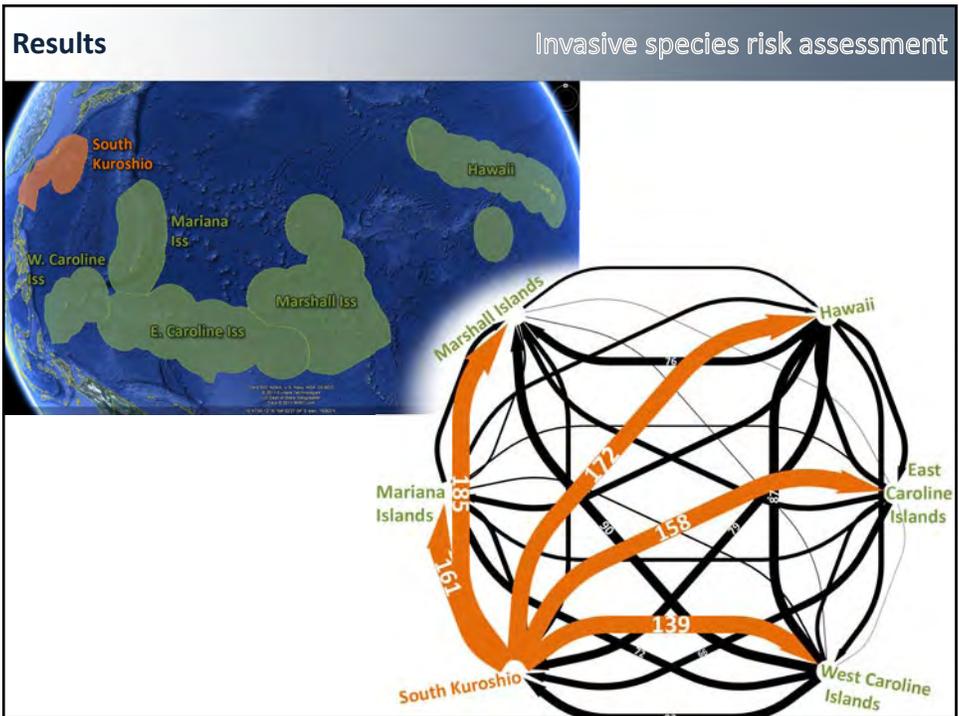
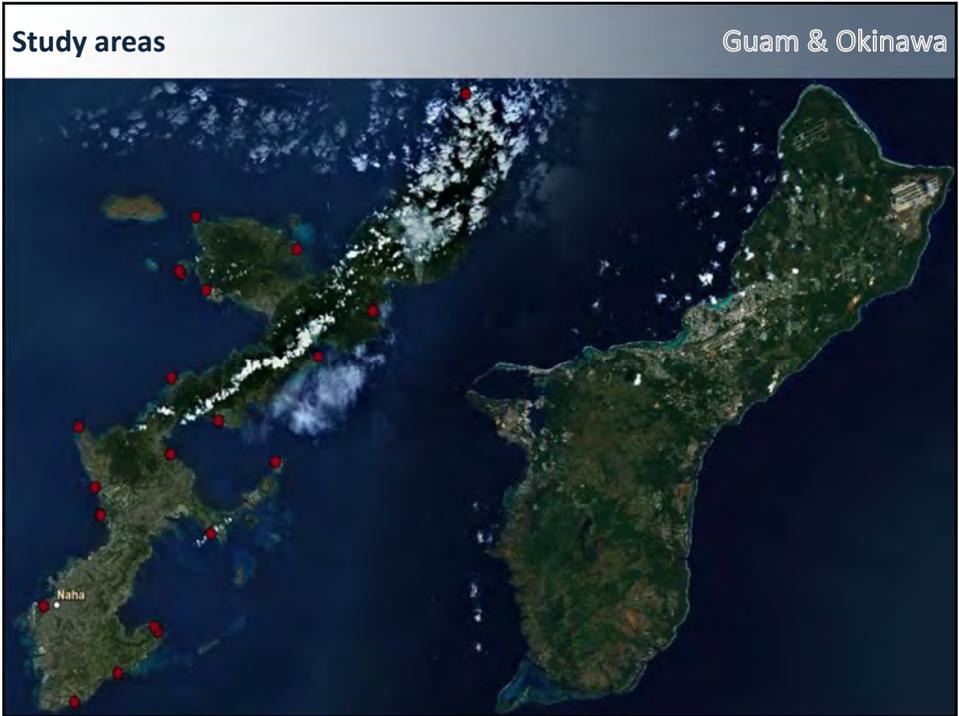
Guam & Okinawa

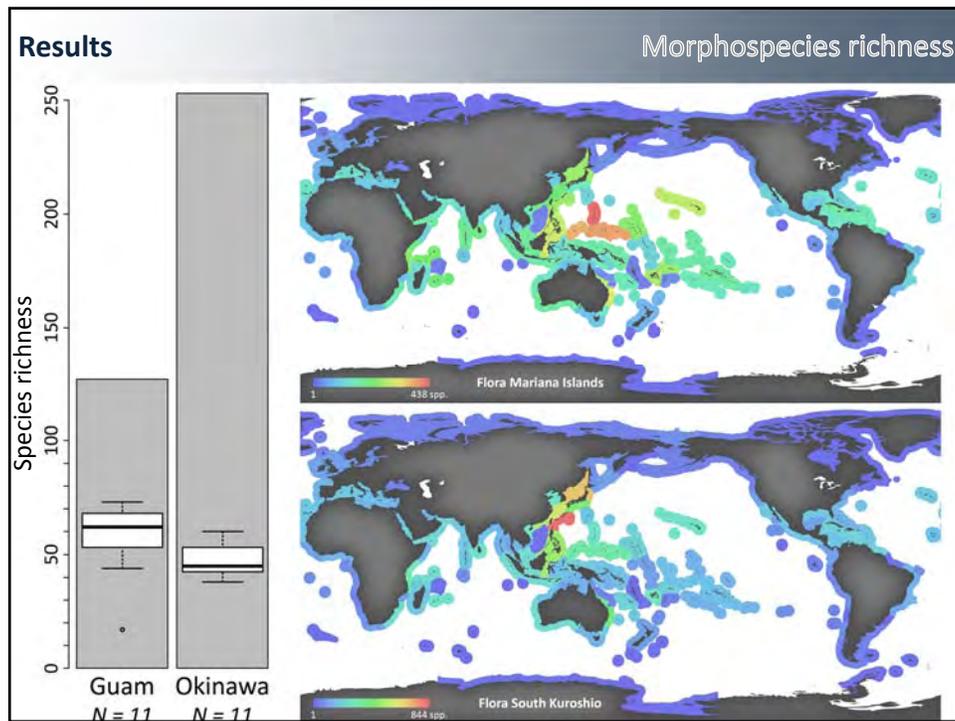


Biodiversity concerns

Guam & Okinawa

- Relocation of marines from Okinawa to Guam
- Address some of these fundamental questions by conducting applied research → risk assessment of invasive species
 - Are we a net exporter of (invasive) algae?
- Morphospecies approach
 - Biogeographic affinity of both island floras @ global scale
 - α -diversity of island floras
 - β -diversity of island floras
 - α -diversity of sites within islands
- DNA barcoding
 - α -diversity of island flora



**Results**

Morphospecies @ island level: SST

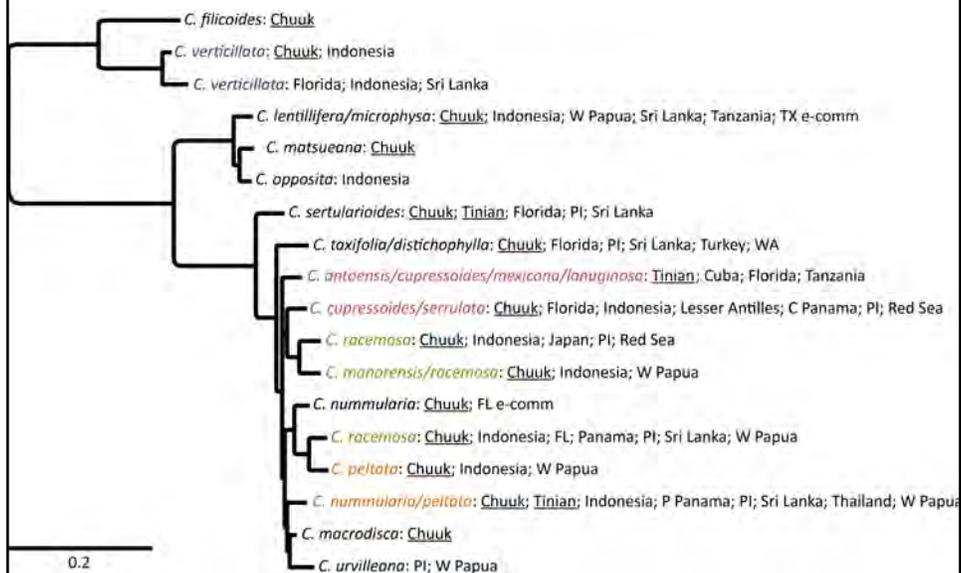
- avgSSTavg *** → based on species distribution ranges
 Flora Mariana Isls (28.6°C): $25.6^{\circ}\text{C} \pm 2.3^{\circ}\text{C}$ (SD); N = 438 spp.
 Flora South Kuroshio (26.6°C): $23.2^{\circ}\text{C} \pm 3.7^{\circ}\text{C}$ (SD); N = 844 spp.
- maxSSTmax ***
 Flora Mariana Isls (29.8°C): $31.3^{\circ}\text{C} \pm 0.9^{\circ}\text{C}$ (SD); N = 438 spp.
 Flora South Kuroshio (29.3°C): $30.9^{\circ}\text{C} \pm 1.1^{\circ}\text{C}$ (SD); N = 844 spp.
- minSSTmin ***
 Flora Mariana Isls (27.5°C): $9.1^{\circ}\text{C} \pm 7.8^{\circ}\text{C}$ (SD); N = 438 spp.
 Flora South Kuroshio (24.0°C): $5.8^{\circ}\text{C} \pm 5.7^{\circ}\text{C}$ (SD); N = 844 spp.
- Coast line length (NS)
 Flora Mariana Isls: $230,482 \text{ km} \pm 218,274 \text{ km}$ (SD); N = 438 spp.
 Flora South Kuroshio: $197,303 \text{ km} \pm 204,528 \text{ km}$ (SD); N = 844 spp.

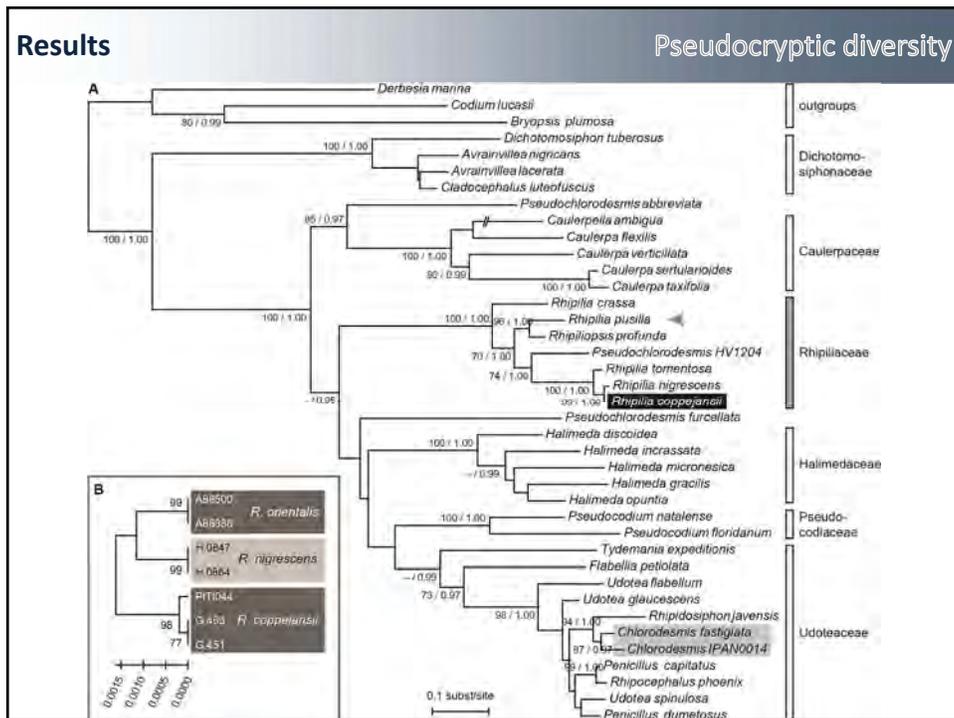
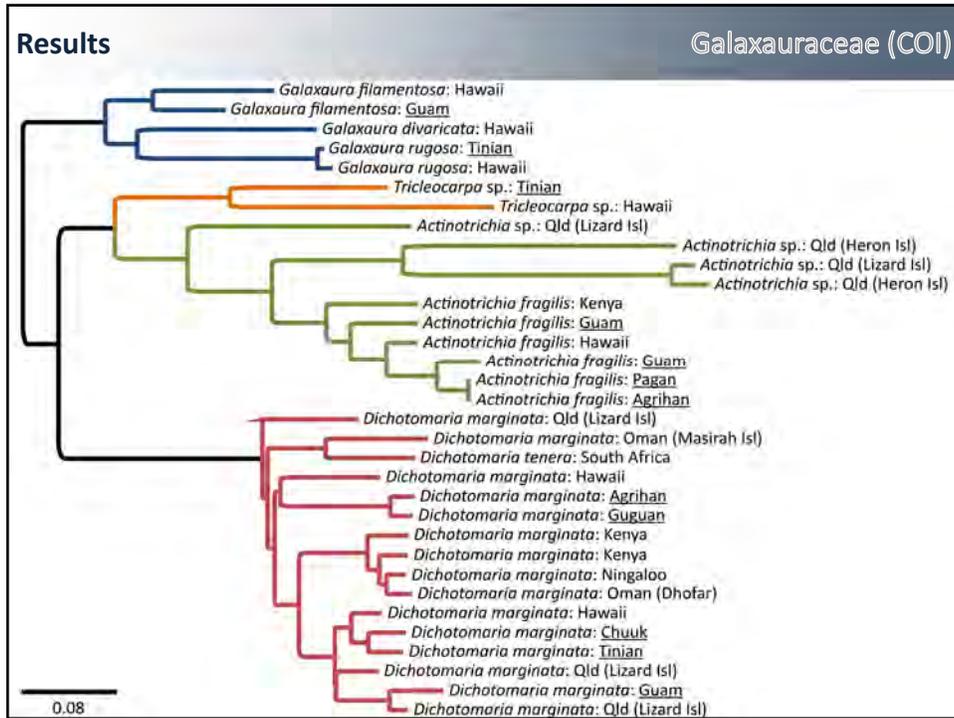
Results

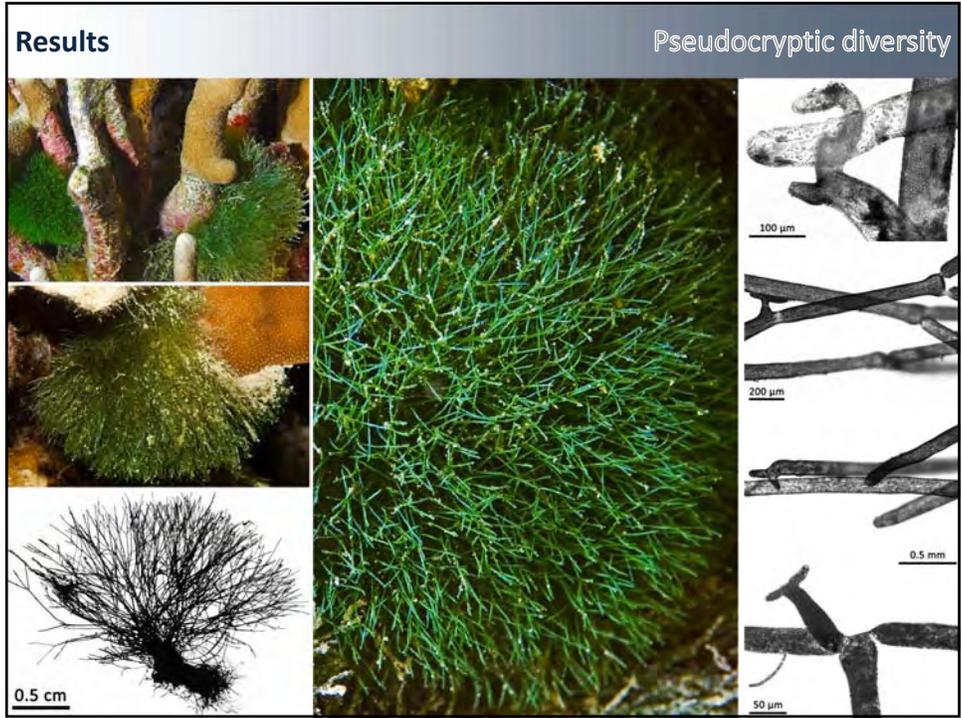
Invasive species risk assessment

- Based on SST affinity of floras, the taxa occurring in these tropical localities have a distribution that extends into temperate waters
 - The risk that (invasive) species from Okinawa could establish in Guam is supported by the SST analysis
 - Is this analysis flawed because our morphospecies concept (and the derived taxon distributions) is inadequate?
Does DNA barcoding reveal a different and more realistic result about the similarity in floras and their temperature affinity?

Results

Caulerpa (tufA)





Acknowledgements**Key partners**

- Gary Saunders, Tanya Moore, and Dan McDevit
- Heroen Verbruggen & Olivier De Clerck
- Fred Gurgel

- Anna Simeon and Jason Biggs
- Naho Miyamoto & Shoichiro Suda
- Eric Verheij
- Gustav Paulay
- Peter Vroom

- Sea Grant
- University of Guam

Final Project Performance Report
 Guam Division of Aquatic and Wildlife Resources
 FY 2011

1. State: Territory of Guam

Grant number: F-14-R-7 [54-S-720850-R-5]

Grant name: Management of Guam’s Marine Fisheries Resources

Project number and name: F-14-R-7 [54-S-720850-R-5]. Project 1. Management of Guam’s Marine Fisheries Resources. Job 7. Assessing Guam’s reef fish spawning aggregations

2. Report Period: October 1, 2010 to September 30, 2011

Report due date: December 29, 2011, Extended to January 30, 2012 under a no-cost extension

3. Location of work: Island of Guam

4. Costs: To be completed by the UOGML Administrative Assistant for submission as soon as possible.

Source	Budgeted	Actual <u> X </u> or Estimated <u> </u>
Federal : _____	\$28,100	\$28,100
State	- 0 -	- 0 -
Other: _____	- 0 -	- 0 -

Total Federal	\$28,100	\$28,100
Total match	- 0 -	- 0 -
Total project:	\$28,100	v

5. Objectives:

A. Compile and analyze 20-years of historical creel data, plus local commercial data, to obtain evidence of spatial and temporal patterns of reef fish spawning aggregation formation as inferred from fisheries interactions documented in creel and commercial surveys.

B. Determine the species identity, date and time of capture, tidal state, and moon phase, and relate to geographic point of capture.

C. Correlate results with those of ongoing projects underway at the University of Guam Marine Laboratory that examine the spatial and temporal patterns of reef fish spawning aggregation formation and function.

D. Plot results onto a GIS map of coastal Guam in an attempt to infer probable reef fish spawning aggregation sites of selected species, and report these data to a limited access global data base of reef fish spawning aggregations maintained by the Society for the Conservation of Reef Fish Aggregations (DAWR will have access).

E. Present results at a scientific meeting in a special session on the conservation and fisheries management of reef fish spawning aggregations.

6. If the work in this grant was part of a larger undertaking with other components and funding, present a brief overview of the larger activity and the role of this project.

N/A

7. Describe how the objectives were met. See “Supplemental Information” for additional requirements and “Attachments” for specialized tables.

Note: a no-cost extension was granted for the completion of this project during FY2011.

Objective A Outcome: Despite difficulties in using the original database program, now no longer supported by the vendor, we have completed the data analysis, mainly from resident spawning aggregation species such as parrotfishes, and transient spawning aggregation species such as emperors, snappers, barracudas, trevallys and surgeonfishes. Much of the data, including the data expansions, was not usable in this analysis because there are too few records (temporally and spatially) within the multi-year data set.

Objective B Outcome: The data were not useful for determinations of daily spawning aggregation activity by those species that utilize resident spawning aggregation behavior. We attempted to correlate patterns of harvest of such species (i.e., parrotfishes) with data from known resident spawning aggregation sites obtained from other projects (Chop, 2009; Donaldson, unpublished data) to determine if some sites were depleted of resident males, thus explaining possibly why spawning aggregation sites are so few along the western coast of Guam. The data set had an insufficient number of geo-referenced records to allow for this. Similarly, transient reef fish spawning aggregation species data could not be geo-referenced for the same reason, however, our technical report to DAWR/Fish and Wildlife Service (in preparation) will show graphs depicting patterns in seasonal and lunar-phase landings.

Objective C Outcome: The limited data set, which did not produce patterns of potential spawning aggregation activity, was insufficient to allow for the comparisons specified.

Objective D Outcome: The lack of sufficient data from each geographical locality did not all for this objective to be achieved (see Objective B Outcome, above).

Objective E Outcome: We are preparing a final (technical) report that will focus upon seasonal and geographic patterns in landings of target spawning aggregation species. Because the limited data set was insufficient to determine the locality of spawning aggregations or correlate landing patterns with known spawning aggregation sites and activity, we will not be delivering the results of this study at a scientific meeting. In the technical report, we will illustrate why the data set was insufficient and offer suggestions for determining possible spawning aggregation activity based upon other methods.

8. Discuss differences between work anticipated in grant proposal and grant agreement, and that actually carried out with Federal Aid grant funds; include differences between expected and actual costs. N/A

9. List any publications or in-house reports resulting from this work. N/A

Name, title, phone number, and e-mail address of person compiling this report:

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Edited by: Jay T. Gutierrez, Assistant Chief, Division of Aquatic and Wildlife Resources (DAWR), (671) 735-3980, jaytgutierrez@yahoo.com

Reference Cited

Chop, K. 2009. Lek-like behavior of the parrotfish, *Chlorurus sordidus* (Scaridae), on a resident spawning aggregation site at Guam, Mariana Islands. M.S. Thesis, University of Guam Marine Laboratory, Mangilao, Guam, USA.

Final Project Performance Report
Guam Division of Aquatic and Wildlife Resources (GDAWR)
FY 2011

1. State: Territory of Guam

Grant number: F-14-R-9

Grant name: Guam Sport Fish Investigations

Project number and name: F-14-R-9. Recruitment sources and dynamics of the unicorn fish *Naso unicornis* on the fringing reefs of Guam

2. Report Period: October 1, 2010 to September 30, 2011

Report due date: January 30, 2012

3. Location of work: Guam, Saipan, Micronesia and Philippines

4. Costs: Please identify sources of federal funds and match and indicate amounts budgeted and spent for each. Indicate if match is in-kind. Indicate in table whether costs are "Actual" or "Estimated"

Source	Budgeted	Actual <u>X</u> or Estimated <u> </u>
Federal : Sport Fish Restoration	\$44,205	\$44,205
State	-0-	- 0 -
Other: _____	-0-	- 0 -

Total Federal	\$44,205	\$44,205
Total match	-0-	-0-
Total project:	\$44,205	\$44,205

5. Objectives:

- 1) Sample individuals from pulses of recruits in at least three localities for analysis of mitochondrial sequences to determine the pattern of relationships among individuals within and between settling pulses.
- 2) Maintain sampling of settling cohorts over time to determine the pattern of change in different genotypes as the cohort develops and individuals are lost through mortality.
- 3) Sample adult genetic structure to determine the relationship between large settlement pulses of larvae and those of established adults.
- 4) Development of microsatellite markers for individuals sampled from current pulses of settling larvae.

- 5) Sampling of adult *N.uniconis* collected from i) Guam and ii) adjacent reefs and island systems of the Marianas Islands for the development of microsatellite markers to investigate the sources of settling pluses of larvae. The initial objective will be to determine the degree of self-recruitment in the Guam populations. This analysis will be sequentially extended to sampling adults from adjacent island systems at increasing distances from Guam.

6. If the work in this grant was part of a larger undertaking with other components and funding, present a brief overview of the larger activity and the role of this project.

N/A

7. Describe how the objectives were met.

Objective 1:

Please see attached final report.

Objective 2:

Please see attached final report.

Objective 3:

Please see attached final report.

Objective 4:

Please see attached final report.

Objective 5:

Please see attached final report.

8. Discuss differences between work anticipated in grant proposal and grant agreement, and that actually carried out with Federal Aid grant funds; include differences between expected and actual costs.

N/A

9. List any publications or in-house reports resulting from this work.

Conservation Genetics Resources DOI 10.1007/s12686-009-9129-1

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Recruitment sources and dynamics of the
blue-spine unicorn fish *Naso unicornis* from
the fringing reefs of Guam.

FINAL REPORT

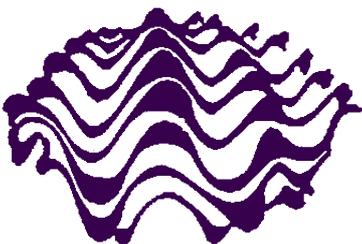
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December 2011

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EXECUTIVE SUMMARY

Naso unicornis is a wide ranging surgeon fish with a distribution that extends throughout the entire Indo-Pacific reef system. This species occupies a variety of reef habitats and is often found on poorly developed reefs or those subject to intense human activity. It is also one of the few species that can consume and process larger brown seaweeds like *Sargassum*, often characteristic of disturbed reefs, and are not deterred by the secondary chemical compounds. However unlike many reef fishes analysis of the population structure using molecular tools has failed to reveal any clear evidence of discrete populations even at the broadest geographic scales. This pattern of a wide geographical distribution lacking in population structure reflects both the capacity for the large and well developed larvae to disperse widely across tropical oceans and the capacity to colonize a variety of reefs including those with high levels of macroscopic algae. As with many species of acanthurid fishes recruitment of this species can occur as major pulses with numerous settlers arriving on reef systems (especially in the central western and southern Pacific) simultaneously. Given the high level of exploitation by local fishermen our primary objective was to determine the degree and pattern of genetic relatedness between pulses of newly settled *Naso unicornis* and with that of the adult population. Using microsatellite analysis we set out to determine the degree to which Guam populations are self recruiting as opposed to relying on external larval sources.

To investigate the spatial and temporal differences in genetic relatedness we sampled 375 *N. unicornis* recruits from five different sites on Guam and one on the neighboring island of Saipan over two consecutive years. During the same period 176 adult fish were collected by spearing or purchased from commercial vendors. Highly polymorphic microsatellite loci were chosen rather than allozyme loci as they are considerably more sensitive to ecologically relevant genetic patterns. Microsatellite loci were amplified for each individual fish using the species specific primers developed by Horn et al. (2010) via PCR amplification. Genetic diversity of the mtDNA from newly settled *N. unicornis* was similar across sites, cohorts and age classes and was just as great as that of the preexisting adult population. There was no genetic structure observed in the mitochondrial control region between sites, cohorts and age classes except for one pair-wise test between the October 2008 sample from Governors and the adult population. These results were confirmed by the high genetic diversity of both recruits and adults from the nuclear microsatellites. Pairwise F_{st} values across eight microsatellite loci also reveal an absence of genetic structure between sites, cohorts and age classes with one exception.

Although 28 putative parent-offspring pairs were identified, the probability that these were false pairs was extremely high. Furthermore none of these relationships were confirmed from mtDNA or by adding more loci. While 13 putative sibling pairs were identified, all but one pair were not sampled at the same site. For example a recruit from Saipan had a relationship of $r=0.4$ with another recruit sampled a year later on the west coast of Guam. Scatter plots of genetic variation in multivariate space revealed considerable overlap between Guam adults, 2008 and 2009 recruits on Guam and recruits from Saipan. A failure to discriminate between

these groups is further support for genetic homogeneity in space and time. While there was no direct evidence of parent-offspring pairs, the true test of self-recruitment, we argue the overlap of adult and juvenile genotype ordinates plus the presence of sibling pairs from different year classes suggests a proportion of larvae were locally spawned. Nevertheless, given the high genetic diversity of recruits, it seems likely the large recruitment event of *N. unicornis* in 2008 and 2009 was comprised of larvae spawned from a variety of sources including the greater west Pacific region.

A haplotype network performed on genetic samples taken from 14 locations including Guam revealed *N. unicornis* populations are unstructured across its entire Indo-Pacific range - a pattern that resembles panmixia. Even remote parts of the Pacific, such as Hawaii, had high connectivity with the Indian Ocean, more than 10 000 km to the west. Therefore genetic exchange at a large spatial scale is probably common for this species. These results support those from the Guam study and confirm that *N. unicornis* is a widely dispersed species that is demographically open at multiple spatial scales.

DRAFT

INTRODUCTION

The study of the dispersive pelagic larval phase of marine organisms continues to be one of the most challenging areas of marine research. The logistical difficulties of studying larval fish in the vast pelagic environment have earned this discipline nicknames like 'the black box' (Leis 1991) and 'the holy grail of marine biology' (Purcell *et al.* 2006). While there are several approaches to assessing larval dispersal, one method that is increasingly popular is to sample cohorts of recently recruited individuals and survey a suite of highly polymorphic microsatellite loci to infer patterns of relationship between recruits and the preexisting adult populations. This approach gives insights into the demographic exchange between neighboring populations (Selkoe *et al.* 2006; Buston *et al.* 2008; Hepburn *et al.* 2009; Planes *et al.* 2009; Christie *et al.* 2010) and can be approached in two different ways:

1) By using genetic markers as direct measures of larval movement, also known as parentage analysis (see Jones *et al.* 2009). This method produces direct evidence of dispersal or self-recruitment but requires large numbers of unlinked loci to confidently connect offspring to parents and demands extensive sampling to find parent offspring pairs amid large and demographically complex reef fish populations. Also, most parentage analysis requires estimates of demographic proportions of adults for obtaining confidence, which can be difficult to obtain in marine populations (Christie *et al.* 2009). While parentage analysis has been successfully applied to some reef fishes (Jones *et al.* 2005; Planes *et al.* 2009), it remains logistically difficult for many marine species in which the amplitude and scale of dispersal is considerable.

2) Indirect appraisals of genetic boundaries, such as conventional population genetic inferences. To deduce ecological patterns of dispersal multiple loci are needed and, in general, the more loci the better. These types of inferences are useful for assessing recent migration when populations are structured. For example if adult populations group into specific genetic clusters newly settled larvae can be assigned to the parent population of origin using a variety of "assignment" tests (Manel *et al.* 2005). Certain Bayesian based analyses also exist that quantify recent migration, within a few generations, as the proportion of individuals that are recent migrants, or that are immediately descended from recent migrants (Wilson & Rannala 2003). These methods, however, are severely compromised when there is a lack of genetic structure between populations. For reef fishes that have genetically homogenous populations across large geographic ranges, indirect methods would probably reveal little. In taxa like *Naso*, the utility of such analyses to resolve ecological migrant exchange is questionable.

Recently Christie *et al.* (2009; 2010) suggested that both indirect and direct measures of dispersal can be combined and implemented effectively even with a modest number of loci. If recruits and adults belong to the same genetic cluster, for example, the probability that two individuals share a parent offspring relationship can be determined based on estimated allele frequencies rather than demographic proportions. Christie *et al.* (2010) used this method to show self-recruitment within genetically connected populations of the damselfish *Stegastes partitus* in the

Bahamas, with 437 adults and 314 recruits and using only seven loci. If such a method can detect self-recruitment amid high gene flow in an abundant species, like *Stegastes partitus*, at a small spatial scale, it might also detect recruitment in a population of *Naso*.

Naso unicornis, the bluespine unicornfish, has a widespread distribution throughout the Indo-Pacific: from the Red Sea and East Africa to Micronesia, Hawaii and French Polynesia, north to southern Japan, and south to the Great Barrier Reef and Lord Howe and Rapa Islands (Froese & Pauly 2008). On Guam, this species is a culturally and commercially important food fish and despite the decline in catch is consistently one of the top ten adult species recorded in the fishery (Hensley & Sherwood 1993).

A previous study by Planes *et al.* (2002) surveyed 132 larvae and 124 recently settled juvenile *N. unicornis* from Moorea, French Polynesia, using 19 allozyme loci. Amongst newly settled results, two conclusions were drawn: 1) There was no evidence for self-recruitment but otolith aging of the recruits revealed individuals settling on the same night were of different ages so they were most likely originated from multiple spawning events. 2) Larvae generally shared closer overall genetic relatedness with each other than with juveniles or adults from the same reef, suggesting that siblings may have recruited together – however not all recruits in the same cohort were siblings. The chaotic genetic recruitment patterns observed by these authors could be consistent with high amounts of external recruitment resulting in demographically open populations.

The focus of this study was to determine the potential sources of *N.unicornis* larvae that colonize Guam's reefs using a variety of molecular tools. This will provide considerable insight as to the degree of connectivity between populations of *N.unicornis* across the southern Mariana Islands. Specifically we set out to:

1. Sample individuals from pulses of recruits from multiple locations for analysis of mitochondrial sequences to determine the pattern of relationships among individuals within and between settling pulses.
2. Sample adult *N.unicornis* collected from Guam for the development of microsatellite markers and to investigate the sources of settling larvae.
3. Use microsatellite loci to confirm the pattern of relationships among individuals within and between settling pulses
4. Determine the degree of self-recruitment by comparing the genetic identity of newly settled *N. unicornis* with the pre-existing adult population using highly polymorphic microsatellites.
5. Look for evidence of sibling relationships within recruitment cohorts and if present investigate if this relationship holds over spatial scales up to 200 km and whether it is stable over more than one recruitment event.

6. Examine whether *N. unicornis*, a habitat generalist, exhibits patterns of isolation for populations across its entire range in the Indo-Pacific.

Analysis of the population structure of settling larvae, the pattern of change over time (as revealed by sequential genetic monitoring/sampling of pulses) and the genetic population structure of adults are important steps in determining the processes that lead to successful recruitment. This aspect adds substantial value to the on-going demographic studies of *N. unicornis* undertaken by one of the authors (JMc). Secondly the microsatellite analysis will assist in determining the sources of recruit pulses and help establish the degree to which Guam populations are self-recruiting as opposed to relying on external larval sources.

METHODS

Field collections on Guam.

In June 2008 a massive recruitment event of the blue-spine unicornfish (*N. unicornis*) occurred at multiple sites around Guam. The exact scale of this mass recruitment is unknown but was significant enough to deliver high numbers of settlement-size larvae to a large portion of the shallow reef flat area around the island. During a similar event in French Polynesia, involving the same species, Doherty *et al.* (2004) reported that as many as 10,000 recruits per km² per night can settle on the reef at the height of settlement. We suggest, therefore, that the total numbers of settlers during this time period was in the hundreds of thousands. The first pulse of recruitment was the largest but based on personal observation by one of the authors (JMc) there was a second pulse in July 2009 and a third in September of that same year. It is also likely that small numbers of larvae continued to settle throughout this time. Recruitment was particularly intense on the western coast of Guam, most notably in the later months. By late August recruits on the east coast were seen only in very small numbers, while west coast sites continued to receive numerous (and more recent) recruits.

We sampled 375 recruits or newly settled larvae from five sites around Guam; Tanguisson, Governors Complex, Cocos Lagoon, Ipan Beach and Pago Bay (Fig. 1). Sampling was done mainly at night by snorkel at depths no greater than 1 m. Immediately following collection, samples were transported to the University of Guam Marine Lab, where a small fin clip was taken and preserved in 80% EtOH. Samples were weighed, measured for fork length and the otoliths and guts removed, which were used for additional projects (see Abellana unpub. thesis 2010). During the same period 176 adult fish were collected from around Guam either by spearing or purchased from commercial vendors (see McIlwain *et al.* 2011 for further details of adult collections).

Laboratory procedures

Genetic processing of *N. unicornis* samples from Guam, for the mitochondrial control region and for microsatellite loci, was performed as outlined in J.Horne unpub. thesis 2011. All individuals were genotyped with at least 12 of the original 15 loci (Nuni 1-

12; Table 2). Seventy seven samples were genotyped twice for quality control and returned consistent results.

Genetic analysis of mtDNA

MtDNA haplotype sequences were aligned as described elsewhere (J.Horne unpub. thesis 2011). The number of haplotypes, haplotype diversity and nucleotide diversity were calculated in DNASP (Rozas *et al.* 2003). Pairwise *Fst* and hierarchal AMOVA were performed between age cohorts and collection sites in ARLEQUIN v. 3.1 (Excoffier *et al.* 2005) using 10,000 permutations. Twenty-five *N. unicornis* haplotypes from Tonga were also analyzed against all Guam samples as an external control and to help place the Guam samples in a broad-scale genetic context.

Summary statistics, tests of Hardy-Weinberg equilibrium and linkage disequilibrium of microsatellite loci

Exact tests for departure from Hardy-Weinberg equilibrium (HWE) were conducted in GENEPOP v. 4.0.10 (Rousset 2008) and also tests of linkage disequilibrium (LD) using the Markov chain algorithm, a dememorization of 10,000, with 20 batches and 5000 iterations per batch. Loci that did not conform to HWE may be under selection and were not used for downstream analyses but this was based solely on allele frequencies in the one adult population sampled in this study because recruitment cohorts are not reproductive populations, potentially contain kinship aggregations and may display allele frequencies that are misleading in this regard. The presence of null alleles, large allele drop out, stuttering and other genotyping errors were assessed in MICROCHECKER v. 2.2.3 (van Oosterhout, 2004). Number of alleles, allelic richness, private alleles, observed and expected heterozygosities based on Hardy-Weinberg proportions were estimated in FSAT v. 2.9.3 (Goudet 2001) and in GENALEX v. 6.4 (Peakall & Smouse 2006). Pair wise *Fst* were performed for each sample site and hierarchal AMOVA with various configurations to detect genetic structure in time and space were implemented in ARLEQUIN.

Discriminant analysis of principal components

Discriminant analysis of principal components (DAPC) is a multivariate analysis that may be used to extract information from large genetic data sets and assign individual genotypes to predefined groups (Jombart *et al.* 2010). First, data is transformed into uncorrelated components, containing most of the genetic information, using principal components analysis (PCA). These components are then subjected to a linear discriminant analysis (DA) that minimizes the genetic variance within populations while maximizing among population variation, thus providing the best discrimination of predefined genetic groups. When prior population information is unavailable, it is possible to identify and describe genetic clusters without defining groups *a priori* using a k-means algorithm, which is based on the same statistical model as discriminant analysis. This method has been shown to be as sensitive as Bayesian clustering programs (Jombart *et al.* 2010) but does not require large amounts of computational time. Furthermore, DAPC does not assume HWE or LD and has very few assumptions making it an extremely versatile methodology.

DAPC scatter plots, were created in the R package Adegenet (Jombart 2008; Jombart *et al.* 2010), to visually represent genetic patterns among *N. unicornis* age

classes and cohorts in space and time in order to give the best genetic discrimination of these groups as they were collected in the field. However, due to a lack of spatial or temporal genetic structure (see results) there was no justification for assigning individuals to predefined sample locations. Instead the “find.clusters” function from the R package Adegenet (Jombart *et al.* 2010) was used to detect genetic clustering without prior group information. First, PCA was performed on data that was scaled with missing data assigned to the mean of the PCA. Next a number of PCs were retained as predictors for discriminant analysis. There are no strict guidelines for determining how many PCs should be retained during this dimensions-reduction step but it is a compromise between the statistical power of more PCs and the stability of assignments (Jombart *et al.* 2010 & references therein). For the purposes of this chapter, the 100 PCs were retained containing 80% of the variation of the data. The correct number of demes (k) was selected based on likelihood score and the Bayesian information criterion with 10,000 iterations.

Parentage analysis and tests of relatedness

To investigate relationships between individuals, Queller & Goodnight’s coefficient of relatedness (r) was calculated for all individuals in a pair wise fashion using the program RELATEDNESS v. 5.0.8 (Queller & Goodnight 1989). Mean r was also calculated for groups based on collection data. On average, $r = 0$ in unrelated individuals or when the relatedness of a group is random, $r = 0.25$ in half siblings and $r = 0.5$ in full siblings. This program calculates r based on a regression using allele frequencies. For this analysis all individuals were weighted equally and, because no genetic structure was detected, the allele frequencies of the entire data set were used (see results).

To detect potential parent-offspring pairs in the data the method described in Christie *et al.* 2009 and Christie *et al.* 2010 was employed. These analyses are presently in the form of script written for the program R (<http://www.Rproject.org>; Ihaka & Gentleman 1996) and are available from the website <http://sites.google.com/site/parentagemethods/>. The main parameters generated are the putative parent-offspring pairs, the probability that any pair is false ($Pr \Phi$) and the expected number of false pairs given the data set. Missing data was reset to the most common allele for each locus for the calculation of allele frequencies (Christie *et al.* 2009; Christie *et al.* 2010) but not when comparing the allele identities of putative parent-offspring pairs.

Population structure

A detailed description of the methods used for the population structure component can be found in Horne *et al.* 2008. The published haplotype network was updated in 2010 to include 40 adult samples from Guam.

RESULTS

Molecular diversity

We resolved approximately 250 bp of the mitochondrial control region and genotyped all samples with 12 microsatellite loci. Genetic diversity of the mtDNA is shown in Table 1 and is similar between sample sites, cohorts and age classes. In other words, the genetic diversity of recruiting individuals was just as great as that of

the preexisting adult population. In total, there were 373 haplotypes observed and approximately 80% of all individuals had unique haplotypes. There was no genetic structure observed in the mitochondrial control region between sites, cohorts or age classes (Table 2), except for one pair wise test between the October sample of recruits from Governors and the adult population. Apart from this one exception, data from the mtDNA suggested that recruitment events of *N. unicornis* were unstructured in space and time. Neither was there any structure detected between the Micronesian samples and 25 adult *N. unicornis* from Tonga although there were four haplotypes shared between Tongan adults and recruits on Guam.

Four of the twelve microsatellites (Nuni 2,4,9,10) were found to have significant departures from HWE and were not used in subsequent analyses (Table 3). Excluded loci also appeared to be the more erratic, with imperfect repeats, of the set. Out of 66 pairwise tests of LD only two were significant (loci Nuni 01 and Nuni 11, $p = 0.03$; Nu07 and Nu12, $p = 0.04$). However these were based only on one adult population and further investigations of LD in the recruitment samples did not repeat this linkage. Therefore these results should be treated cautiously. According to MICROCHECKER, loci Nuni 02 and Nuni 09 are affected by null alleles but both of these loci were already excluded for HWE. It might also be mentioned that null alleles are expected to exaggerate genetic differentiation (Chapuis & Estoup 2007), which is clearly not a problem with this data set. Diversity indices for the eight remaining loci are presented in Table 4.

As with the mtDNA, genetic diversity in the nuclear microsatellites was highly similar in both recruits and adults. To the extent that these samples represent the actual genetic diversity, it would appear that the recruits are slightly more genetically diverse than the preexisting population on Guam, in both the mitochondrial and nuclear genome. The average inbreeding coefficient for all groupings is low and for some of the sites it is negative, indicating a lack of inbreeding and, by extension, a lack of relationship within some age cohorts from the same site. There were also a large number of private alleles (40 in total) most of which belonged to recruits. In spatially discrete reproductive populations the presence of private alleles can indicate long-term isolation (Slatkin 1985; Lowe & Allendorf, 2010). However in this case a large number of rare alleles in the recruits may indicate the genetic diversity is greater than our sample would suggest. It might also be taken as evidence for long distance migration. Pairwise F_{st} values across eight microsatellite loci are reported in Table 5. As with the mtDNA there is a striking absence of structuring between sites, cohorts and age classes, with only two exceptions. One significant test of population structure was between June and October samples of the 2008 recruits at Governors, suggesting temporal instability at this site. All hierarchical AMOVA analyses produced non-significant fixation indices of $\Phi_{st} = 0.0$, regardless of how populations were arranged.

Relatedness and Parentage analysis

Based on eight microsatellite loci, 28 putative parent-offspring pairs were identified, however, given the allele frequencies of the data set, the probability that any of these were false pairs was extremely high ($\Pr \Phi = 1.0$) and the expected number of false pairs in the data was 44.93. Furthermore, none of these relations could be

confirmed from mtDNA or by adding more loci. Therefore, there is no evidence that any parent offspring-pairs were sampled in this study.

Pair wise relatedness between individuals and the mean relatedness coefficient for each group is given in Figures 1a and 1b. Overall, recruits had a mean relatedness of 0.0 and the mean for adults was only slightly lower ($r = -0.0057$). Mean relatedness within the sampling sites of recruits ranged between $r = -0.0175$ and -0.125 . Notwithstanding the negative mean relatedness, some individuals from the same sites were genetically similar enough to suspect half or even full sibling relationships and may be evidence that siblings recruit together. For the purposes of this study, however, putative sibling pairs were defined as those individuals that shared a mtDNA haplotype and had a pair wise coefficient of relatedness in the microsatellites of $r > 0.19$. In reality this only indicates maternal siblings and individuals with $r < 0.19$ also have the potential for sibling relationship. However, notwithstanding that these criteria are very strict and may underestimate the true number of sibling relationships, using the diversity of mtDNA haplotypes ($N_h = 373$) in combination with the pair wise relatedness values is conservative and helps ensure that type II errors are avoided when inferring kinship between two individuals.

Given the above criteria there were 13 putative sibling pairs identified among sampled recruits (Table 6). Only a single pair, from among the Governors Complex samples, came from the same site, all others were not sampled together. Three of these pairs were separated and collected at Guam and Saipan. In one of these cases, a recruit from Saipan had a relationship of $r = 0.4$, enough to suspect a full kinship, with another recruit sampled a year later at Governors on Guam. There was no missing data in either of these recruits. Therefore, while there is some evidence that siblings may have settled in close proximity, recruiting *N. unicornis* were perhaps more likely to be related to individuals outside of their sample site than within. Note also that mean relatedness among recruits, as a whole, was higher than mean relatedness for any specific sample site. Six out of 13 putative sibling relationships were between year classes, so recruits were perhaps just as likely to be related to recruits of other generations as to their own cohorts.

Discriminant analysis of principal components

Scatter plots of genetic variation in multivariate space revealed considerable overlap between Guam adults, 2008 and 2009 recruits on Guam and recruits from Saipan (Fig.2). A failure to discriminate between these groups strongly suggests genetic homogeneity in space and time. Each group also occupies all quadrants of the plot and possesses individuals that lie well beyond the 95% inertia ellipses of the group. The same may be said of the recruits alone, when they are segregated according to sample site (Fig.3), with the exception of Pago 2008 and Pago 2009, which do not overlap and mostly occupy separate quadrants.

The k-means algorithm identified three genetic clusters (Fig.4) but one contained only a single individual. The remaining two clusters were composed of individuals from all age classes, year classes and individuals sourced from Saipan. When subjected to DAPC these two genetic clusters were clearly differentiated by a single discriminant function (Fig.5). DAPC can sometimes create artifactual clusters (Jombart *et al.* 2010), therefore these “non-geographic” clusters might not be a

biologically significant pattern. It should also be noted that AMOVA performed on the same microsatellite data detected significant genetic differentiation between these two clusters ($\Phi_{st} = 0.04$, $p = 0.000$). There is no visible concordance between the non-geographic partitioning observed here and non-geographic structures found in the mtDNA. If these two genetic clusters are a true pattern in the data, they are a signal that has arisen beyond the spatial and temporal scale of this study.

DRAFT

Population structure

Pair wise F_{st} values were small and not significant for any pair of populations (Table 7). Isolation-by-distance analysis conducted on these values show a negative relationship, albeit a weak and non-significant negative relationship, between genetic and geographic distances ($r = -0.2716$, $p = 0.889$). AMOVA fixation indices were small and not significant for all spatial comparisons (Table 8). There was no population structure detected between the Indian and Pacific oceans at the IPB ($\Phi_{ct} = -0.006$, $p = 1.0$). There was no population structure detected within the Pacific Ocean between west (GBR, Guam, Tonga) and central (Tahiti, Hawaii) populations ($\Phi_{ct} = 0.001$, $p = 0.3$). Likewise, there was no structure between north (Guam, Hawaii) and south (GBR, Tonga, Tahiti) Pacific populations ($\Phi_{ct} = 0.001$, $p = 0.9$).

Spatially, *N. unicornis* appears to have unstructured populations across its entire Indo-Pacific range in a pattern that resembles panmixia. Moreover, the haplotype network for this species boasts nine haplotypes from more than one location (Fig. 6). Five haplotypes were sampled from both the Indian and Pacific Oceans. Even remote parts of the Pacific, such as Hawaii, appeared to have high connectivity with the Indian Ocean. Thus, genetic exchange at a large spatial scale may be somewhat common *N. unicornis*. Nevertheless, when the data set was organized as clades, AMOVA fixation indices were deep and significant ($\Phi_{st} = 0.426$, $p = 0.0001$).

Table 1: Mitochondrial control region genetic diversity for adult *N. unicornis* from Guam and recent recruits from Guam and Saipan: number of samples (n), number of haplotypes (N_h), haplotype diversity (h) and nucleotide diversity (π).

	n	N_h	h	π
1. Adults	94	89	0.99	0.0787
2008 Recruits	246	217	0.99	0.0852
West Coast	150	138	0.99	0.0847
2. Governors June	27	26	0.99	0.0790
3. Governors Aug.	56	56	1.0	0.0857
4. Governors Oct.	32	31	0.99	0.0916
5. Tanguison June	39	38	0.99	0.0821
6. Tanguison Aug.	13	13	1.0	0.0802
East Coast	78	76	0.99	0.0869
7. Pago	24	24	1.0	0.0813
8. Ipan	35	35	1.0	0.0924
9. Cocos	20	20	1.0	0.0841
2009 Recruits	79	74	0.99	0.0800
West Coast	44	43	0.99	0.0809
10. Governors	33	32	0.99	0.0788
11. Tanguison	11	11	1.0	0.0859
East Coast	35	33	0.99	0.0790
12. Pago	11	9	0.96	0.0778
13. Ipan	13	13	1.0	0.0866
14. Cocos	11	11	1.0	0.0717
15. Saipan Recruits	28	28	1.0	0.0817
Total	469	373	0.99	0.0828

Table 2: Pair wise *Fst* values from mtDNA control region sequences for adult and recruit *N. unicornis* from Guam as numbered above. Also recruits from Saipan (15) and adults from Tonga (16). Values lower than 0.001 are displayed as 0. Uncorrected significant values ($\alpha = 0.05$) are in bold. No pair wise comparisons were significant after bonferroni correction ($\alpha = 0.000416$).

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	0															
2	0.001	0														
3	0.004	0.003	0													
4	0.012	0	0	0												
5	0.008	0	0	0	0											
6	0	0	0	0	0	0										
7	0	0	0	0	0	0	0									
8	0.007	0.007	0	0	0.003	0.001	0.002	0								
9	0	0	0	0	0	0	0	0	0							
10	0.003	0.009	0.001	0.006	0	0	0	0	0	0						
11	0.015	0.027	0	0	0	0.011	0.004	0	0	0.009	0					
12	0.022	0.008	0	0	0	0.010	0.011	0	0	0.012	0	0				
13	0	0.014	0.002	0.007	0.006	0	0.002	0	0.009	0.004	0.021	0.036	0			
14	0	0	0	0	0	0	0	0	0	0	0	0.001	0	0		
15	0.009	0.006	0	0	0.003	0.003	0.004	0	0.002	0.007	0	0	0.022	0	0	
16	0.007	0	0	0	0	0	0	0	0	0	0	0	0	0	0.008	0

Table 3: Exact tests for departure from Hardy-Weinberg equilibrium from 176 adult *N. unicornis* from Guam, for 12 polymorphic microsatellite loci and the total number of alleles (N_a) for each. The metric used is Weir and Cockerham's (1984) F_{IS} with corresponding probability. P values less than 0.05 are considered significant departures and indicate possible selection acting on these loci (highlighted with bold italics) and were not used in further analyses.

Locus name	N_a	F_{IS}	p
Nuni01	12	0.0050	0.5568
<i>Nuni02</i>	<i>17</i>	<i>0.2457</i>	<i>0.0000</i>
Nuni03	33	0.0416	0.0640
<i>Nuni04</i>	<i>26</i>	<i>0.0358</i>	<i>0.0382</i>
Nuni05	22	0.0658	0.2652
Nuni06	38	0.0364	0.2240
Nuni07	24	0.0293	0.1131
Nuni08	13	0.0425	0.0531
<i>Nuni09</i>	<i>25</i>	<i>0.2313</i>	<i>0.0000</i>
<i>Nuni10</i>	<i>25</i>	<i>0.0458</i>	<i>0.0053</i>
Nuni11	11	0.1174	0.1389
Nuni12	28	-0.0037	0.4875

Table 4: Genetic diversity indices for all *N. unicornis* adults from Guam and recruits from Guam and Saipan across eight microsatellite loci. Number of samples (n), average number of alleles across 8 loci (N_a), observed and expected heterozygosity (H_O , H_E), the population specific average inbreeding coefficient (F_{IS}), allelic richness (R_S) and number of private alleles (P_a). Bold type serves only to highlight larger groupings of samples.

	n	N_a	H_O	H_E	F_{IS}	R_S	P_a
1. Adults	176	18	0.798	0.827	0.039	12	10
2008 Recruits	268	19.75	0.787	0.829	0.051	12.32	21
West Coast	176	18	0.783	0.828	0.057	13.49	11
2. Governors June	30	12.25	0.798	0.808	0.016	7.42	1
3. Governors Aug.	58	15.25	0.770	0.824	0.066	7.78	5
4. Governors Oct.	33	12.625	0.776	0.811	0.047	7.77	2
5. Tanguison June	39	13.5	0.791	0.829	0.048	7.75	2
6. Tanguison Aug.	13	10.875	0.796	0.803	0.015	7.76	0
East Coast	92	16.75	0.795	0.824	0.034	13.65	10
7. Pago	25	12.625	0.784	0.813	0.059	7.87	2
8. Ipan	39	14.25	0.801	0.821	0.012	7.88	3
9. Cocos	28	12.75	0.795	0.810	0.006	7.65	2
2009 Recruits	88	16.25	0.793	0.821	0.035	11.97	5
West Coast	47	14.375	0.798	0.821	0.025	13.31	3
10. Governors	32	13.0	0.804	0.818	0.017	8.09	1
11. Tanguison	16	10.375	0.784	0.803	0.017	7.45	0
East Coast	40	13.75	0.788	0.809	0.031	13.27	1
12. Pago	11	8.875	0.783	0.791	0.013	7.57	2
13. Ipan	20	10.375	0.802	0.795	-0.003	7.66	1
14. Cocos	9	7.25	0.766	0.758	-0.007	7.65	0
15. Saipan Recruits	30	13.25	0.801	0.823	0.026	12.64	4
Total	562	16.813	0.795	0.825	0.038	13.53	40

Table 5: Pair wise *Fst* values across eight microsatellite loci for adult and recruit *N.unicornis* from Guam as numbered above. Plus recruits from Saipan (15). Values lower than 0.001 are displayed as 0. Uncorrected significant values are in bold ($\alpha = 0.05$). No pair wise comparisons were significant after bonferroni correction ($\alpha = 0.000476$).

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	0														
2	0.002	0													
3	0	0	0												
4	0.002	0.009	0.002	0											
5	0	0	0	0.003	0										
6	0	0	0	0	0	0									
7	0	0.002	0	0.004	0.002	0	0								
8	0	0	0	0.006	0.001	0	0	0							
9	0	0.002	0	0.006	0	0	0.003	0	0						
10	0	0.005	0	0	0.001	0	0.002	0.003	0	0					
11	0	0	0	0	0	0	0	0	0.002	0	0				
12	0	0.006	0.007	0.004	0	0	0.003	0.008	0.006	0	0	0			
13	0	0.002	0	0	0	0	0	0	0	0	0	0	0		
14	0.003	0	0	0.007	0	0	0.002	0.003	0.005	0.002	0	0.006	0	0	
15	0.007	0.002	0	0	0	0.001	0.013	0.013	0.010	0	0	0.002	0	0	0

Table 6: List of putative sibling pairs among sampled *N. unicornis* recruits from Guam and Saipan. All putative pairs share a mtDNA haplotype and have a pair wise coefficient of relatedness of $r > 0.19$.

Sibling 1	Sibling 2	Pair wise coefficient of relatedness
Governors, Oct, 2009	Saipan Oct, 2008	$r = 0.40$
Governors, Jun, 2008	Cocos, Oct, 2009	$r = 0.27$
Governors, Jun, 2008	Tanguison, Aug, 2008	$r = 0.32$
Governors, Jun, 2008	Governors, Aug, 2008	$r = 0.34$
Pago, Jun, 2008	Tanguison, Aug, 2008	$r = 0.25$
Pago, Jun, 2008	Governors, Aug, 2008	$r = 0.24$
Ipan, Jun, 2008	Governors, Aug, 2008	$r = 0.28$
Ipan, Jun, 2008	Saipan, Oct, 2008	$r = 0.24$
Governors, Oct, 2008	Cocos, Oct, 2009	$r = 0.26$
Governors, Aug, 2008	Tanguison, Aug, 2009	$r = 0.20$
Governors, Oct, 2008	Tanguison, Jun, 2008	$r = 0.20$
Saipan, Oct, 2008	Tanguison, Jun, 2008	$r = 0.26$
Ipan, Jun, 2008	Governors, Oct, 2009	$r = 0.20$

Table 7: Pairwise population F_{st} for eight Indo-Pacific populations and p values on the above diagonal. All values are not significant.

	Seychelles	Cocos	WA	GBR	Tahiti	Hawaii	Tonga	Guam
Seychelles		0.08	0.16	0.85	0.36	0.25	0.45	0.79
Cocos	0.02363		0.07	0.27	0.26	0.21	0.41	0.11
WA	0.01827	0.03348		0.09	0.11	0.24	0.34	0.14
GBR	-0.01285	0.00638	0.02067		0.27	0.25	0.55	0.34
Tahiti	0.00257	0.00846	0.02123	0.00513		0.21	0.41	0.50
Hawaii	0.00859	0.01249	0.01184	0.00548	0.01004		0.23	0.13
Tonga	-0.00120	0.00050	0.00483	-0.0029	0.00062	0.00751		0.45
Guam	-0.01036	0.01532	0.01576	0.00150	-0.0019	0.01049	-0.0008	

Table 8: AMOVA fixation indices (Φ_{st}), percentage of genetic variation (%) and accompanying p values for population comparisons at multiple spatial scales. Overall = (eight locations Seychelles-Hawaii).

Comparison	Fixation index	%	p
Overall AMOVA	$\Phi_{st} = 0.0052$	0.52	p = 0.136
Indian Ocean vs. Pacific Ocean	$\Phi_{st} = 0.0009$ $\Phi_{sc} = 0.007$ $\Phi_{ct} = -0.006$	99.91 0.73 -0.64	p = 0.134 p = 0.078 p = 1.0
Central Pacific vs. West Pacific	$\Phi_{st} = 0.003$ $\Phi_{sc} = 0.002$ $\Phi_{ct} = 0.001$	99.61 0.21 0.18	p = 0.253 p = 0.2 p = 0.3
North Pacific vs. South Pacific	$\Phi_{st} = 0.002$ $\Phi_{sc} = 0.004$ $\Phi_{ct} = -0.001$	99.76 0.43 -0.19	p = 0.250 p = 0.221 p = 0.9
North GBR vs. Central GBR vs. South GBR	$\Phi_{st} = 0.0256$	2.5	p = 0.151
Clade vs. Clade	$\Phi_{st} = 0.426$	42.61	p < 0.001



Figure 1: Map of the five sites where collections were made of newly settled *N.unicornis* recruits used in the genetic analysis

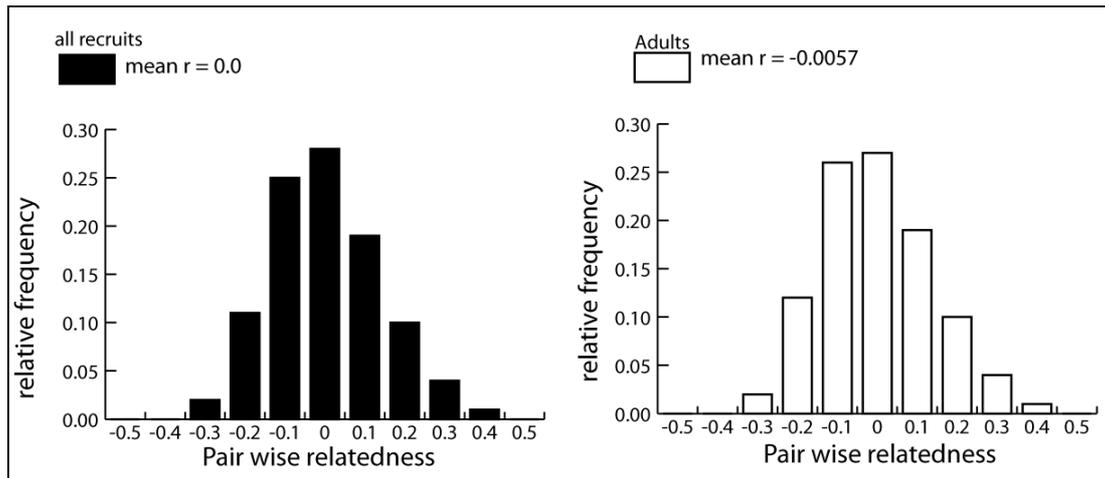


Figure 1a: Pair wise relatedness distributions for all recruit samples from both Guam and Saipan from 2008 and 2009, and all adult *N. unicornis* samples from Guam along with the average relatedness (mean r) from both groups.

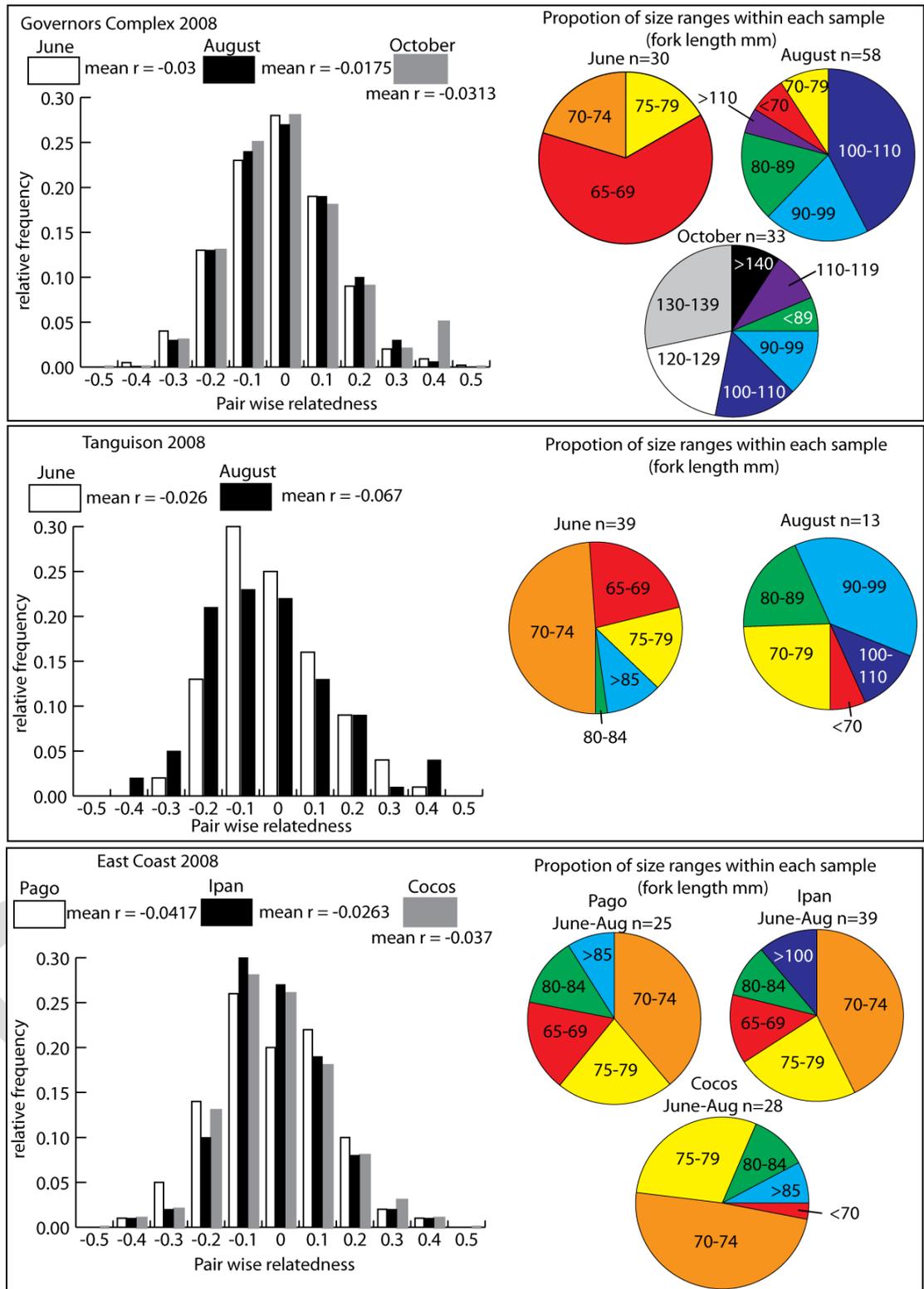


Figure 1b: [left] Pair wise relatedness distributions for all sample sites of *N. unicornis* recruits from Guam during the 2008 recruitment season only, along with the average relatedness (mean r) from each group. [right] Pie graph depictions of the proportions of size ranges of recruits from each sample site and the number of samples collected.

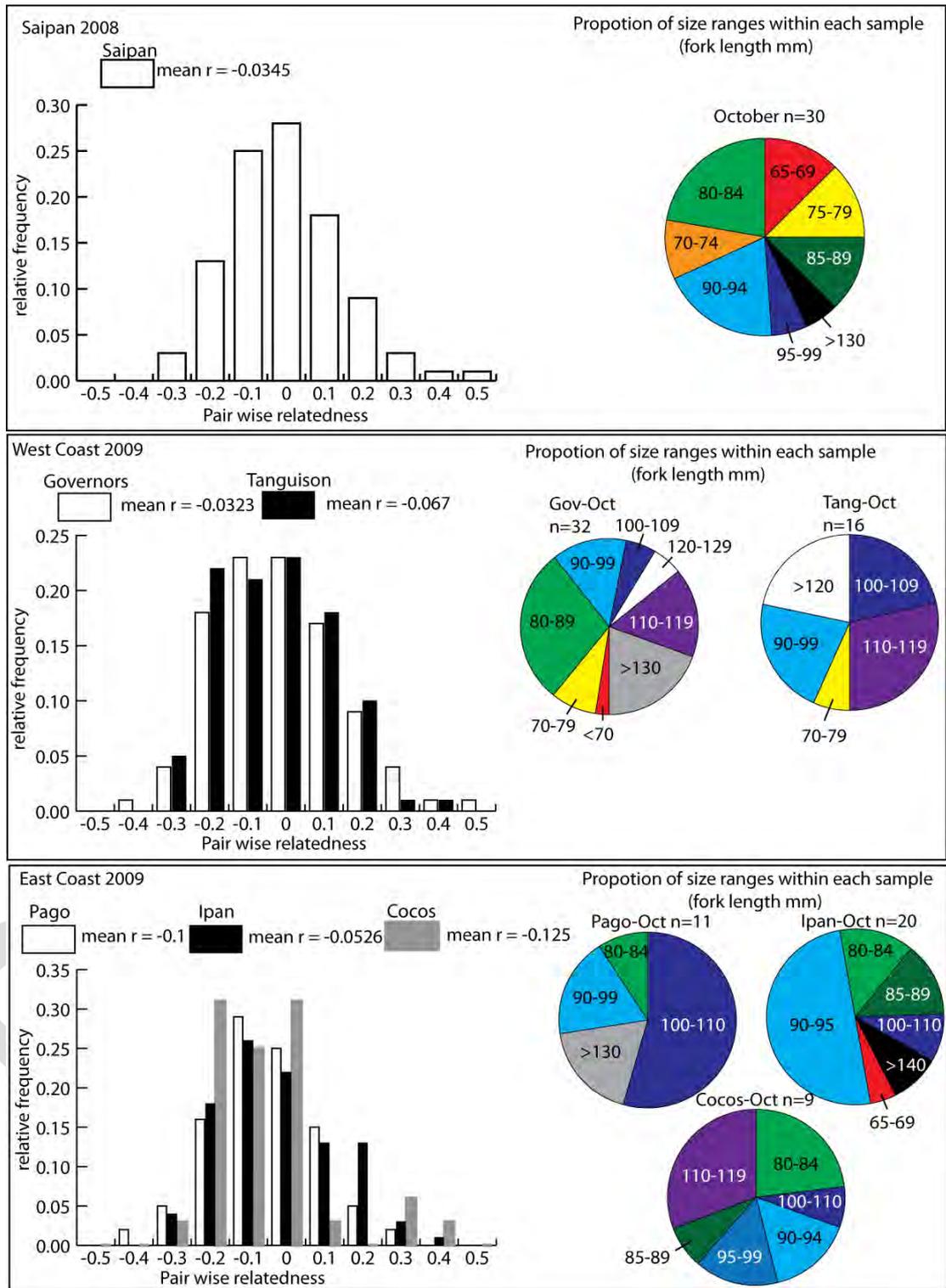


Figure 1b: [left] Pair wise relatedness distributions for all sample sites of *N. unicornis* recruits from Guam and Saipan during the 2008-2009 recruitment season, along with the average relatedness (mean r) from each group. **[right]** Pie graph depictions of the proportions of size ranges of recruits from each sample site and the number of samples collected.

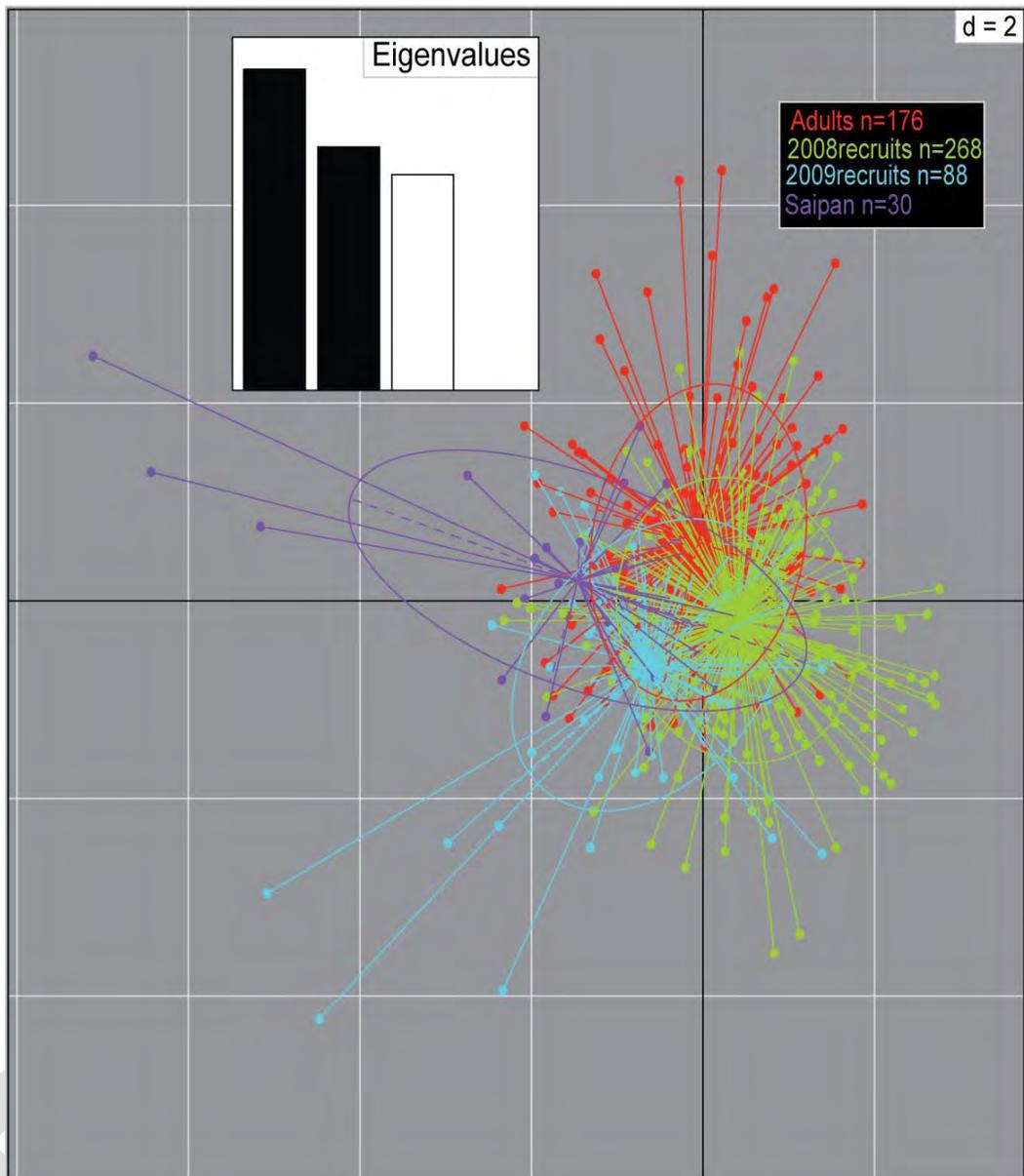


Figure 2: DAPC scatterplot of *N. unicornis* adults from Guam and recruits from Guam and Saipan. Individual genotypes are represented by dots. Dots are grouped by location, age class or year class and represented by colors and 95% inertia ellipses. Eigenvalues are displayed in the top left quadrant. The first two eigenvalues (black) show the amount of genetic information shown in the x and y-axes respectively.

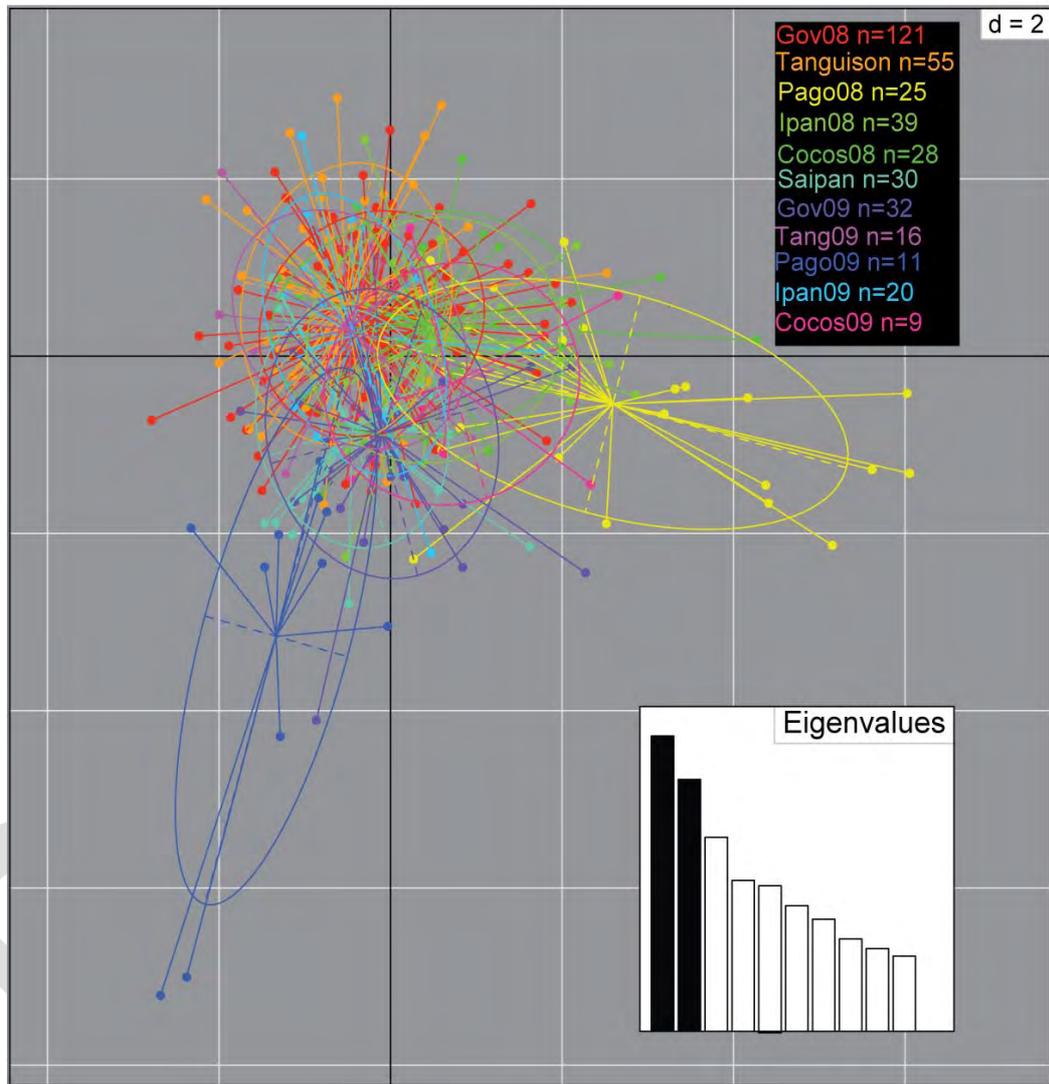


Figure 3: DAPC scatterplot of *N. unicornis* recruits from Guam. Individual genotypes are represented by dots. Dots are grouped by sample site and years, represented by colors and 95% inertia ellipses. Eigenvalues are displayed in the bottom right corner. The first two eigenvalues (black) show the amount of genetic information shown in the x and y-axes respectively

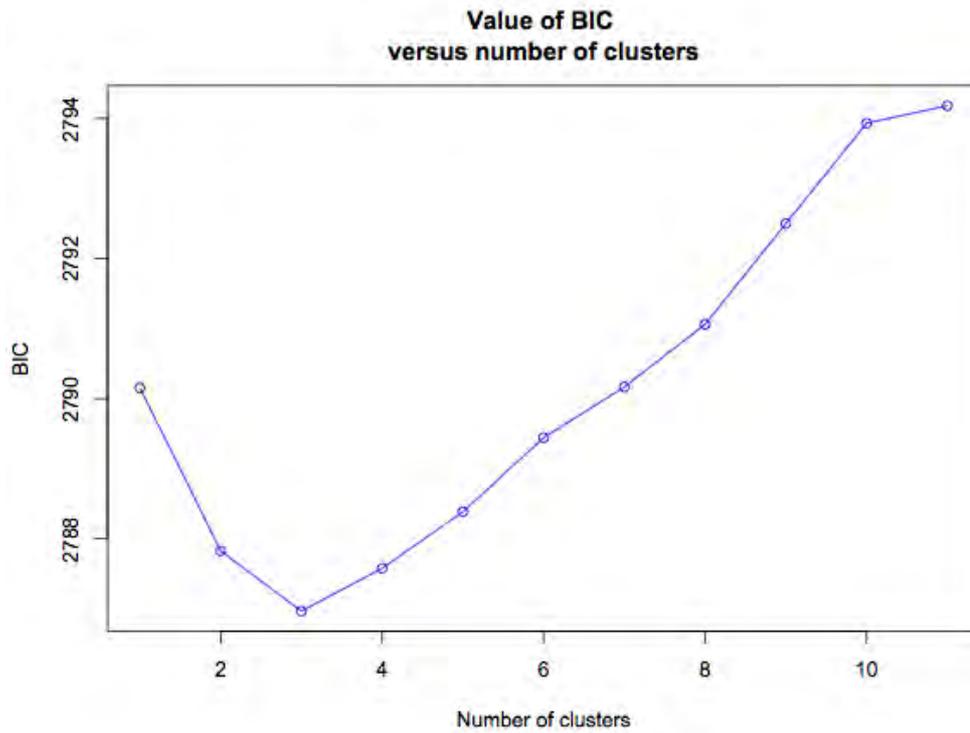


Figure 4: Likelihood of the number of genetic clusters based on the Bayesian information criterion (BIC), using the k-means algorithm (Jombart *et al.* 2010).

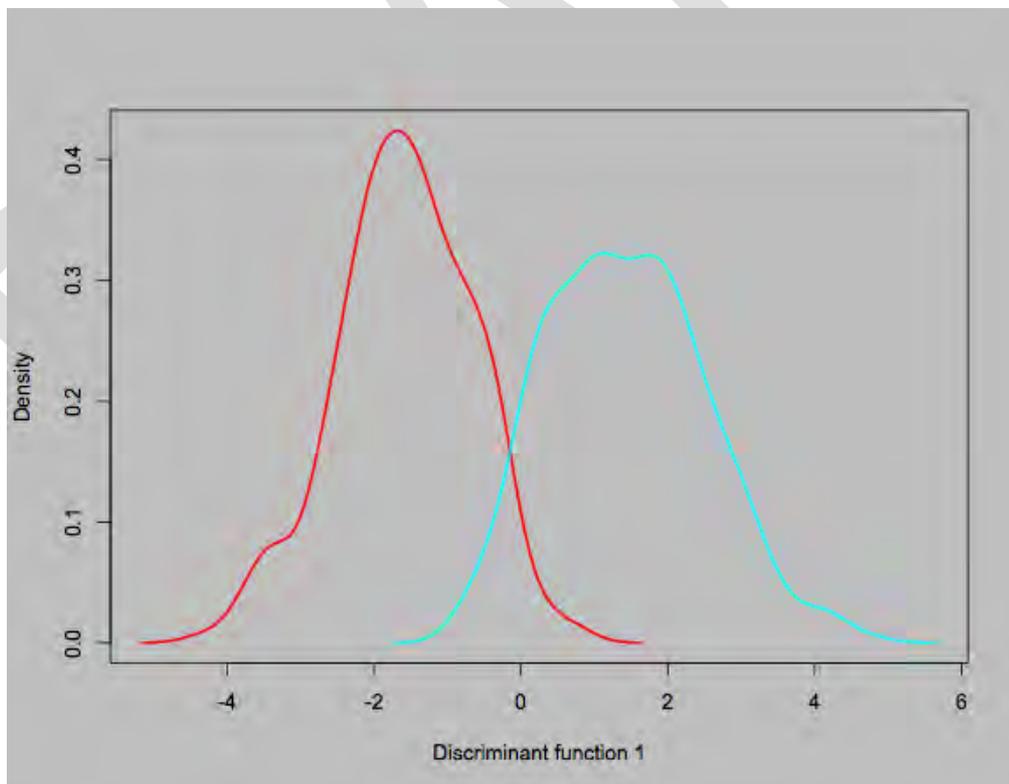


Figure 5: Discrimination of genetic cluster 1 (red) and genetic cluster 2 (blue). Here genetic variation between the two clusters can be represented on a single axis (discriminant function 1).

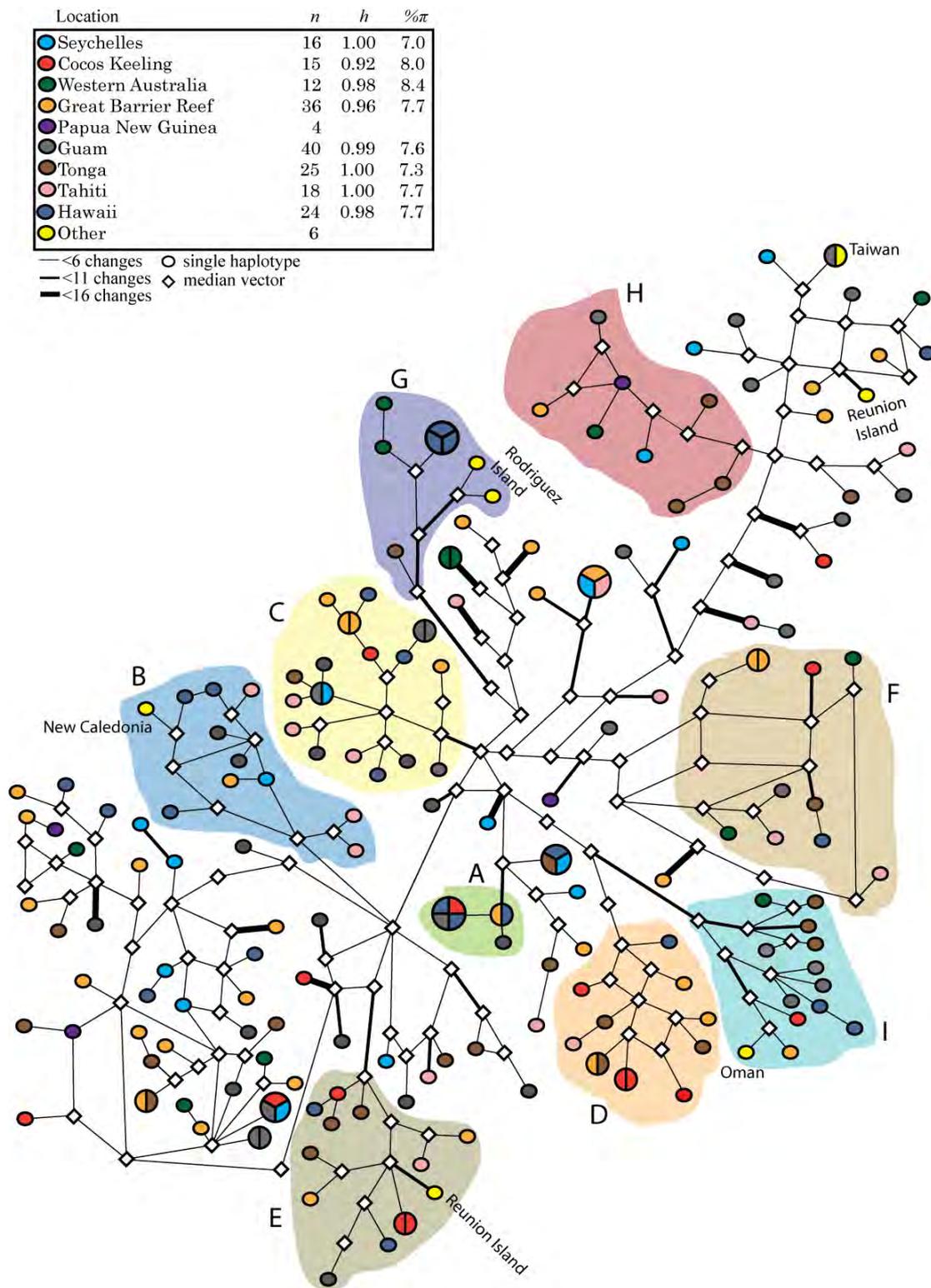


Figure 6: Median joining network of 196 *N. unicornis* haplotypes. For each population, sample size (*n*), haplotype diversity (*h*) and nucleotide diversity (% π) are provided.

DISCUSSION

Comparisons with previous studies

The results of this study and that of Planes *et al.* (2002) are complimentary as mean relatedness of recruiting *N. unicornis* larvae in Moorea was $r = 0.002$ and therefore close enough to random to presume that larvae originated from different spawning events. Likewise, there was no evidence that recruits from Guam were any more closely related than random, and in many instances, mean relatedness in groups of larvae from the same reef flat was much less than zero. Yet, when Planes *et al.* grouped recruits based on otolith age they found that groups of recruits of the same age had a much higher relatedness ($r = 0.05 - 0.33$). In the present study recruits were not aged but at many locations recruits with pair wise relatedness values of 0.5 or higher were observed. It is unknown whether these individuals are the same age or not but they may likely be the progeny of single spawning events. However, unlike Planes *et al.* (2002) I surveyed multiple settlement sites around the island of Guam and observed equally high pair wise relatedness between recruits that settled many kilometers apart. Again these were not aged but the same logic applies. Even so, because I lacked demographic information from otolith analyses and I only used eight microsatellite loci, I opted for strict criteria, requiring $r > 0.19$ and shared mtDNA haplotypes, before I was willing to infer kinship. Only 13 pairs of recruits qualified as putative siblings under these criteria and of these only one pair was from the same settlement site (table 7.6). Planes *et al.* (2002) offered the first conclusive evidence that sibling reef fishes remained together throughout the pelagic larval phase and settled together (see also Buston *et al.* 2009). Our data suggests that few of the surviving offspring of a single spawning choose to settle together, remain together for the duration of the pelagic larval phase or even settle synchronously.

Planes *et al.* (2002) detected significant genetic structure between recruiting larval *N. unicornis* and juveniles on the same reef flat collected ten days apart. They argue this pattern emerged as the result of genetic drift due to the family-structure of pre-settlement larval pools and that mortality and mixing alter allele frequencies after settlement takes place. It is possible that the family-structure of larval pools and detectable genetic heterogeneity between cohorts of recruits and developmental stages is evidence of a stochastic sorting of genes during the pelagic larval phase also known as sweepstakes reproduction (Hedgecock *et al.* 2007). Based on the data presented in this study we question the notion that successive recruitment pulses of *N. unicornis* are structured in time by stochastic processes and sweepstakes reproduction for three reasons. First, even if pre-settlement larval pools contain disproportionate numbers of siblings, the extreme genetic diversity of the post-settlement recruits refutes that only a small number of progenitors contribute to the next generation's gene pool, regardless of whether recruits belong to the same larval pool or not. Allele frequencies in *N. unicornis* recruits may experience sorting following recruitment events due to high post-larval mortality (Doherty *et al.* 2004). Still, on Guam, old groups of large juveniles were just as genetically diverse as young groups of small juveniles (Table 4; Fig. 1b). Second, if successive recruitment pulses are structured in time from stochastic processes one might expect more differentiation between entire year classes than was observed in this study. Third,

nearly half of the putative sibling pairs were separated by year class. Clearly, many of the same progenitors are contributing to the gene pool year after year.

Self-recruitment and external recruitment

In spite of the intensity of *N. unicornis* recruitment and an adult population size kept relatively low by intense fishing pressure, there was no evidence that any parent-offspring pairs were sampled from Guam. However the presence of self-recruitment cannot be rejected outright because of the lack of genetic differentiation between adults and recruits. Overlap of adult and juvenile genotype ordinates in reduced space (Fig. 2) might also suggest self-recruitment. Additionally, because some recruits from different year classes may be siblings we suspect that they may have been locally spawned, if not on Guam itself then elsewhere in the Marianas. Nevertheless, given the high genetic diversity of recruits, it seems unlikely that the massive recruitments of *N. unicornis* could be exclusively composed of locally spawned individuals. Most likely, there are a variety of sources for recruits, including self-recruitment. Multi-generational siblings could also be evidence of source-sink population dynamics, rather than local replenishment. Therefore, a significant portion of the recruits on Guam probably originated elsewhere.

The *N. unicornis* populations on Guam and Saipan, although separated by more than 200 km, appeared to be demographically connected, if not by direct migrant exchange then by drawing recruits from the same pools of migrants. Amazingly, three of the recruits sampled on Saipan (10%) were likely to have siblings that settled on Guam, suggesting that frequent migrant exchange on an ecological time scale occurs at least within the Marianas archipelago and probably further. From the perspective of mtDNA structure, Guam recruits were just as genetically undifferentiated with adults from Tonga as they were with adults from Guam. Further evidence that suggests migrant exchange occurs beyond the Marianas is the large number of private alleles observed (Table 4). Some of these may have naturally low frequencies, or be underrepresented in the data due to sampling bias. Alternatively it is also possible that some of these recruits are migrants originating in populations where these alleles were not so rare.

Recent studies propose that both self-recruitment and dispersal are important demographic processes for marine organisms (Planes *et al.* 2009; Jones *et al.* 2009). A recent study of a highly dispersive species, the Caribbean spiny lobsters, revealed a bimodal dispersal kernel, where ~60% of recruits settle < 450 km from where they were spawned and ~22% were predicted to disperse over 1000 km, with few at intermediate distances (Butler *et al.* 2011). A bimodal dispersal kernel for the *N. unicornis* population on Guam seems not only plausible but necessary, because habitat at a distance between 300 -1000 km is scarce. Hypothetically, dispersal of just over 1000 km in *N. unicornis* puts many areas in range of Guam: Iwo Jima and the Ogasawara islands to the north, Yap and Palau to the southwest, the Caroline islands and Pohnpei to the southeast. Dispersal on the order of 2000 km puts Guam within reach of the Philippines, New Guinea, Okinawa and the Marshall islands. Previous studies have shown the maximum dispersal potential for *Naso* species is indeed much greater because some species have been reported as strays across the 5000 km expanse of the East Pacific Barrier (Randall 2002). Therefore, recruits sampled in this survey could have come from a large number of areas, especially

those lying to the east from which the north equatorial current flows (see Eble *et al.* in press).

CONCLUSIONS AND RECOMMENDATIONS

- Massive recruitment events of the blue spine unicornfish, *N. unicornis* are genetically diverse assemblages of offspring from many spawning events and are not the progeny of a few fecund adults with skewed reproductive fitness.
- Our genetics results suggests that some of these recruits maintain close proximity to siblings throughout the larval phase and settlement but that not all kin settle together.
- Kinship relationships between recruits exist between year classes suggesting that reproductive success from year to year is not purely stochastic.
- Evidence for self-recruitment on Guam was not strong but a portion of recruits are likely to have been spawned locally. This suggests that both self-recruitment and dispersal are demographically significant in this species, as has been proposed for other reef fishes (Planes *et al.* 2009).
- Isolated adult populations of *N. unicornis* in the southern Mariana Is archipelago almost certainly exchange migrants directly. We demonstrate it is possible to observe kinship in a highly dispersive coral reef fish species at a spatial scale of hundreds of km.
- A bi-modal dispersal kernel for this species is highly probable with recruits sourced from any number of areas within a 1000-2000 km radius of Guam.
- Spatially, *N. unicornis* appears to have unstructured populations across its entire Indo-Pacific range in a pattern that resembles panmixia. Genetic exchange at a large spatial scale is probably common for this species.
- Management of a widely dispersed exploited species like *N. unicornis* that crosses international boundaries remains a challenge for local resource agencies. On Guam where populations of *N. unicornis* rely partially on self-recruitment, input controls implemented at the local level (e.g. minimum size limits based on size at first reproduction) safeguards the production of the next generation for this species
- .For *N. unicornis*, a widely dispersed species with a demographically open population, Marine Protected Area's would be most effective if implemented at a broad geographic scale – e.g. across Micronesia and the western Pacific. This would, however, require collaboration at the regional level, similar to that of the Micronesia Challenge.

ACKNOWLEDGEMENTS

Funding for the majority of this work was provided by the Sport Fish Restoration Fund program through Guam's Division of Aquatic and Wildlife Resources (DAWR)(grant F14-R-9). We thank Mark Priest, Alyssa Marshall and Sheena Abellana for their assistance with sample collection. Special thanks to Lyn van Herwerden from James Cook University for providing the infrastructure to do the genetics work.

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Annual Project Performance Report
Guam Division of Aquatic and Wildlife Resources (GDAWR)
FY 2011

1. State: Territory of Guam

Grant number: F-14-R-10

Grant name: Guam Sport Fish Investigations

Project number and name: F-14-R-10. Assessing Patterns of Movement, Recruitment, and Spawning Frequency of *Lethrinus harak* in Relation to Guam's Marine Preserves

2. Report Period: October 1, 2010 to September 30, 2011

Report due date: January 30, 2012

3. Location of work: Guam, Island-Wide, Focused in Piti Marine Preserve

4. Costs: Please identify sources of federal funds and match and indicate amounts budgeted and spent for each. Indicate if match is in-kind. Indicate in table whether costs are "Actual" or "Estimated"

Source	Budgeted	Actual <u>X</u> or Estimated <u> </u>
Federal : Sport Fish Restoration	\$132,195.00	\$138,079.00
State	-0-	- 0 -
Other: _____	-0-	- 0 -

Total Federal	\$132,195.00	\$138,079.00
Total match	-0-	-0-
Total project:	\$132,195.00	\$138,079.00

5. Objectives:

1. Establish a contract between the University of Guam Marine Laboratory (UOGML) and Department of Agriculture through the signing of a Memorandum of Understanding (by January 2009)
2. To determine movement distances and quantify population estimates of *Lethrinus harak* within the marine preserves we will use a mark-release-resighting technique which involves visual census of individuals tagged with elastomer tags within the

boundaries of Achang and Piti marine preserves. This will also enable us to identify sex-specific patterns of movement and habitat.

3. We will use a remote acoustic tagging method which includes deploying an array of receivers along the Achang and Piti marine preserve boundaries to quantify movement patterns, residency times and home range size of individually tagged *L. harak* over a 2 year period.
4. Establishing the frequency and timing of spawning is often the first step in a population assessment of an exploited reef fish species. We will use a non-destructive sampling method to observe changes in gonad stages of female individuals over a twelve month period with sampling intensified (every few days) during suspected times of spawning.
5. We will determine the timing, frequency, and habitat specificity of recruitment using fortnightly surveys over a twelve month period and back-calculation of otolith daily increments from juvenile specimens collected throughout the project's duration.

6. If the work in this grant was part of a larger undertaking with other components and funding, present a brief overview of the larger activity and the role of this project.

N/A

7. Describe how the objectives were met.

Objective 1:

The processing of the Memorandum of Understanding began April 2009 and was completed when signed by Governor Felix Camacho on 12 May 2009.

Objective 2:

Data for movement patterns and distances and home range estimates have been collected using ultrasonic acoustic telemetry in Piti Marine Preserve based on 18 tagged individuals ranging in size from 19 to 32 cm FL. These data are presently being analyzed, but preliminary results suggest that *Lethrinus harak* individuals have relatively small home ranges within the reef flat at Piti and high site fidelity.

Objective 3:

An array of VEMCO VR2W remote acoustic receivers was successfully deployed in Piti Marine Preserve, covering ~70% of the site. *A priori* and *in situ* range testing ensured that tagged fish within the array were recorded $\geq 95\%$ of the time, with a mean maximum range of 120 m per receiver. Preliminary results from the tagging experiment have successfully identified movement patterns and quantified home ranges of *Lethrinus harak* (see response to objective 2). We have also determined that movement across MPA boundaries is unlikely, which ensures sufficient protection of this population and likely other populations at the other protected sites.

Objective 4:

We have pinpointed the timing, duration, and location of spawning within the Piti Marine Preserve. Mature individuals are leaving their limited home range sites on the reef flat and migrating out of the northernmost channel nightly between full moon and last quarter moon each month. Individuals appear to convene just offshore of receiver 105889 (Figure 1) and remain there throughout the night, returning to their respective home ranges before sunrise. We strongly suspect this migration is for spawning purposes and ongoing efforts are aimed at verifying this. The spawning and reproductive data, coupled with demographic data from previous work, lends itself conveniently for future modeling to predict the relative contribution of marine preserves to island-wide reproductive potential, which we suspect is high. In 2011, we have continued sampling of mature individuals around various moon phases for verification of spawning periods.

Objective 5:

The timing and frequency of recruitment is ongoing but much has been inferred from the reproductive timing results derived from the acoustic telemetry component.

8. Discuss differences between work anticipated in grant proposal and grant agreement, and that actually carried out with Federal Aid grant funds; include differences between expected and actual costs.

N/A

9. List any publications or in-house reports resulting from this work.

Two peer-review publications are in preparation. The first paper models the impacts of various management scenarios on *Lethrinus harak* demography in light of the recent legislation which aims to alter the status of the marine preserves. The second paper focuses on movement patterns, home range, and spawning migrations of *Lethrinus harak*. The findings of the second paper will be presented at the 12th International Coral Reef Symposium in Cairns, Australia, in July 2012.

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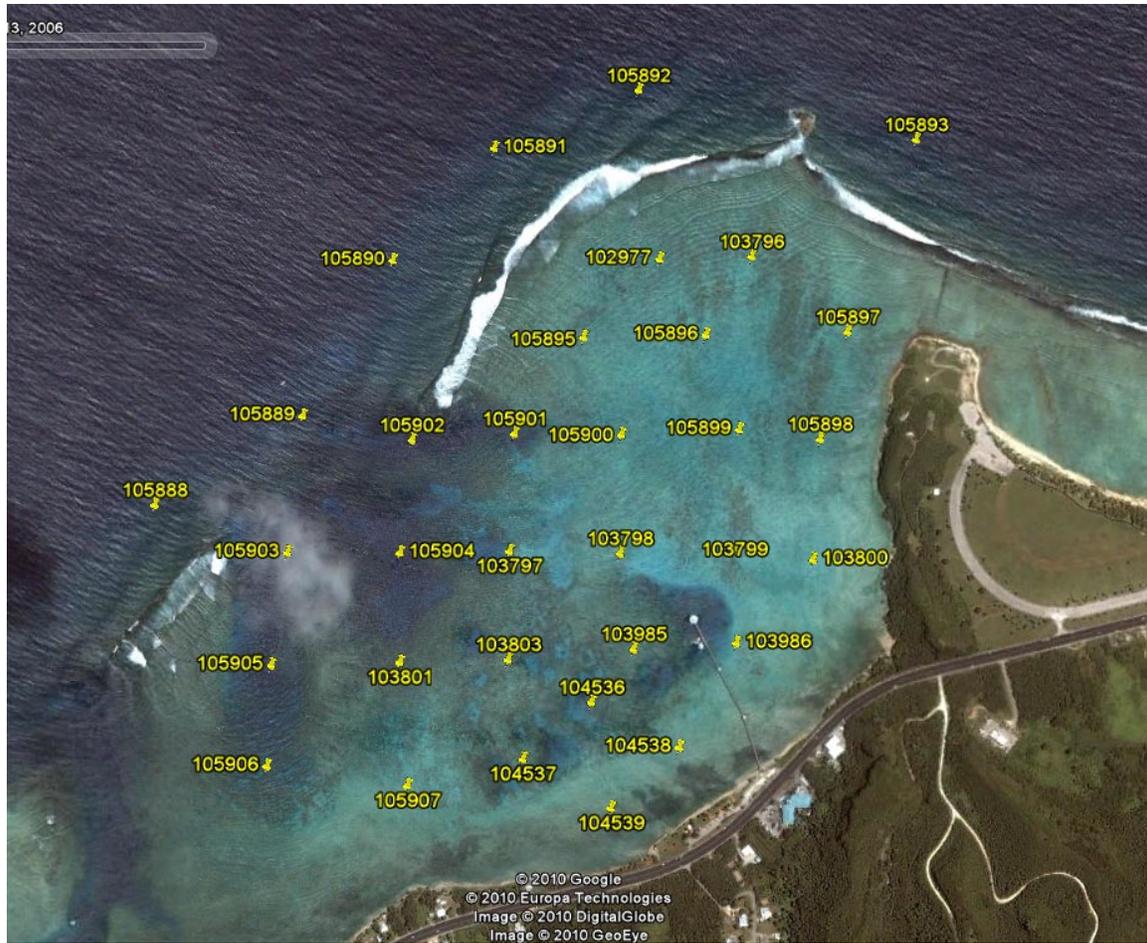


Figure 1. Map of Piti Marine Preserve showing locations of receivers and receiver codes.

Annual Project Performance Report
 Guam Division of Aquatic and Wildlife Resources (GDAWR)
 FY 2011

1. State: Territory of Guam

Grant number: F-14-R-18

Grant name: Guam Sport Fish Investigations

Project number and name: F-14-R-18. Quantifying and assessing the effects of sedimentation on fish abundance, fish diversity, and benthic habitats including corals-
 Unfunded

2. Report Period: October 1, 2010 to September 30, 2011

Report due date: January 30, 2012

3. Location of work: Guam, Island-Wide, Focused in Piti Marine Preserve

4. Costs: Please identify sources of federal funds and match and indicate amounts budgeted and spent for each. Indicate if match is in-kind. Indicate in table whether costs are “Actual” or “Estimated”

Source	Budgeted	Actual <u>X</u> or Estimated <u> </u>
Federal : Sport Fish Restoration	-0-	-0-
State	-0-	- 0 -
Other: _____	-0-	- 0 -

Total Federal	-0-	-0-
Total match	-0-	-0-
Total project:	-0-	-0-

5. Objectives:

1. Establish a memorandum of understanding with the University of Guam and the Department of Agriculture. (Completed)
2. Establish 19 and 17 fixed sites at Asan and Piti respectively to include the rivers for a total of 36 permanent sites (Fig. 1).
3. Build and deploy/retrieve (monthly) sediment traps for each fixed site, analyze sediment for weight, percent terrestrial composition, and size class.

4. Select 15-20 sites from the 36 permanent sites which adequately represent the gradient of sedimentation and establish three fixed 15 m transects at each.
5. Deploy turbidity loggers and temperature/light loggers at each of the fixed transect sites.
6. Deploy a weather station to log rain, wind, temperature, and light parameters in the Asan/Piti area for the duration of the sediment study.
7. Conduct two sets of fish counts on the fixed transects, one at 6 months and a final at 12 months.
8. Conduct two sets of benthic surveys using photo transect methods for a selection fixed transects, one at 6 months and a final at 12 months.
9. Indicator species analysis and evaluation of species' ability to cope with the effects of sedimentation through *in situ* observations and laboratory experiments using PAM fluorescence.
10. Re-evaluate existing data sets from reef communities around Guam to validate the developed sediment tolerance classification of reef biota and to determine local effects of sedimentation around Guam.
11. Compare sediment data obtained in the current study with archived sediment data from War in the Pacific National Historical Park and other past and present studies in the Asan/Piti area.
12. Report, publish, and present on the impact of land-based sedimentation on coral reef fish and benthos.

6. If the work in this grant was part of a larger undertaking with other components and funding, present a brief overview of the larger activity and the role of this project.

N/A

7. Describe how the objectives were met.

The objectives were not met for this reporting period because, although the grant was approved in FY2011, no funds were available for the project.

8. Discuss differences between work anticipated in grant proposal and grant agreement, and that actually carried out with Federal Aid grant funds; include differences between expected and actual costs.

N/A

9. List any publications or in-house reports resulting from this work.

N/A

Name, title, phone number, and e-mail address of person compiling this report:

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GUAM
SPORT FISH INVESTIGATIONS
F-17-R-2 and F-19-E-2
ANNUAL PERFORMANCE REPORTS
FY 2011

January 28, 2012

Division of Aquatic and Wildlife Resources,
Department of Agriculture
163 Dairy Road
Mangilao, Guam 96913
671-735-3955/6

Freshwater Investigations F-17-E-2 and Fisheries Aquatic Education, F-19-E-

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Annual Project Performance Report

Guam Division of Aquatic and Wildlife Resources (GDAWR)
FY 2011

1. State: Territory of Guam

Grant number: F-17-R-2

Grant name: Guam Freshwater Sport Fish Investigations

Project number and name: F-17-R-2. Project 1. Freshwater Monitoring Program.

2. Report Period: October 1, 2010 to September 30, 2011

Report due date: December 29, 2011, Extended to January 30, 2012

3. Location of work: Island of Guam

4. Costs:

Source	Budgeted	Actual ___or Estimated__ X__
Federal : _____	\$42,968.00	\$37,454.00
State		
Other: _____		

Total Federal	\$42,968.00	\$37,454.00
Total match		
Total project:	\$42,968.00	\$37,454.00

5. Objectives:

1. To monitor the freshwater fishery resource of Guam by monitoring seven rivers once per year in three watersheds for analysis and comparison between watersheds.
2. To develop a recreational fishery based on native species in Guam's rivers by collecting biological information on all of Guam's rivers.
3. To develop educational material to heighten public interest in native species found in freshwater ecosystems.

6. If the work in this grant was part of a larger undertaking with other components and funding, present a brief overview of the larger activity and the role of this project. N/A

7. Describe how the objectives were met.

Surveys were conducted in seven streams to determine the effect a dam has on tropical river fauna (Masso 1/5/2011, Matgue 1/5/11, Cetti 2/15/2011, Ylig 3/23/2011, Sella 4/20/2011, Tonguam 9/10/2011, and Geus 9/27/2011). In order to determine species composition, organism density, and habitat characteristics, visual surveys and physical data collections were conducted in randomly chosen quadrats, in both experimental (impacted by the dam) and control (not affected by the dam) rivers. Data was entered into a spreadsheet so statistical analyses can be performed to compare data between experimental and control sites and within baseline data collected in FY97.

Several additional rivers in which the freshwater fauna was unknown were surveyed, and the data collected and entered into a database (See attached assessment sheet). The goal of this survey is to produce a comprehensive inventory of Guam's freshwater biological resources, and to provide a baseline for future environmental work in the rivers.

The report provides a brief summary of the freshwater fishery projects for Guam in FY 11. The Division of Aquatic and Wildlife Resources (GDAWR) will complete a more thorough report.

- 8. Discuss differences between work anticipated in grant proposal and grant agreement, and that actually carried out with Federal Aid grant funds; include differences between expected and actual costs.** Not all seven rivers monitored annually could be surveyed during FY 2011. Heavy rains of near 50% above average through much of the year caused poor visibility in the rivers, making visual surveys impossible. Frequently, heavy rains caused river water levels and flow rates to be unsafe for surveys to be conducted. Additionally, completion of the Masso reservoir project took a large amount of freshwater fisheries staff time.
- 9. List any publications or in-house reports resulting from this work.** None

Name, title, phone number, and e-mail address of person compiling this report:

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Annual Project Performance Report

Guam Division of Aquatic and Wildlife Resources (GDAWR)
FY 2011

1. State: Territory of Guam

Grant number: F-17-R-2

Grant name: Guam Freshwater Sport Fish Investigations

Project number and name: F-17-R-2. Project 2. Fisheries Studies in Fena Lake

2. Report Period: October 1, 2010 to September 30, 2011

Report due date: December 29, 2011, Extended to January 30, 2012

3. Location of work: Island of Guam

4. Costs:

Source	Budgeted	Actual <u>X</u> or Estimated _____
Federal : _____	\$2,158.00	\$0.00
State		
Other: _____		

Total Federal	\$2,158.00	\$0.00
Total match		
Total project:	\$2,158.00	\$0.00

5. Objectives:

Monitor the freshwater fishery in Fena Reservoir by conducting a stock assessment, using electrofishing and mark-recapture methodology to determine species density, and other environmental parameters.

6. If the work in this grant was part of a larger undertaking with other components and funding, present a brief overview of the larger activity and the role of this project. N/A

7. Describe how the objectives were met. Due to ongoing access issues with the Navy, work on this project was not completed in 2011. The Navy requires a 15-day advance notice and an escort in order to conduct surveys. The requirement is too restrictive because when surveys have to be rescheduled due to rain, for example, the department

has to submit another 15-day notice. Furthermore, surveys are dependent on the availability of an escort.

8. Discuss differences between work anticipated in grant proposal and grant agreement, and that actually carried out with Federal Aid grant funds; include differences between expected and actual costs. N/A

9. List any publications or in-house reports resulting from this work. None

Name, title, phone number, and e-mail address of person compiling this report: This report was prepared by R. Brent Tibbatts. Fisheries Biologist II, Telephone number 735-3987. E-mail- brent.tibbatts@gmail.com
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Annual Project Performance Report

Guam Division of Aquatic and Wildlife Resources (GDAWR)
FY 2011

1. State: Territory of Guam

Grant number: F-17-R-2

Grant name: Guam Freshwater Sport Fish Investigations

Project number and name: F-17-R-2. Project 3. Masso Reservoir Fisheries Monitoring

2. Report Period: October 1, 2010 to September 30, 2011

Report due date: December 29, 2011, Extended to January 30, 2012

3. Location of work: Island of Guam

4. Costs:

Source	Budgeted	Actual <u>X</u> or Estimated <u> </u>
Federal : _____	\$26,775	\$39,130
State		
Other: _____		

Total Federal	\$26,775	\$39,130
Total match		
Total project:	\$26,775	\$39,130

5. Objectives:

To monitor the freshwater fishery resource in Masso reservoir and to develop a management plan for recreational fishery on the lake by conducting mark-recapture studies on a yearly basis to collect biological information of the freshwater fisheries resource.

6. If the work in this grant was part of a larger undertaking with other components and funding, present a brief overview of the larger activity and the role of this project. N/A

7. Describe how the objectives were met.

During 2011, 197 *Kuhlia rupestris*, 63 shrimp, 4 eels, and a sleeper goby were relocated

or stocked into the Masso reservoir during the construction phase of the project when there was no activity or when activity was slow. Staff made many visits to the reservoir to remove the water thyme (*Hydrilla*) from the reservoir. The reservoir is covered with the water thyme and staff are removing it to encourage more native growth within the reservoir. Furthermore, staff removed trash debris from the reservoir to enhance the beauty of the reservoir.

8. Discuss differences between work anticipated in grant proposal and grant agreement, and that actually carried out with Federal Aid grant funds; include differences between expected and actual costs. N/A

10. List any publications or in-house reports resulting from this work. None

Name, title, phone number, and e-mail address of person compiling this report: This report was prepared by Jay T. Gutierrez, Assistant Chief, (671) 735-3980, jaytgutierrez@yahoo.com

Rivers	Native Species	Introduced Species	Habitat	Date Surveyed	GPS
1. Achang	Fish <i>Ellechelon vaigiensis</i> <i>Kuhlia rupestris</i> <i>Moolgarda engeli</i> <i>Periophthalmus argentilineatus</i> <i>Zenarchopterus dispar</i>	No Record	<ul style="list-style-type: none"> limited channelization moderately developed area, lots of trash 		
2. Agaga	No Record	No Record	<ul style="list-style-type: none"> adjacent to cleared area, evidence of soil erosion 		
3. Agana	Fish <i>Anguilla bicolor?</i> <i>Anguilla marmorata</i> <i>Awaous guamensis</i> <i>Eleotris fusca</i> <i>Ellechelon vaigiensis</i> <i>Kuhlia rupestris</i> <i>Neomyxus leuciscus</i> <i>Stiphodon</i> sp. <i>Taenioides limicola</i> <i>Zenarchopterus dispar</i> Invertebrates <i>Macrobrachium lar</i>	Fish <i>Clarias batrachus</i> <i>Cyprinus carpio</i> <i>Gambusia affinis</i> <i>Oreochromis mossambicus</i> <i>Poecilia reticulata</i> <i>Tilapia zillii</i> Plants <i>Eichornia crassipes</i> <i>Hydrilla verticillata</i>	<ul style="list-style-type: none"> channelized heavily developed area 		

<p>4. Agfayan</p>	<p>Fish <i>Anguilla marmorata</i> <i>Eleotris fusca</i>* <i>Kuhlia rupestris</i> <i>Lutjanus argentimaculatus</i> <i>Mugilogobius cavifrons</i> <i>Periophthalmus argentilineatus</i> <i>Stiphodon sp.</i> <i>Taeniodes limicola</i> <i>Zenarchopterus dispar</i> Invertebrates <i>Caridina sp.</i>* <i>Macrobrachium lar</i>* <i>Scylla serrata</i> <i>Nerites</i> Plants <i>Nypa fruticans</i></p>	<p>Fish <i>Gambusia affinis</i> <i>Oreochromis mossambicus</i></p>	<ul style="list-style-type: none"> • aquaculture ponds adjacent to river • agricultural encroachment • dredge/fill intrusion from road construction 	<p>6-16-08 unnamed trib to Acfayan EMAP*</p>	
<p>5. Aguada</p>	<p>Fish <i>Anguilla marmorata</i> <i>Sicyopus sp.</i> Invertebrates <i>Atyoida pilipes</i> <i>Caridina sp.</i> <i>Melanooides tuberculata</i> <i>Neritina pettiti</i> Mayfly larvae Dragonfly larvae Pyralid caterpillars</p>	<p>No Record</p>	<ul style="list-style-type: none"> • Area burns regularly 	<p>2-25-08</p>	<p>EMAP- near Navy tank farm</p>

<p>6. Ajayan</p>	<p>Fish <i>Anguilla marmorata</i> <i>Eleotris fusca</i> <i>Ellechelon vaigiensis</i> <i>Kuhlia rupestris</i> <i>Lutjanus argentimaculatus</i> <i>Moolgarda engeli</i> <i>Periophthalmus argentilineatus</i> <i>Sicyopterus lagocephalus</i> <i>Stenogobius sp.</i> <i>Stiphodon sp.</i> Invertebrates <i>Macrobrachium lar</i> <i>Varuna littorata</i> <i>Neritina variegata</i> snails in the family Neritidae snails in the family Thiaridae Plants <i>Nypa fruticans</i></p>	<p>Amphibians <i>Bufo marinus</i> <i>Rana sp.</i> Fish <i>Gambusia affinis</i> <i>Channa striata</i> <i>Oreochromis mossambicus</i> Invertebrates <i>Pila conica</i> Plants <i>Hydrilla verticillata</i></p>	<ul style="list-style-type: none"> heavy siltation from grass fires 	<p>4-7-05</p>	
<p>7. Alatgue</p>	<p>No Record</p>	<p>No Record</p>	<ul style="list-style-type: none"> drains into the La Sa Fua River 		

<p>8. Almagosa</p>	<p>Fish <i>Anguilla marmorata*</i> <i>Awaous guamensis*</i> <i>Mugilogobius cavifrons*</i> <i>Sicyopterus lagocephalus*</i> <i>Stiphodon sp.*</i> Invertebrates <i>Atyoida pilipes</i> <i>Macrobrachium lar</i> <i>Thiara granifera</i> Insects <i>Corixidae</i> <i>Pyralidae</i> Plants <i>Ceratopteris gaudichaudii</i></p>	<p>Fish <i>Cichla ocellaris</i> <i>Gambusia affinis</i> <i>Oreochromis mossambicus</i> <i>Tilapia zillii</i> Amphibians <i>Bufo marinus</i> Invertebrates <i>Physalid snails</i> Plants <i>Hydrilla verticillata</i> <i>Lemna minor</i></p>	<ul style="list-style-type: none"> • located on restricted naval property, little human impact • drains into Fena Lake • Thiarids abundant below waterfall, none found above waterfall • On 5/18/05, reservoir was approximately 12 feet below spillway • On 8-1-07, reservoir was approximately 18 feet below spillway • Lemna and physalids first seen 8/1/07 • Lemna and physalids widespread 6/19/08 • Flatworms? common 6/19/08 • Atyids gravid 6/29/10 	<p>04/19/04 06/19/08*</p>	<p>N 13.25.518 E 144.61.280 gauging station at top of falls</p>
<p>9. Aplacho</p>	<p>Fish <i>Anguilla marmorata</i> <i>Awaous guamensis</i> <i>Eleotris fusca</i> <i>Kuhlia rupestris</i> <i>Sicyopterus lagocephalus</i> Invertebrates <i>Caridina sp.</i> <i>Macrobrachium lar</i> <i>Nerites</i> <i>Thiarids</i></p>	<p>Fish <i>Poecilia reticulata</i> Amphibians <i>Bufo marinus</i> Reptiles <i>Trachemys scripta elegans</i> Plants <i>Hydrilla verticillata</i> Invertebrates <i>Physalid snails.</i></p>	<ul style="list-style-type: none"> • drains into the Atantano Wetland • concrete spillway approximately 10 feet high under bridge at Shell refinery • human debris i.e. tires, concrete, trash in river above bridge 	<p>02/12/04</p>	<p>N 13.24.889' E 144.40.931' (at road going to Shell refinery) survey was conducted in an area approximately 30 meters downstream of the road to a site approximately 150 meters upstream from the bridge.</p>

<p>10. As Cola Sito</p>	<p>Fish <i>Anguilla marmorata</i> <i>Awaous guamensis</i> <i>Eleotris fusca</i> <i>Kuhlia rupestris</i> <i>Stenogobius sp.</i> <i>Stiphodon sp.</i> Invertebrates <i>Macrobrachium lar</i> <i>Neritina pulligera</i> <i>Neritina variegata</i> <i>Neritina sp.</i></p>	<p>Amphibians <i>Bufo marinus</i></p>	<ul style="list-style-type: none"> • drains into the Nengilao River • unnamed tributary was surveyed for EMAP 	<p>Surveyed with EMAP 5-1-07</p>	
<p>11. Asalonso</p>	<p>Fish <i>Anguilla marmorata</i> <i>Awaous guamensis</i> <i>Awaous ocellaris</i> <i>Eleotris fusca</i> <i>Kuhlia rupestris</i> <i>Stiphodon sp.</i> <i>Sicyopterus lagocephalus</i> Invertebrates <i>Macrobrachium lar</i> <i>Neritina pettiti</i> <i>Caridina typus</i> <i>Varuna littorata</i> Plants <i>Nypa fruticans</i></p>	<p>Fish <i>Oreochromis mossambicus</i> Amphibians <i>Bufo marinus</i> <i>Rana sp.</i></p>	<ul style="list-style-type: none"> • Drains into Asalonso Bay • Asphalt debris from Route 4 in river from typhoon flooding • tech. report? • No Thiarids found!! 	<p>1-27-04</p>	<p>N 13.19.738 E 144.45.738 (where river runs under Route 4) Survey was conducted from a site approximately 400 meters downstream of the road and continued for an additional 100 meters downstream.</p>

<p>12. Asan</p>	<p>Fish <i>Anguilla marmorata</i> <i>Eleotris fusca</i> <i>Stenogobius sp.</i> <i>Stiphodon sp.</i> <i>Kuhlia rupestris</i> Invertebrates <i>Atyoida pilipes</i> <i>Caridina mertoni</i> <i>Caridina typus</i> <i>Macrobrachium lar</i> <i>Macrobrachium latidactylus?</i> <i>Neritina petiti</i> <i>Neritina pulligera</i> <i>Neritina variegata</i> <i>Septaria porcellana</i> <i>Thiara granifera</i> <i>Varuna littorata</i> Insects <i>Paraplea puella</i> Plants <i>Chara sp.</i></p>	<p>Fish <i>Oreochromis mossambicus.</i></p>	<ul style="list-style-type: none"> • channelized • heavily developed area • Atyids gravid 1-26-2010 		
<p>13. Asdonao</p>	<p>No Record</p>	<p>No Record</p>	<ul style="list-style-type: none"> • no record 		
<p>14. Asgadoo</p>	<p>No Record</p>	<p>No Record</p>	<ul style="list-style-type: none"> • no record 		
<p>15. Aslinget</p>	<p>No Record</p>	<p>No Record</p>	<ul style="list-style-type: none"> • drains into the Pauliluc River 		

<p>16. Asmafines</p>	<p>Fish <i>Anguilla marmorata</i> <i>Awaous guamensis</i> <i>Kuhlia rupestris</i> <i>Sicyopterus</i> <i> lagocephalus</i> <i>Sicyopus</i> sp. <i>Stenogobius</i> sp. <i>Stiphodon</i> sp. <i>Stiphodon</i> <i>percnopterygionus</i> Invertebrates <i>Atyoida pilipes</i> <i>Caridina nilotica</i> <i>Caridina serratiostris</i> <i>Caridina typus</i> <i>Caridina weberi</i> <i>Macrobrachium lar</i> snails in the family Neritidae snails in the family Thiaridae</p>	<p>No Record</p>	<ul style="list-style-type: none"> • fairly remote • frequent wild land fires contribute to soil erosion in the area 		
<p>17. Asmaile</p>	<p>No Record</p>	<p>No Record</p>	<ul style="list-style-type: none"> • intermittent 		
<p>18. Astaban</p>	<p>No Record</p>	<p>No Record</p>	<ul style="list-style-type: none"> • drains into the Madog River 		

<p>19. Atantano</p>	<p>Fish <i>Ambassis buruensis</i>* <i>Eleotris fusca</i>* <i>Kuhlia rupestris</i>* <i>Lutjanus fulvus</i> <i>Monodactylus argenteus</i>* <i>Moolgarda seheli</i>* <i>Mugilogobius cavifrons</i>* <i>Periophthalmus argentilineatus</i> <i>Redigobius bikolanus</i>* <i>Stenogobius sp.*</i> <i>Zenarchopterus dispar</i> Invertebrates <i>Caridina serratirostris</i>* <i>Caridina sp.*</i> <i>Macrobrachium lar</i>* <i>Neritina squamipicta</i>* <i>Thiara granifera</i>* Plants <i>Nypa fruticans</i> <i>Avicennia alba</i> <i>Rhizophora apiculata</i></p>	<p>Fish <i>Gambusia affinis</i> <i>Poecilia reticulata</i>* Amphibians <i>Bufo marinus</i>* Invertebrates <i>Leeches</i>* Plants <i>Hydrilla verticillata</i>*</p>	<ul style="list-style-type: none"> • largest and best developed mangrove swamp on Guam • channelized • impacts from adjacent shipping, docking, and oil refinery facilities • Atyids gravid* • Glassfish abundant • Redigobius abundant 	<p>3/6/06 EMAP*</p>	<p>N 13.420016 E 144.680797 Where the Atantano and Tenjo meet.</p>
<p>20. Atate</p>	<p>No Record</p>	<p>No Record</p>	<ul style="list-style-type: none"> • drains into the Ugum River 		
<p>21. Auau</p>	<p>No Record</p>	<p>No Record</p>	<ul style="list-style-type: none"> • no record 		
<p>22. Big Guatali</p>	<p>No Record</p>	<p>Fish <i>Oreochromis mossambicus</i></p>	<ul style="list-style-type: none"> • drains into Atantano River (may have similar fauna that is unrecorded) 		

23. Bile	Fish <i>Anguilla marmorata</i> <i>Awaous guamensis</i> <i>Kuhlia rupestris</i> <i>Lutjanus argentimaculatus</i> <i>Stiphodon sp.</i> Invertebrates <i>Macrobrachium lar</i>	No Record Amphibians <i>Bufo marinus</i>	<ul style="list-style-type: none"> • no record 		
24. Bolanos	No Record	No Record	<ul style="list-style-type: none"> • drains into the Laelae River 		
25. Bonya	Invertebrates <i>Atyoida pilipes</i> <i>Atyopsis spinipes</i> <i>Caridina typus</i> <i>Macrobrachium lar</i>	No Record	<ul style="list-style-type: none"> • probably somewhat impacted by carabao (runs through Morrow Lake, a known carabao wallow) • drains into the Tolaeyuus River 		
26. Bubulao	Fish <i>Anguilla marmorata</i> <i>Awaous guamensis</i> <i>Sicyopus sp.</i> <i>Stiphodon sp.</i> Invertebrates <i>Caridina sp.</i> <i>Macrobrachium lar</i>	No Record	<ul style="list-style-type: none"> • remote • surrounded by private land, some agricultural impacts • drains into the Ugum River 		

<p>27. Cetti</p>	<p>Fish <i>Anguilla marmorata</i> <i>Awaous guamensis</i> <i>Awaous ocellaris</i> <i>Chanos chanos</i> <i>Eleotris fusca</i> <i>Ellechelon vaigiensis</i> <i>Kuhlia rupestris</i> <i>Lutjanus argentimaculatus</i> <i>Monodactylus argenteus</i> <i>Plectrorhinchus albovittatus</i> <i>Sicyopterus lagocephalus</i> <i>Sicyopus sp.</i> <i>Stenogobius sp.</i> <i>Stiphodon sp.</i> Invertebrates <i>Atyoida pilipes</i> <i>Atyopsis spinipes</i> <i>Caridina typus</i> <i>Clithon corona</i> <i>Clithon sowerbyana</i> <i>Macrobrachium lar</i> <i>Melanoides tuberculata</i> <i>Neritina auriculata</i> <i>Neritina pettiti</i> <i>Neritina pulligera</i> <i>Neritina squamipicta</i> <i>Neritina turrata</i> <i>Neritina variegata</i> <i>Stenomelania plicaria</i> Plants <i>Nypa fruticans</i></p>	<p>No Record Amphibians <i>Bufo marinus</i></p>	<ul style="list-style-type: none"> • remote • some human impacts from a campsite near the mouth • <i>Stiphodon</i>, <i>Macrobrachium</i>, thiarids and atyids found above road 3-12-07 • Atyids gravid- 3-12-07 • Small <i>Kuhlia</i> abundant 1-27-08 		
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28. Chagame	No Record	No Record	<ul style="list-style-type: none"> drains into the La Sa Fua River 		
29. Chaligan	Fish <i>Kuhlia rupestris</i> <i>Moolgarda engeli</i> fish in the family Gerridae	Fish <i>Oreochromis</i> <i>mossambicus</i>	<ul style="list-style-type: none"> relatively undisturbed 		
30. Chaot	Fish <i>Anguilla bicolor</i> * <i>Anguilla marmorata</i> <i>Awaous guamensis</i> <i>Eleotris fusca</i> <i>Stiphodon</i> sp. Invertebrates <i>Macrobrachium lar</i>	Fish <i>Clarias batrachus</i> * <i>Cyprinus carpio</i> <i>Gambusia affinis</i> <i>Oreochromis</i> <i>mossambicus</i> <i>Poecilia reticulata</i> <i>Tilapia zillii</i> * Reptiles <i>Trachemys scripta</i> <i>elegans</i> * Invertebrates <i>Pila conica</i> * Plants <i>Hydrilla verticillata</i>	<ul style="list-style-type: none"> drains into Agana Wetland 	<p>Surveyed on 8-16-04 under Route 4 bridge</p> <p>Surveyed pond where oil spill had taken place, near San Miguel school 9-6-06*</p>	
31. Dante	No Record	No Record	<ul style="list-style-type: none"> drains into the Inarajan River 		
32. Fensol	No Record	No Record	<ul style="list-style-type: none"> drains into the Laolao River 		
33. Finile	Fish <i>Anguilla marmorata</i> <i>Sicyopus</i> sp. <i>Stiphodon</i> sp. Invertebrates <i>Atyoida pilipes</i> <i>Caridina nilotica</i> <i>Macrobrachium lar</i> <i>Nerites</i> <i>Septaria porcellana</i> <i>Thiara granifera</i>	Fish <i>Poecilia reticulata</i>	<ul style="list-style-type: none"> no record 	<p>Surveyed with EMAP on 4-30-07</p>	

34. Fintasa	Fish <i>Anguilla marmorata</i> <i>Awaous guamensis</i> <i>Eleotris fusca*</i> Invertebrates <i>Caridina</i> sp. <i>Macrobrachium lar</i>	No Record	<ul style="list-style-type: none"> • drains into the Laolao River 	Surveyed on 10-6-01 during DPR boonie stomp * Surveyed with E-Map 3-17-09	
35. Fonte	Fish <i>Anguilla bicolor</i> <i>Sicyopus</i> sp.	Fish <i>Poecilia reticulata</i> <i>Oreochromis mossambicus</i>	<ul style="list-style-type: none"> • a dam was constructed in 1910 • headwaters: less developed • lower reaches flow through the village of Maina, popular swimming area 		
36. Gaan	Fish <i>Kuhlia rupestris</i> <i>Moolgarda engeli</i> Invertebrates <i>Caridina</i> sp. <i>Macrobrachium lar</i>	No Record	<ul style="list-style-type: none"> • lots of trash • very limited flow • heavily developed area 		

<p>37. Geus</p>	<p>Fish <i>Anguilla marmorata</i> <i>Awaous guamensis</i> <i>Kuhlia rupestris</i> <i>Sicyopterus</i> <i> lagocephalus</i> <i>Sicyopus sp.</i> <i>Stiphodon sp.</i> Invertebrates <i>Atyoida pilipes</i> <i>Caridina spp.</i> <i>Macrobrachium lar</i> <i>Macrobrachium</i> <i> latidactylus</i> <i>Neritina petiti</i> <i>Neritina pulligera</i> <i>Neritina variegata</i> Insects Mayfly larvae Pyralid caterpillars Plants <i>Nypa fruticans</i></p>	<p>Fish <i>Gambusia affinis</i> <i>Oreochromis</i> <i> mossambicus</i> Amphibians <i>Bufo marinus</i> <i>Rana sp.</i> Plants <i>Monochoria vaginalis</i></p>	<ul style="list-style-type: none"> • some dredge/fill construction in the area • Adult Bufo, no tadpoles • Macrobrachium and Atyoida abundant in some pools (>50 per) 	<p>EMAP 3/20/06</p>	
<p>38. Guatali</p>	<p>Fish <i>Kuhlia rupestris</i> Invertebrates <i>Caridina sp.</i> <i>Macrobrachium lar</i></p>	<p>Fish <i>Poecilia reticulata</i> Amphibians <i>Bufo marinus</i></p>	<ul style="list-style-type: none"> • drains into the Atantano Wetland • rechannelized from road routing 	<p>04/09/04</p>	<p>N 13.25.518 E 144.41.280 Near tanks on the grounds of the Shell refinery</p>
<p>39. Ieygo</p>	<p>Fish <i>Awaous guamensis</i> <i>Sicyopus sp.</i> <i>Stiphodon sp.</i> Invertebrates <i>Atyoida pilipes</i> <i>Macrobrachium lar</i> <i>Neritina pulligera</i></p>	<p>No Record</p>	<ul style="list-style-type: none"> • drains into the Atate River 	<p>EMAP 4/8/2010</p>	

40. Imong	<p>Fish <i>Anguilla marmorata</i> <i>Awaous guamensis</i> <i>Stiphodon</i> sp. <i>Mugilogobius cavifrons</i></p> <p>Invertebrates <i>Caridina</i> sp. <i>Macrobrachium lar</i> snails in the family Thiaridae</p>	<p>Fish <i>Cichla ocellaris</i> <i>Oreochromis</i> <i>mossambicus</i> <i>Tilapia zillii</i> <i>Poecilia reticulata</i> <i>Gambusia affinis</i></p>	<ul style="list-style-type: none"> • located on restricted naval property, little human impact • drains into Fena Lake 		
41. Inarajan	<p>Fish <i>Anguilla marmorata</i> <i>Awaous guamensis</i> <i>Kuhlia rupestris</i> <i>Lutjanus</i> <i>argentimaculatus</i> <i>Sicyopterus</i> <i>lagocephalus</i> <i>Stiphodon</i> sp.</p> <p>Invertebrates <i>Atyoida pilipes</i> <i>Caridina nilotica</i> <i>Macrobrachium lar</i></p> <p>Plants <i>Nypa fruticans</i></p>	<p>Reptiles <i>Pelodiscus sinensis</i></p> <p>Fish <i>Gambusia affinis</i> <i>Oreochromis</i> <i>mossambicus</i></p>	<ul style="list-style-type: none"> • adjacent to developed area • adjacent to aquaculture facilities • floodplain used extensively for agriculture 		

42. La Sa Fua	Fish <i>Anguilla marmorata</i> <i>Sicyopterus lagocephalus</i> <i>Sicyopus sp.</i> <i>Stiphodon sp.</i> Invertebrates <i>Atyoida pilipes</i> <i>Caridina longirostris</i> <i>Macrobrachium lar</i> <i>Thiarids</i> Plants <i>Nypa fruticans</i>	No Record	<ul style="list-style-type: none"> no record 	3/27/06	
43. Laelae	No Record	No Record	<ul style="list-style-type: none"> drains into the Umatac River 		
44. Laolao	Fish <i>Awaous guamensis</i> <i>Eleotris fusca</i> <i>Stiphodon sp.</i>	Amphibians <i>Bufo marinus</i> <i>Rana guentheri</i>	<ul style="list-style-type: none"> drains into the Inarajan River 	3/17/2010 Surveyed with freshwater bio-security team.	
45. Laguan	No Record	No Record	<ul style="list-style-type: none"> drains into the Chagame River 		
46. Laguas	Fish <i>Periophthalmus argentilineatus</i> Invertebrates <i>Caridina sp.</i> Leeches <i>Macrobrachium lar</i> <i>Thiarids</i>	Fish <i>Poecilia reticulata</i>	<ul style="list-style-type: none"> Surveyed below old dam 6-9-08 River is intermittent below dam 	6/9/08 EMAP	
47. Liyog	Fish <i>Ellechelon vaigiensis</i> <i>Periophthalmus argentilineatus</i> Invertebrates <i>Scylla serrata</i>	No Record	<ul style="list-style-type: none"> moderately developed area 	12/27/2010 Surveyed while retrieving a turtle shell	

48. Lonfit	Fish <i>Anguilla marmorata</i> <i>Awaous guamensis</i> <i>Kuhlia rupestris</i> <i>Sicyopterus</i> <i>lagocephalus</i> <i>Sicyopus sp.</i> <i>Stenogobius sp.</i> <i>Stiphodon sp.</i> Invertebrates <i>Macrobrachium lar</i> <i>Neritina pulligera</i> <i>Neritina squamipicta</i> <i>Neritina variegata</i> <i>Thiara granifera</i>	Fish <i>Oreochromis</i> <i>mossambicus</i> <i>Tilapia zillii</i> Reptiles <i>Trachemys scripta</i> <i>elegans</i> Plants <i>Hydrilla verticillata</i>	<ul style="list-style-type: none"> • adjacent to Ordot Dump • drains into the Pago River 	09/16/04	At bridge N 13.26.03.7 E 144.45.36.9 End of survey N 13.26.03.2 E 144.45.32.9
49. Maagas	Fish <i>Anguilla marmorata</i> <i>Awaous guamensis</i> <i>Kuhlia rupestris</i> <i>Lutjanus</i> <i>argentimaculatus</i> <i>Stiphodon sp.</i> Invertebrates <i>Macrobrachium lar</i> <i>Neritina pulligera</i> <i>Neritina squamipicta</i> <i>Neritina variegata</i> <i>Thiarids</i>	Fish <i>Cichla ocellaris</i> <i>Clarias batrachus</i> <i>Oreochromis</i> <i>mossambicus</i> <i>Tilapia zillii</i>	<ul style="list-style-type: none"> • located on restricted naval property, little human impact • heavily impacted by carabao, deer, and pigs • drains into the Talofofu River 	01/12/04	Beginning of survey N 13.21.28.5 E 144.42.46.7
50. Maemong	No Record	No Record	<ul style="list-style-type: none"> • drains into the Tolaeyuus River 		
51. Madofan	No Record	No Record	<ul style="list-style-type: none"> • adjacent to cleared area • impacted by soil erosion 		

52. Madog	Fish <i>Anguilla marmorata</i> <i>Awaous guamensis</i> <i>Eleotris fusca</i> <i>Kuhlia rupestris</i> <i>Sicyopterus</i> <i>lagocephalus</i> <i>Sicyopus sp.</i> <i>Stenogobius sp.</i> <i>Stiphodon sp.</i> Invertebrates <i>Caridina nilotica</i> <i>Macrobrachium lar</i> Nerites	Amphibians <i>Bufo marinus</i> <i>Rana sp.</i> Reptiles <i>Trachemys scripta</i> <i>elegans</i>	<ul style="list-style-type: none"> drains into the Umatac River 	1/22/07 EMAP	
53. Mahlac	Fish <i>Kuhlia rupestris</i> <i>Stiphodon sp.</i> Invertebrates Nerites	No Record	<ul style="list-style-type: none"> drains into the Talofofu River 	Surveyed on 8-3-05	
54. Malaja	No Record	No Record	<ul style="list-style-type: none"> drains into the Talofofu River 		
55. Manell	<i>Eleotris fusca</i> <i>Moolgarda engeli</i> <i>Periophthalmus</i> <i>argenteolineatus</i> <i>Stiphodon sp.</i> <i>Zenarchopterus dispar</i> Invertebrates <i>Caridina sp.</i> <i>Macrobrachium lar</i> Plants <i>Nypa fruticans</i>	No Record	<ul style="list-style-type: none"> channelized intermittent 	10/7/2011	No snails seen, and low numbers of all other organisms Atyids gravid 10/7/2011

<p>56. Manenggon</p>	<p>Fish <i>Anguilla marmorata</i> <i>Awaous guamensis</i> <i>Eleotris fusca</i> <i>Kuhlia rupestris</i> <i>Sicyopus</i> sp. <i>Stiphodon</i> sp. Invertebrates <i>Atyoida pilipes</i> <i>Caridina nilotica</i> <i>Caridina typus</i> <i>Macrobrachium lar</i> <i>Melanoides tuberculata</i> <i>Neritina pulligera</i> <i>Neritina squamipicta</i> <i>Neritina variegata</i> <i>Thiara granifera</i></p>	<p>Fish <i>Oreochromis mossambicus</i> <i>Tilapia zillii</i></p>	<ul style="list-style-type: none"> • limited human impact • influenced by some construction of Leo Palace Resort • drains into the Ylig River 	<p>08/13/04</p>	
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<p>57. Masso</p>	<p>Fish <i>Anguilla marmorata</i> <i>Awaous guamensis</i> <i>Eleotris fusca</i> <i>Caranx sexfasciatus</i> <i>Kuhlia rupestris</i> <i>Sicyopterus lagocephalus</i> <i>Sicyopus sp.*</i> <i>Stiphodon sp.*</i> Invertebrates <i>Atyoida pilipes</i> <i>Caridina sp.</i> <i>Macrobrachium lar*</i> <i>Neritina variegata</i> <i>Neritina pettiti</i> <i>Neritina pulligera</i> <i>Neritina squamipicta*</i> <i>Septaria porcellana</i> <i>Thiarids</i></p>	<p>Fish <i>Clarias batrachus</i> <i>Gambusia affinis</i> <i>Oreochromis mossambicus</i> <i>Poecilia reticulata*</i> Invertebrates <i>Pila conica</i> <i>Pomacea canaliculata</i> Amphibians <i>Bufo marinus</i> <i>Rana sp.</i></p>	<ul style="list-style-type: none"> • dam provides a recreational reservoir • moderately developed area • metallic debris in river below reservoir • tadpoles not common in river • surveyed from below reservoir to bridge behind GSA • 	<p>Below reservoir 04/28/04</p> <p>Above reservoir 3/3/06*</p>	<p>13.27.623 N 144.41.527 E GPS reading at bridge behind GSA</p>
<p>58. Matgue</p>	<p>Fish <i>Anguilla marmorata</i> <i>Awaous guamensis</i> <i>Eleotris fusca</i> <i>Kuhlia rupestris</i> <i>Megalops cyprinoides</i> <i>Moolgarda engeli</i> <i>Neomyxus leuciscus</i> <i>Stenogobius sp.</i> <i>Stiphodon sp.</i> Invertebrates <i>Caridina nilotica</i> <i>Macrobrachium lar</i></p>	<p>Fish <i>Oreochromis mossambicus</i> Invertebrates Planorbid snails</p>	<ul style="list-style-type: none"> • A lot of trash • Macrobrachium gravid 1/05/07 	<p>12/15/06</p> <p>From bridge at marine corps drive upstream approximately 100 meters</p>	<p>13.28.262 N 144.42.411 E Start of survey</p> <p>13.28.147 N 144.42.427 E End of survey</p>

59. Maulap	Fish <i>Anguilla marmorata</i> <i>Awaous guamensis</i> <i>Stiphodon</i> sp. Invertebrates <i>Atyopsis spinipes</i> <i>Caridina nilotica</i> <i>Caridina serratirostris</i> <i>Caridina typus</i> <i>Macrobrachium lar</i> <i>Melanoides tuberculata</i> <i>Thiara granifera</i>	Fish <i>Cichla ocellaris</i> <i>Oreochromis</i> <i>mossambicus</i> <i>Tilapia zillii</i>	<ul style="list-style-type: none"> located on restricted naval property, little human impact drains into Fena Lake atyids and Macrobrachium gravid 3-12-08 	01/12/04	Beginning of survey N 13.21.22.7 E 144.41.48.1 End of survey N 13.21.15.0 E 144.41.48.6
60. Namu	Fish <i>Awaous guamensis</i> <i>Kuhlia rupestris</i> <i>Moolgarda engeli</i> <i>Sicyopus</i> sp. <i>Sicyopterus</i> <i>lagocephalus</i> <i>Stiphodon</i> sp. Invertebrates <i>Atyoida spinipes</i> <i>Caridina nilotica</i> <i>Macrobrachium lar</i> <i>Clithon coronata</i> <i>Neritina variegata</i>	Fish <i>Oreochromis</i> <i>mossambicus</i> <i>Poecilia reticulata</i> Amphibians <i>Bufo marinus</i> <i>Rana nigomaculata</i> Reptiles <i>Trachemys scripta</i> <i>elegans</i> Invertebrates leeches	<ul style="list-style-type: none"> channelized heavily developed area tin and other debris fish are fed at the Namu Falls park 	04/01/04	N 13.23.520 E 144.40.489 (at Namu Park) survey was conducted from a site approximately 150meters downstream of the park to the pool below the falls in the park
61. Nelansa	No Record	No Record	<ul style="list-style-type: none"> drains into the Yledigao River 		
62. Nengilao	No Record	No Record	<ul style="list-style-type: none"> drains into the Taleyfac River 		
63. Pagachao	No Record	No Record	<ul style="list-style-type: none"> drains into the Nengilao River 		

<p>64. Pago</p>	<p>Fish <i>Anguilla marmorata</i> <i>Awaous guamensis</i> <i>Caranx sexfasciatus</i> <i>Kuhlia rupestris</i> <i>Lutjanus argentimaculatus</i> <i>Sicyopus</i> sp. <i>Stiphodon</i> sp. <i>Taenioides limicola</i> Invertebrates <i>Atyoida pilipes</i> <i>Macrobrachium lar</i> <i>Neritina pulligera</i> <i>Neritina squamipicta</i> <i>Neritina variegata</i> Plants <i>Nypa fruticans</i></p>	<p>Fish <i>Gambusia affinis</i> <i>Oreochromis mossambicus</i> <i>Tilapia zillii</i></p>	<ul style="list-style-type: none"> • adjacent to some agriculture 		
<p>65. Pajon</p>	<p>No Record</p>	<p>No Record</p>	<ul style="list-style-type: none"> • drains into the Laelae River 		
<p>66. Pasamano</p>	<p>No Record</p>	<p>No Record</p>	<ul style="list-style-type: none"> • drains into the Inarajan River 		
<p>67. Paulana</p>	<p>Fish <i>Stiphodon</i> sp. Invertebrates <i>Atyoida pilipes</i> <i>Caridina</i> sp. <i>Macrobrachium lar</i> <i>Neritina pulligera</i> <i>Thiarids</i></p>	<p>No Record</p>	<ul style="list-style-type: none"> • drains into the Atantano River 	<p>6/02/08 EMAP</p>	
<p>68. Pauliluc</p>	<p>Plants <i>Nypa fruticans</i></p>	<p>No Record</p>	<ul style="list-style-type: none"> • no record 		

<p>69. Pigua</p>	<p>Fish <i>Anguilla marmorata</i> <i>Awaous guamensis</i> <i>Eleotris fusca</i> <i>Kuhlia rupestris</i> <i>Lutjanus argentimaculatus</i> <i>Sicyopterus lagocephalus</i> <i>Sicyopus sp.</i> <i>Stiphodon sp.</i> Invertebrates <i>Atyopsis spinipes</i> <i>Caridina nilotica</i> <i>Caridina typus</i> <i>Macrobrachium lar</i></p>	<p>No Record</p>	<ul style="list-style-type: none"> • moderately developed area 		
<p>70. Sadog</p>	<p>Fish <i>Anguilla marmorata</i> <i>Awaous guamensis</i> <i>Stiphodon sp.</i> <i>Mugilogobius cavifrons</i> Invertebrates <i>Caridina sp.</i> <i>Macrobrachium lar</i> snails in Thiaridae Pyralid caterpillars</p>	<p>Fish <i>Cichla ocellaris</i> <i>Gambusia affinis</i> <i>Oreochromis mossambicus</i> <i>Poecilia reticulata</i> <i>Tilapia zillii</i> Reptiles <i>Pelodiscus sinensis</i></p>	<ul style="list-style-type: none"> • located on restricted naval property, little human impact • drains into the Imong River • water level high on 9-12-08, <i>Stiphodon</i> seen at starting location 	<p>07/23/04</p>	
<p>71. Sagge</p>	<p>No Record</p>	<p>No Record</p>	<ul style="list-style-type: none"> • drains into the Talofofu River 		
<p>72. Sagua</p>	<p>No Record</p>	<p>No Record</p>	<ul style="list-style-type: none"> • no record 		
<p>73. Salinas</p>	<p>Fish <i>Kuhlia rupestris</i></p>	<p>Fish <i>Poecilia reticulata</i> Amphibians <i>Bufo marinus</i> <i>Rana sp.</i></p>	<ul style="list-style-type: none"> • 	<p>12/12/06</p>	
<p>74. San Nicolas</p>	<p>No Record</p>	<p>No Record</p>	<ul style="list-style-type: none"> • drains into the Chagame River 		

75. Sarasa	No Record	No Record	<ul style="list-style-type: none"> • drains into the Talofofu River 		
76. Sasa	<p>Fish <i>Kuhlia rupestris</i> <i>Moolgarda engeli</i> <i>Mugilogobius cavifrons</i> <i>Periophthalmus argentilineatus</i> <i>Zenarchopterus dispar</i></p> <p>Plants <i>Avicennia alba</i> <i>Rhizophora apiculata</i></p>	<p>Fish <i>Oreochromis mossambicus</i> <i>Poecilia reticulatus</i></p>	<ul style="list-style-type: none"> • mangroves • impacts from adjacent shipping, docking, and oil refinery facilities 		
77. Sella	<p>Fish <i>Anguilla marmorata</i> <i>Awaous guamensis</i> <i>Awaous ocellaris</i> <i>Eleotris fusca</i> <i>Kuhlia rupestris</i> <i>Sicyopterus lagocephalus</i> <i>Sicyopus</i> sp. <i>Stenogobius</i> sp. <i>Stiphodon percnopterygionus</i> <i>Stiphodon</i> sp.</p> <p>Invertebrates <i>Atyoida pilipes</i> <i>Atyopsis spinipes</i> <i>Caridina typus</i> <i>Caridina serratiostris</i> <i>Macrobrachium lar</i></p>	No Record	<ul style="list-style-type: none"> • fairly remote • some human impacts from hiking • frequent wild land fires contribute to soil erosion in the area • very small (10cm) eel caught in tributary 3-19-07 		

78. Sigua	Fish <i>Anguilla marmorata</i> * <i>Awaous guamensis</i> * <i>Eleotris fusca</i> * <i>Kuhlia rupestris</i> * <i>Sicyopus sp.</i> * <i>Stiphodon sp.</i> * Invertebrates <i>Caridina spp.</i> * <i>Macrobrachium lar</i> * <i>Neritina squamipicta</i> * Flatworm*	Amphibians <i>Bufo marinus</i> <i>Rana nigromaculatus</i>	<ul style="list-style-type: none"> • fairly remote • some human impacts from hiking • wild land fires contribute to soil erosion in the area • drains into the Pago River • Atyids gravid* • Thiarids abundant* • <i>Stiphodon</i> abundant* • <i>Stiphodon</i> and <i>Sicyopus</i> showing courtship colors* • <i>Bufo</i> common* • <i>Awaous</i> fairly common* 	3-13-06* EMAP	N 13.427974 E 144.745426
79. Sumay	Fish <i>Ambassis buruensis</i> <i>Kuhlia rupestris</i> <i>Lutjanus monostigma</i> <i>Moolgarda engeli</i> <i>Neomyxus leuciscus</i> <i>Zenarchopterus dispar</i>	No Record	<ul style="list-style-type: none"> • fairly good condition 		
80. Suyafe	No Record	No Record	<ul style="list-style-type: none"> • no record 		
81. Taelayag	Fish <i>Anguilla marmorata</i> <i>Kuhlia rupestris</i> <i>Moolgarda engeli</i> <i>Periophthalmus argentilineatus</i>	No Record	<ul style="list-style-type: none"> • partially channelized • heavily silted • trash 	7-22-09	

82. Taguag	Fish <i>Anguilla marmorata</i> <i>Awaous guamensis</i> <i>Eleotris fusca</i> <i>Kuhlia rupestris</i> <i>Sicyopterus lagocephalus</i> <i>Sicyopus sp.</i> <i>Stiphodon sp.</i> Invertebrates <i>Macrobrachium lar</i> <i>Nerites</i>	Amphibians <i>Bufo marinus</i>	<ul style="list-style-type: none"> • In residential neighborhood • Some debris 	2/08/05	
83. Taleyfac	Fish <i>Abudefduf septemfaciatus</i> <i>Ellechelon vaigiensis</i> <i>Kuhlia rupestris</i> <i>Lutjanus argentimaculatus</i> <i>Lutjanus fulvus</i> <i>Moolgarda engeli</i> <i>Periophthalmus argentilineatus</i> Invertebrates <i>Atyoida pilipes</i> <i>Caridina typus</i>	No Record	<ul style="list-style-type: none"> • moderately silted • moderately developed area 		
84. Talisay	No Record	No Record	<ul style="list-style-type: none"> • located on restricted naval property, little human impact • drains into the Maemong River 		

<p>85. Talofofu</p>	<p>Fish <i>Anguilla marmorata</i> <i>Apogon lateralis</i> <i>Awaous guamensis</i> <i>Caranx ignobilis</i> <i>Caranx melampygu</i> <i>Caranx sexfasciatus</i> <i>Eleotris fusca</i> <i>Kuhlia rupestris</i> <i>Moolgarda engeli</i> <i>Sicyopterus lagocephalus</i> <i>Stiphodon</i> sp. <i>Zenarchopterus dispar</i> Invertebrates <i>Atyoida pilipes</i> <i>Atyopsis spinipes</i> <i>Caridina nilotica</i> <i>Caridina typus</i> <i>Macrobrachium lar</i> <i>Neritina pulligera</i> <i>Neritina</i> sp. <i>Scylla serrata</i> sponges in the family Spongillidae</p>	<p>Fish <i>Cichla ocellaris</i> <i>Clarias batrachus</i> <i>Gambusia affinis mossambicus</i></p>	<ul style="list-style-type: none"> • adjacent to aquaculture facility • frequent wild land fires contribute to soil erosion in the area • moderately developed • some human impacts from a jungle river tourist attraction 		
<p>86. Tarzan</p>	<p>Fish <i>Anguilla marmorata</i> <i>Awaous guamensis</i> <i>Eleotris fusca</i> <i>Sicyopterus lagocephalus</i> <i>Stiphodon</i> sp. Invertebrates <i>Atyoida pilipes</i> <i>Macrobrachium lar</i> <i>Nerites</i></p>	<p>Fish <i>Poecilia reticulata</i> <i>Xiphophorus helleri</i> Amphibians <i>Bufo marinus</i></p>	<ul style="list-style-type: none"> • fairly remote • some human impacts from hiking in the area • wild land fires contribute to soil erosion in the area • drains into the Ylig River 	<p>EMAP 3-5-08</p>	

87. Tenjo	Fish <i>Kuhlia rupestris</i> * <i>Mugilogobius cavifrons</i> * <i>Redigobius bikolanus</i> * Invertebrates Thiarids*	No Record	<ul style="list-style-type: none"> drains into the Atantano Wetland 	EMAP 3/6/06*	
88. Tinago	Fish <i>Anguilla marmorata</i> <i>Awaous guamensis</i> <i>Kuhlia rupestris</i> <i>Lutjanus argentimaculatus</i> <i>Moolgarda engeli</i> <i>Sicyopterus lagocephalus</i> <i>Stenogobius sp.</i> <i>Stiphodon sp.</i> <i>Zenarchopterus dispar</i> Invertebrates <i>Macrobrachium lar</i> Thiarids <i>Varuna littorata?</i> Plants <i>Ceratopteris gaudichaudii</i>	Amphibians <i>Bufo marinus</i> <i>Rana sp.</i> Plants <i>Lemna minor</i>	<ul style="list-style-type: none"> drains into the Pauliluc River lower reach below road choked with bamboo and fallen trees, causing flooding during typhoons 	02/06/04	N 13.17.235 E 144.45.235 (where river runs under Route 4) survey was conducted approximately 150 meters upstream and 200 meters downstream from where river runs under road
89. Tinechong	Plants <i>Ceratopteris gaudichaudii</i> *	Fish <i>Clarias batrachus</i> * <i>Poecilia reticulata</i> * Amphibians <i>Rana sp.*</i>	<ul style="list-style-type: none"> drains into the Sagge River river was dry when surveyed, only pools remained in channel* 	4-3-06 EMAP*	

90. Togcha (E)	Fish <i>Anguilla marmorata</i> <i>Awaous guamensis</i> <i>Lutjanus argentimaculatus</i> <i>Sicyopus sp.</i> <i>Stiphodon sp.</i> Invertebrates <i>Atyids</i> <i>Macrobrachium lar</i> <i>Melanoides tuberculata</i> <i>Neritina pettiti</i> <i>Neritina pulligera</i> <i>Neritina variegata</i>	Fish <i>Oreochromis mossambicus</i> <i>Poecilia reticulatus</i> Amphibians <i>Bufo marinus</i> <i>Rana sp.</i> Invertebrates <i>Physalid snails</i> <i>Leeches</i>	<ul style="list-style-type: none"> sewage treatment plant discharges secondarily treated effluent into the river 	11-22-05 Guppies very abundant	Start (just upstream from treatment plant) N 13° 22.07.7 E 144° 45.10.9 End N 13° 22.07.7 E 144° 45.10.9
91. Togcha (W)	Fish <i>Anguilla marmorata</i> <i>Awaous guamensis</i> <i>Eleotris fusca</i> <i>Kuhlia rupestris</i> <i>Monodactylus argenteus</i> <i>Moolgarda engeli</i>	Amphibians <i>Bufo marinus</i> <i>Rana sp.</i>	<ul style="list-style-type: none"> Next to small cemetery in Agat 	05/13/05 10-31-06	N 13.23'35.1 E 144.39'42.0 At small cemetery N 13.23'36.3 E 144.39'44.5 At sewer inflow pipe Surveyed at bridge where river flows under R.R. Cruz street

92. Toguan	<p>Fish <i>Anguilla marmorata</i> <i>Awaous guamensis</i> <i>Awaous ocellaris</i> <i>Kuhlia rupestris</i> <i>Sicyopterus lagocephalus</i> <i>Sicyopus</i> sp. <i>Stenogobius</i> sp. <i>Stiphodon</i> sp.</p> <p>Invertebrates <i>Atyoida pilipes</i> <i>Caridina nilotica</i> <i>Caridina serratirostris</i> <i>Clithon brevispina</i> <i>Macrobrachium lar</i> <i>Neritina pulligera</i> <i>Neritina variegata</i> <i>Septaria porcellana</i> <i>Thiarids</i> Pyralid caterpillars</p>	<p>Amphibians <i>Bufo marinus</i></p> <p>Plants <i>Lemna minor</i></p>	<ul style="list-style-type: none"> • Adjacent to water treatment plant. • Lower reaches of river channelized 	<p>1-31-05 <i>Sicyopus</i> showing mating colors <i>Bufo</i>, <i>Stiphodon</i>, <i>Awaous</i>, <i>Nerites</i>, <i>Septaria</i> very common. 2-14-06 <i>Stiphodon</i> showing courtship colors</p>	<p>Start (next to water treatment plant) N 13° 17.181 E 144° 39.840</p> <p>End N 13° 17.164 E 144° 40.003</p>
93. Tolaeyuus	<p>Fish <i>Awaous guamensis</i> <i>Kuhlia rupestris</i> <i>Stiphodon</i> sp.</p> <p>Invertebrates <i>Macrobrachium lar</i> <i>Thiara granifera</i></p> <p>Plants <i>Chara</i> sp. <i>Potamogeton</i> sp.</p>	<p>Fish <i>Clarias batrachus</i></p> <p>Plants <i>Hydrilla verticillata</i></p>	<ul style="list-style-type: none"> • drains into the Maagas River via the Lost or Hidden River • contains an approximately 400 m subterranean passage • located on restricted naval property, little human impact 	<p>1-20-05 <i>Stiphodon</i> and <i>Kuhlia</i> above underground passage @ bridge 735 2-13-06</p>	<p>N 13.21.35.8 E 144.41.38.1 Reading taken at bridge 736</p>
94. Tongan	No Record	No Record	<ul style="list-style-type: none"> • intermittent 		
95. Topony	No Record	No Record	<ul style="list-style-type: none"> • drains into the Yledigao River 		

96. Ugum	<p>Fish <i>Anguilla marmorata</i> <i>Awaous guamensis</i> <i>Eleotris fusca</i> <i>Kuhlia rupestris</i> <i>Microphis leiaspis</i> <i>Sicyopterus lagocephalus</i> <i>Stiphodon</i> sp. Invertebrates <i>Atyoida pilipes</i> <i>Caridina nilotica</i> <i>Caridina serratirostris</i> <i>Caridina typus</i> <i>Caridina weberi</i> <i>Macrobrachium lar</i> <i>Neritina squamipicta</i> <i>Septaria porcellana</i> Nerites Thiarids sponges in the family Spongillidae</p>	<p>Fish <i>Gambusia affinis</i> <i>Oreochromis mossambicus</i> Amphibians <i>Rana</i> sp.</p>	<ul style="list-style-type: none"> weir provides drinking water for some southern villages frequent wild land fires contribute to soil erosion in the area 50 acres of trees were planted in the watershed in between August and November 1999 drains into the Talofofu River 	<p>Upper Ugum surveyed on 5-13-04</p> <p>Ugum below Talofofu falls surveyed on 2-22-06</p>	<p>GPS N 13.19.383 E 144.43.343</p>
97. Umatac	<p>Fish <i>Anguilla marmorata</i> <i>Awaous guamensis</i> <i>Eleotris fusca</i> <i>Kuhlia rupestris</i> <i>Stiphodon</i> sp. Invertebrates <i>Atyoida pilipes</i></p>	<p>No Record Reptiles <i>Trachemys scripta elegans</i></p>	<ul style="list-style-type: none"> heavily developed area area under agriculture and grazing pressure 		
98. Unnamed stream	No Record	No Record	<ul style="list-style-type: none"> located between the Manell and the Sufafe Rivers 		
99. Yledigao	No Record	No Record	<ul style="list-style-type: none"> drains into the Inarajan River 		

<p>100. Ylig</p>	<p>Fish <i>Anguilla marmorata</i> <i>Awaous guamensis</i> <i>Kuhlia rupestris</i> <i>Lutjanus argentimaculatus</i> <i>Microphis leiaspis</i> <i>Sicyopterus lagocephalus</i> <i>Sicyopus sp.*</i> <i>Stiphodon sp.</i> <i>Taeniodes limicola</i> <i>Zenarchopterus dispar</i> Invertebrates <i>Atyoida pilipes</i> <i>Atyopsis spinipes</i> <i>Caridina nilotica</i> <i>Caridina typus</i> <i>Caridina serratirostris</i> <i>Macrobrachium lar</i> <i>Macrobrachium latidactylus</i> <i>Neritina pettiti*</i> <i>Neritina pulligera</i> <i>Neritina squamipicta</i> <i>Neritina variegata</i> <i>Thiara granifera</i> sponges in the family Spongillidae Plants <i>Nypa fruticans</i> <i>Potamogeton marianensis*</i></p>	<p>Fish <i>Oreochromis mossambicus</i> <i>Tilapia zillii</i></p>	<ul style="list-style-type: none"> • moderately developed area • adjacent to agricultural and grazing areas • large patches of <i>Potamogeton</i> in upper reaches (EMAP) • Atyids gravid 6/4/08 • Female <i>Sicyopus</i> gravid 6/4/08 • Nerite eggs abundant 	<p>07/27/04 01/05/05 6/04/08 EMAP*</p>	<p>At USGS gauging station N 13°23'32.9" E 144°45'13.0" Ending site N 13°23'29.0" E 144°45'10.4"</p>
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<p>101. unnamed stream-tributary to Ugum</p>	<p>Fish <i>Ambassis buruensis</i> <i>Awaous guamensis</i> <i>Chanos chanos</i> <i>Eleotris fusca</i> <i>Gerrids</i> <i>Kuhlia rupestris</i> <i>Lutjanus argentimaculatus</i> <i>Moolgarda engeli</i> <i>Stenogobius sp.</i> <i>Zenarchopterus dispar</i> Invertebrates <i>Macrobrachium lar</i> <i>Nerites</i> <i>Thiarids</i> <i>Varuna littorata</i></p>	<p>Fish <i>Clarias batrachus</i> <i>Oreochromis mossambicus</i></p>	<p>Glassfish abundant Very large tilapia and catfish Large nerite eggs Old gauging station Drains into Ugum</p>	<p>5/27/05</p>	
<p>102. Small River on Mt. Santa Rosa</p>		<p>Fish <i>Gambusia affinis</i> <i>Poecilia reticulata</i></p>	<p>River runs underground and through several caves.</p>	<p>Surveyed 8-30-05</p>	<p>GPS N 13.31.919 E 144.54.906</p>

Reservoirs	Native Species	Introduced Species	Habitat	Date Surveyed	GPS
1. Fena	<p>Fish <i>Anguilla marmorata</i> <i>Awaous guamensis</i> <i>Kuhlia rupestris</i> <i>Mugilogobius cavifrons</i> <i>Sicyopterus lagocephalus</i> <i>Stiphodon</i> sp. Invertebrates <i>Caridina</i> sp. <i>Thiara granifera</i> Snails in the family Neritidae? Plants <i>Ceratopteris gaudichaudii</i></p>	<p>Reptiles <i>Pelodiscus sinensis</i> Fish <i>Cichla ocellaris</i> <i>Gambusia affinis</i> <i>Oreochromis mossambicus</i> <i>Poecilia reticulata</i> <i>Tilapia zillii</i> Plants <i>Hydrilla verticillata</i></p>	<ul style="list-style-type: none"> • located on restricted naval property, little human impact • impacted by carabao, deer, and pigs • heavily silted from erosion caused by upland fires • Hydrilla vanished in March, 2006. 		

<p>2. Masso</p>	<p>Fish <i>Anguilla marmorata</i> <i>Awaous guamensis</i> <i>Eleotris fusca</i> <i>Sicyopterus lagocephalus</i> <i>Stiphodon</i> sp. Invertebrates <i>Atyoida pilipes</i> <i>Caridina</i> sp. <i>Macrobrachium lar</i> <i>Neritina pulligera</i> <i>Varuna littorata</i> Plants <i>Ceratopteris gaudichaudii</i></p>	<p>Fish <i>Clarias batrachus</i> <i>Gambusia affinis</i> <i>Oreochromis mossambicus</i> <i>Poecilia reticulata</i> Invertebrates <i>Pila conica</i> <i>Pomacea canaliculata</i> Plants Hydrilla verticillata Reptiles <i>Trachemys scripta elegans</i> Amphibians <i>Bufo marinus</i> <i>Eleutherodactylus planirostris</i> <i>Rana (Pelophylax) nigromaculata</i></p>	<ul style="list-style-type: none"> • heavily silted from erosion caused by upland fires • human impacts from fishing and gathering of apple snails • from 2008-2011, more than 11,000 trees planted in Masso watershed • Atyids gravid, 8-2-2011 	<p>Reservoir drained and dredged during 2010. Tilapia, eels, gobies, snails harvested by contractor. Reservoir refilled on 12-25 2010</p>	
<p>3. Yona “lake” #1</p>	<p>Invertebrates Thiarid snails</p>	<p>Fish Tilapia Amphibians <i>Bufo marinus</i> Invertebrates Planorbid snails</p>	<ul style="list-style-type: none"> • Lake at entrance to Leo Palace Resort 		
<p>4. Yona “lakes” #’s 2 & 3</p>	<p>Invertebrates Thiarid snails</p>	<p>Fish <i>Oreochromis mossambicus</i> Amphibians <i>Bufo marinus</i></p>	<ul style="list-style-type: none"> • Holding ponds at Leo Palace Resort 	<p>Surveyed 6-1-04</p>	<p>GPS reading at lake number 2 N 13.24.786 E 144.44.969</p>
<p>5. Pond #1</p>	<p>Fish <i>Anguilla marmorata</i></p>	<p>Fish <i>Clarias batrachus</i></p>	<ul style="list-style-type: none"> • Pond on Ed Poppe’s property 	<p>Surveyed 8-3-05</p>	<p>GPS N 13.21.22.282</p>

		<i>Gambusia affinis</i> <i>Oreochromis mossambicus</i> Amphibians <i>Rana sp.</i>			E 144.43.49.655
6. Pond #2	Fish <i>Anguilla marmorata</i>	Fish <i>Gambusia affinis</i> <i>Oreochromis mossambicus</i> Invertebrates <i>Sinotaia magniciano</i>	<ul style="list-style-type: none"> • Pond on Ed Poppe's property 	Surveyed 8-3-05	GPS N 13.21.22.415 E 144.43.50.273
7. Ed's Lake	Fish <i>Megalops cyprinoides</i>	Fish <i>Clarias batrachus</i>	<ul style="list-style-type: none"> • Lake on Ed Poppe's property 	Surveyed 8-3-05	GPS N 13.21.23.639 E 144.43.48.349

Springs	Native Species	Introduced Species	Habitat	Date Surveyed	GPS
<p>1. Agana</p>	<p>Fish <i>Anguilla bicolor?</i> <i>Anguilla marmorata</i> <i>Awaous guamensis</i> <i>Eleotris fusca</i> <i>Stiphodon</i> sp. Invertebrates <i>Macrobrachium lar</i> <i>Thiarids</i></p>	<p>Fish <i>Clarias batrachus</i> <i>Cyprinus carpio</i> <i>Gambusia affinis</i> <i>Oreochromis mossambicus</i> <i>Poecilia velifera</i> <i>Poecilia reticulata</i> <i>Tilapia zillii</i> Reptiles <i>Trachemys scripta elegans</i> Amphibians <i>Bufo marinus</i> Invertebrates <i>Physalid snails</i> <i>Pila conica</i> <i>Planorbid snails</i> <i>Pomacea canaliculata</i> <i>Sinotaia magnificiana</i> Plants <i>Eichornia crassipes</i> <i>Hydrilla verticillata</i> <i>Nymphaea caerulea</i> <i>Nymphaea X daubenyaba</i></p>	<ul style="list-style-type: none"> • heavily developed area • construction projects have filled some wetland areas • Eichornia removed 2/20/08 		

2. Almagosa	Invertebrates <i>Atyopsis spinipes</i> <i>Macrobrachium lar</i>	No Record	• located on restricted naval property, little human impact		
3. Bona	No Record	No Record	• no record		
4. Janum	No Record	No Record	• no record		
5. Mataguac	No Record	No Record	• no record		
6. Santa Rita	Fish <i>Anguilla marmorata</i>	No Record	• no record		
7. Santa Rosa	No Record	No Record	• no record		

Caves and Sinkholes

	Native Species	Introduced Species	Habitat	Date Surveyed	GPS
1. Marbo Cave	Fish Blind cave eleotrid Eleotris fusca Invertebrates Macrobrachium lar <i>Halocaridinides sp.</i> Algae <i>Bostrichia tenera</i> <i>Chroococcus turgidus</i> <i>var. thermalis</i> <i>Microcystis marginata</i> <i>Trentepohlia aurea</i>	Fish <i>Oreochromis</i> <i>mossambicus</i>	Cavern		
2. Pagat Cave	<i>Halocaridinides sp.</i> <i>Macrobrachium lar</i>		Cavern		
3. Piggy Cave	Invertebrates <i>Macrobrachium lar</i>		Cavern		
4. Fadian Cave	Invertebrates Crab (Varuna?) Macrobrachium lar Halocaridinides sp. Fish Eleotris fusca		Cavern	09-07-05	N 13.31.876 E 144.55.019
5. Faifai beach Cave	Invertebrates <i>Discoplax longipes</i>		Cavern		

	Fish <i>Eleotris fusca</i>				
6. Asiga water cave (N)	Invertebrates <i>Discoplax longipes</i> Fish <i>Eleotris fusca</i> Blind cave eleotrid		Cavern	11-11-06	
6. Tarague water well #4	Fish <i>Anguilla marmorata</i> <i>Eleotris melanosoma</i>	Fish <i>Gambusia affinis</i> <i>Oreochromis mossambicus</i>	Sinkhole and Cavern		
7. Hawaiian Rock sinkhole	Fish <i>Eleotris fusca</i> Invertebrates sponges in the family Spongillidae		Sinkhole		
8. Ipan sinkhole	<i>Halocaridinides sp.</i>		Sinkhole		
9. private sinkhole in Ipan	<i>Halocaridinides sp.</i>		Sinkhole		
10. Lost Pond		Fish <i>Astronotus ocellatus</i> <i>Clarias batrachus</i> <i>Oreochromis mossambicus</i> <i>Poecilia reticulata</i> <i>Poecilia velifera</i> <i>Xiphophorus helleri</i> Reptiles <i>Trachemys scripta elegans</i>	Sinkhole		
11. Yigo cave with stream	Insects Dragonfly larvae		Caves on property of Shawn Wusstig's relatives.	Surveyed on 8-30-05	N 13.32.024 E 144.55.351
12. Cave in Yigo with waterfall			Caves on property of Shawn Wusstig's	Surveyed on 8-30-05	N 13.31.874 E 144.55.020

			relatives.		
Wetlands					
Near entrance to Big Navy	<i>Kuhlia rupestris</i>	<i>Clarias batrachus</i>	Across the street from old Toyland	Surveyed on 8-6-09	

Annual Project Performance Report

Guam Division of Aquatic and Wildlife Resources, Department of Agriculture
FY 2011

1. State: Territory of Guam

Grant number: F-19-E-2

Grant name: Guam Sport Fish Aquatic Education

Project number and name: F-19-E-2. Project 1. Guam Sport Fish Aquatic Education. Job 1. Printing, Development, And Distribution Of Fisheries Posters, Brochures, Marine Preserve Public Service Announcements, And Educational Outreach Items.

2. Report Period: October 1, 2010 to September 30, 2011

Report due date: December 29, 2011, Extended to January 30, 2012

3. Location of work: Guam: Island wide

4. Costs:

Source	Budgeted	Actual <u>X</u> or Estimated <u> </u>
Federal: Sport Fish Restoration	\$44,177	\$22,386.69
State		
Other:		
Total Federal	\$44,177	\$22,386.69
Total match		
Total project:	\$44,177	\$22,386.69

5. Objectives:

1. Obtain a purchase order to print 5000 (ea) of the multi-lingual scientific pelagic and food fish posters by July 2011, and distribute to the public to increase communication amongst the different language speakers.
2. Obtain a purchase order to print 2500 (ea) of the freshwater posters by July 2011, and distribute to the public to increase communication and knowledge of Guam's freshwater resources.

3. Obtain a purchase order to print 2500 (ea) of the marine preserve posters and brochures, as needed, and distribute to the public to increase communication and knowledge of Guam's marine preserves by July 2011.
4. Obtain a purchase order to print up to 1000 (ea) of "Help Save Guam's Reefs" on pencils, pens, stickers, pins, badges, and hats then distribute to the public as incentives at presentations, lectures, and events to increase communication and knowledge of Guam's marine resources by February 2011.
5. Digitize poster and brochure files for future use by September 2011.
6. Distribute other fisheries posters as they become available to further the knowledge pertaining to aquatic resources of Guam.
7. On an annual basis, obtain a purchase order by August of each year to print 6,000 of the 2012 fishing calendars and distribute to the public to increase communication and knowledge of Guam's aquatic, freshwater, and marine preserve resources.
8. Obtain a purchase order for 100 Gold Archival DVD's by January 2011.

6. If the work in this grant was part of a larger undertaking with other components and funding, present a brief overview of the larger activity and the role of this project.

N/A

7. Describe how the objectives were met. See "Supplemental Information" for additional requirements and "Attachments" for specialized tables.

The following objectives were met by the following activities during FY11:

- 1) Purchase orders were obtained for the printing of 1440 (ea) and 1000 (ea) "Help Save Guam's Reefs" – neon pencils (with 32 lead) and white eraser and pens with silver accents and marching soft grip. The items were given out during presentations for question and answer during outreach events and handed out during creel surveys.
- 2) Pelagic, food fish, and freshwater resource posters are in supply. Posters were not ordered this FY11.
- 3) Fisheries posters pertaining to aquatic resources of Guam were distributed to the general public, government agencies, private companies and educational institutions.
- 4) The marine preserve poster and brochure was not printed because the information has not been updated.
- 5) There were not posters and brochures that needed digitizing this year.
- 6) Fish posters were handed out at presentations, schools, and other events.
- 7) The purchase order to print the 2012 calendars will be obtained in FY12.
- 8) A purchase order was not obtained for the 100 gold archival DVDs.
- 9) Although not stated as an objective, the Masso Reservoir sign, which provides information about the project (to educate and inform the public), was purchased under the aquatic education grant and installed at the reservoir.

8. Discuss differences between work anticipated in grant proposal and grant agreement, and that actually carried out with Federal Aid grant funds; include differences between expected and actual costs. Difficulties in hiring an individual for the aquatic resource position resulted in many of the objectives not being met. The division is looking at alternatives to attract qualified individuals to apply for the position such as offering an option for a Master's degree through the Rare Pride Campaign. A biologist was detailed to the position but has been on military leave throughout most of FY11.

9. List any publications or in-house reports resulting from this work. N/A

Name, title, phone number, and e-mail address of person compiling this report:

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Annual Project Performance Report

Guam Division of Aquatic and Wildlife Resources, Department of Agriculture
FY 2011

1. State: Territory of Guam

Grant number: F-19-E-2

Grant name: Guam Sport Fish Aquatic Education

Project number and name: F-19-E-2. Project 1. Guam Sport Fish Aquatic Education. Job 2: Produce posters and brochures illustrating: land events as they affect Guam's Coastal waters, reef and fisheries; life cycle of five common reef fishes; and reef fish functional group

2. Report Period: October 1, 2010 to September 30, 2011

Report due date: December 29, 2011, Extended to January 30, 2012

3. Location of work: Guam: Island wide

4. Costs:

Source	Budgeted	Actual <u>X</u> or Estimated <u> </u>
Federal: Sport Fish Restoration	\$8,436	\$0
State		
Other:		
Total Federal	\$8,436	\$0
Total match		
Total project:	\$8,436	\$0

5. Objectives:

1. Contract to update reef fish life cycle brochure and print (1000 @) for public dissemination by February 2011.
2. Contract to assemble sedimentation brochure on the impacts to reefs and then print brochures (1000 @) for public education by February 2011.

6. If the work in this grant was part of a larger undertaking with other components and funding, present a brief overview of the larger activity and the role of this project.
N/A

7. Describe how the objectives were met. See “Supplemental Information” for additional requirements and “Attachments” for specialized tables.

Several of the objectives were not met FY11. 1) A printer company was not identified to print poster and brochures. 2) Purchase orders for posters and brochures were not completed. 3) Posters and brochures were not distributed to the public, educational institutions, to include displays.

The partially completed erosion-reef poster, brochure elements and produce text, line-art and photographs produced from previous FY09 was archived in the REIO digital library.

8. Discuss differences between work anticipated in grant proposal and grant agreement, and that actually carried out with Federal Aid grant funds; include differences between expected and actual costs.

Difficulties in hiring an individual for the aquatic resource position resulted in many of the objectives not being met. The division is looking at alternatives to attract qualified individuals to apply for the position such as offering an option for a Master’s degree through the Rare Pride Campaign. A biologist was detailed to the position but has been on military leave throughout most of FY11.

10. List any publications or in-house reports resulting from this work. N/A

Name, title, phone number, and e-mail address of person compiling this report:

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Annual Project Performance Report

Guam Division of Aquatic and Wildlife Resources, Department of Agriculture
FY 2011

1. State: Territory of Guam

Grant number: F-19-E-2

Grant name: Guam Sport Fish Aquatic Education

Project number and name: F-19-E-2. Project 1. Guam Sport Fish Aquatic Education. Guam Sports Fish Aquatic Education. Job 3: Maintenance and expansion of Aquatic education website

2. Report Period: October 1, 2010 to September 30, 2011

Report due date: December 29, 2011, Extended to January 30, 2012

3. Location of work: Guam: Island wide

4. Costs:

Source	Budgeted	Actual X or Estimated
Federal: Sport Fish Restoration	\$19,820	\$0.0
State		
Other:		
Total Federal	\$19,820	\$0.0
Total match		
Total project:	\$19,820	\$0.0

5. Objectives:

- a. Contract webmaster services to maintain the software programming of the GDAWR aquatic website, and to, update the design/appearance of the website by March 2011.
- b. REIO provides content maintenance: Post available aquatic education materials, project reports, photos, etc every month or as needed.
- c. Disseminate new information in a timely manner on a monthly basis or as needed.

6. If the work in this grant was part of a larger undertaking with other components and funding, present a brief overview of the larger activity and the role of this project.
N/A

7. Describe how the objectives were met. See “Supplemental Information” for additional requirements and “Attachments” for specialized tables.

Objectives 1, 2, and 3 were not met for FY11.

8. Discuss differences between work anticipated in grant proposal and grant agreement, and that actually carried out with Federal Aid grant funds; include differences between expected and actual costs.

Difficulties in hiring an individual for the aquatic resource position resulted in many of the objectives not being met. The division is looking at alternatives to attract qualified individuals to apply for the position such as offering an option for a Master’s degree through the Rare Pride Campaign. A biologist was detailed to the position but has been on military leave throughout most of FY11.

11. List any publications or in-house reports resulting from this work. N/A

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Annual Project Performance Report

Guam Division of Aquatic and Wildlife Resources, Department of Agriculture
FY 2011

1. State: Territory of Guam

Grant number: F-19-E-2

Grant name: Guam Sport Fish Restoration Aquatic Education

Project number and name: F-19-E-2. Project 1. Guam Sport Fish Aquatic Education. Job 4: Maintain digital library of fish and marine habitat photos

2. Report Period: October 1, 2010 to September 30, 2011

Report due date: December 29, 2011, Extended to January 30, 2012

3. Location of work: Guam: Island wide

4. Costs:

Source	Budgeted	Actual or Estimated
Federal: Sport Fish Restoration	\$5,947	\$0.0
State		
Other:		
Total Federal		
Total match		\$0.0
Total project:	\$5,947	\$0.0

5. Objectives

- a. Maintain photographs of images needed in the assessment, digitally photographing fish and marine habitat as needed.
- b. Update photographs on the Fisheries section poster display board and have them printed by March 2011.
- c. Archive the images as JPEG files on Gold/archival compact disks to assure retention of the quality of the images as needed.

6. If the work in this grant was part of a larger undertaking with other components and funding, present a brief overview of the larger activity and the role of this project.

N/A

7. Describe how the objectives were met. See “Supplemental Information” for additional requirements and “Attachments” for specialized tables.

The objectives of this project were not met for FY11.

8. Discuss differences between work anticipated in grant proposal and grant agreement, and that actually carried out with Federal Aid grant funds; include differences between expected and actual costs.

Difficulties in hiring an individual for the aquatic resource position resulted in many of the objectives not being met. The division is looking at alternatives to attract qualified individuals to apply for the position such as offering an option for a Master's degree through the Rare Pride Campaign. A biologist was detailed to the position but has been on military leave throughout most of FY11.

9. List any publications or in-house reports resulting from this work. N/A

Name, title, phone number, and e-mail address of person compiling this report:

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Annual Project Performance Report

Guam Division of Aquatic and Wildlife Resources, Department of Agriculture
FY 2011

1. State: Territory of Guam

Grant number: F-19-E-2

Grant name: Guam Sport Fish Aquatic Education

Project number and name: F-19-E-2. Project. 1. Guam Sport Fish Aquatic Education.
Job 5. Public Presentations of Aquatic Resources

2. Report Period: October 1, 2010 to September 30, 2011

Report due date: December 29, 2011, Extended to January 30, 2012

3. Location of work: Guam: Island wide

4. Costs:

Source	Budgeted	Actual <u>X</u> or Estimated <u> </u>
Federal: Sport Fish Restoration	\$52,316	\$19,786
State		
Other:		
Total Federal	\$52,316	\$19,786
Total match	-0-	
Total project:	\$52,316	\$19,786

5. Objectives:

- a. Conduct 320 public presentations annually to various groups, events, or schools to increase the public's understanding of the importance of Guam's reefs, the knowledge of fish and other marine life, Guam's marine preserves, the importance of watersheds, or the damaging effects of soil erosion on coral reefs due to grassland fires.
- b. To increase public understanding via media of the importance of Guam's reefs, the knowledge of fish and other marine life, and of Guam's marine preserves on an annual basis throughout the fiscal year.

6. If the work in this grant was part of a larger undertaking with other components and funding, present a brief overview of the larger activity and the role of this project.

N/A

7. Describe how the objectives were met. See "Supplemental Information" for additional requirements and "Attachments" for specialized tables.

The objectives were met by the following activities during FY11:

a) The Division of Aquatic and Wildlife Resources (DAWR) delivered a total of forty-three (43) presentations (See Table 1) one coral reef ecology, toxic marine sea creatures, and fish to: public and private elementary, middle schools and high schools (22); University of Guam (UOG) classes (4); summer camps (4), career days (5), science fair (1), environmental events (3), hotels (2), and Department of Defense Education Activity (DODEA) school (2).

8. Discuss differences between work anticipated in grant proposal and grant agreement, and that actually carried out with Federal Aid grant funds; include differences between expected and actual costs.

The dramatic difference in projected and actual costs could be attributed to a typing error. The projected number of presentations should have been 32 not 320. Further, presenting the information in terms of total man-hours versus number of presentations may be more informative. The former will give an indication of the number of hours spent presenting to the various groups.

9. List any publications or in-house reports resulting from this work. N/A

Name, title, phone number, and e-mail address of person compiling this report: Jay T. Gutierrez, Assistant Chief, DAWR, Phone (671) 735-3980, E-mail jaytgutierrez@yahoo.com.

Table 1. Department of Agriculture Division of Aquatic and Wildlife Resources (DAWR) Public Presentation	
Date	Presentation
12/15/2010	George Washington High School
12/23/2010	Merizo Elementary School
12/24/2010	F B Leon Guerrero Middle School
12/25/2010	Career Day Astumbo Elementary
3/2/2011	Career Day PC Lujan Elementary
3/4/2011	C.L. Taitano Elementary
3/7/2011	Ordot - Chalan Pago Elementary
3/8/2011	Ordot - Chalan Pago Elementary
3/8/2011	Career Day Presentation
3/11/2011	Guam Plaza Hotel
3/14/2011	Adacao Elementary
3/17/2011	D.L. Perez Elementary
3/18/2011	Simon Sanchez High School
3/18/2011	C.L. Taitano Elementary
3/24/2011	Guam Adventist Academy
3/24/2011	University of Guam Class
3/25/2011	Guam High School
3/25/2011	Guam Plaza Hotel
3/28/2011	D.L. Perez Elementary
3/28/2011	University of Guam Class
3/30/2011	L P Untalan Middle School
4/4/2011	McCool Elementary/Middle School
4/5/2011	School Presentation
4/7/2011	Science Fair F B Leon Guerrero Middle School
4/12/2011	Career Day George Washington High School
4/14/2011	Inarajan Middle School
4/15/2011	Career Day Simon Sanchez High School
4/15/2011	L P Untalan Middle School
4/26/2011	Tamuning Elementary
4/28/2011	L P Untalan Middle School
4/28/2011	Tamuning Elementary
4/30/2011	Earth Day Display/Presentation
5/1/2011	May Festival Display/Presentation
5/12/2011	Simon Sanchez High School
5/17/2011	UPI Elementary

Table 1. Department of Agriculture Division of Aquatic and Wildlife Resources (DAWR) Public Presentation (Cont.)

6/7/2011	GGARP Event
6/27/2011	Kid's camp
7/8/2011	M A Ulloa Elementary
7/14/2011	Kid's camp
7/15/2011	University of Guam Class
7/26/2011	4H Camp
8/3/2011	University of Guam Class
8/5/2011	Kid's camp

Annual Project Performance Report
Guam Division of Aquatic and Wildlife Resources (GDAWR)
FY 2011

1. State: Territory of Guam

Grant number: F-19-R-2

Grant name: Guam Sport Fish Aquatic Education

Project number and name: F-19-R-2. Project 1. Guam Sport Fish Aquatic Education. Job 7. Inshore Kid's Fishing Derby

2. Report Period: October 1, 2010 to September 30, 2011

Report due date: December 29, 2011, Extended to January 31, 2011

3. Location of work: Island of Guam

4. Costs:

Source	Budgeted	Actual <u>X</u> or Estimated <u> </u>
Federal :	\$31,202.00	\$32,450.00
State		
Other: _____		

Total Federal	\$31,202.00	\$32,450.00
Total match		
Total project:	\$31,202.00	\$32,450.00

5. Objectives:

1. To teach sport fishing, provide young fishers with a positive fishing experience, and poster in them a conservation and management ethic, which will be determined through evaluation forms, by hosting two kid's fishing derbies each year for up to 75 participants per derby event at an appropriate site along the coastline of Guam.
2. To provide an opportunity for parents and children to learn about and practice basic fishing skills including knot-tying and casting by participating in the Department's fishing derbies and clinics that are held twice each year.

6. If the work in this grant was part of a larger undertaking with other components and funding, present a brief overview of the larger activity and the role of this project.

N/A

7. Describe how the objectives were met.

This year two derbies were held; the first on June 18th (N=37 kids) and the second on July 16th (n=43). Kids competed in three categories of fish: longest fish, longest triggerfish, and most fish caught. The 37 children who competed in the derby on June 18th caught 68 fish. Weather conditions were fair, with some short rain showers, but generally ok, and water conditions were flat. Heavy rains prior to the derby and the threat of heavy rains on the day of the derby, most likely lead to low participation on June 18th. On July 16th, 43 children competed, and caught 37 fish. Weather conditions were moderate, overcast with some rain and light winds. The water was a bit choppy

Two workshops were held for kids who were registered but didn't know how to fish or needed practice. The first workshop was held on Saturday, June 11th, and the second was held on Saturday, July 19th. The workshops were attended by 3-kids on June 11th, and 2 kids on July 19th.

All participants were given evaluation forms, and asked to provide comments and suggestions for the Kids Derby. A total of 35 evaluation forms were returned to DAWR staff, 15 on June 18th, and 20 on July 16th. Please see attached Table 1 and Table 2 for the results of the surveys.

8. Discuss differences between work anticipated in grant proposal and grant agreement, and that actually carried out with Federal Aid grant funds; include differences between expected and actual costs. N/A

List any publications or in-house reports resulting from this work. None

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Table 2. Results from the Kids Fishing Derby Evaluation sheet for 6-18-2011

15 responses turned in- some questions had more than one response, and some were left blank

1. How did you hear about the derby?

Friends-1

Newspaper-1

PDN-111

Online-1

Radio-11

Advertisement/word of mouth-1

KUAM-1

Staff-111

My daughter joined before-11

It's great for the kids to get out of the house away from the tv and games-1

2. What other areas would you like to have the Kid's Fishing Derby at?

Ypao-11111

Matapang-11

Tumon-111

East Agana-111

Agat seaside-1

Gun Beach-1

Piti-1111

Asan-1

Ritidian-1

Cocos-1

Here is just fine-11

Pago Bay-1

3. What do you think would make the derby better?

Longer fishing time- 3 to 4 hours-11

More publication of the event-1

Other activities, such as longest cast- target casting-1

No is not think better than this. Let the kids have fun learning to fish-1

Fishing derby in the preserve-1

We like it, we have fun-1

It is good as is though it would be better if it was held at other locations-1

All good. Ran great-1

Fishing in the reserve areas, so the kids can experience catching and educate them on how important reserve areas are to Guam-1

Nothing really. It is fun all day-1

Better place-1

Good the way it is-1

5. Did you learn anything about conservation? If so, what?

If I caught small fish, I will let them go to make the fish get bigger and make more baby fish-1

Catch and release very good-1

Catch and release-111

Let the fish go if small-1

Return small fish to the ocean-1

How lazy my kids are-1

Catch and release will preserve fish for future generations-1

Recycling-1

It preserves different species-1

How we can save baby fishes to grow up and make more fishes for generation to generation-1

I missed that part-1

6. Other comments, suggestions?

Good job Department of Agriculture. We had so much fun-1

Great way for kids to kick off the summer and have fun fishing-1

How about a fishing derby for manamko 55 and over-1

You guys did a very good job. Thank you. See you next year.-1

All good. First time with my son in the derby.-1

Please keep recycling-1

The staff was all good. See you next year-1

Give the kids the catching a fish experience- Go reserve for this type of event only-1

Continue to have this derby for the kids. Maybe more often-1

Ok with me-1

Good job. Job well done to your officials-1

Mark spots for safety reasons. Distance between each participant. It'll help the kids know how far apart they should be from one another. Parents should be at least 3 yards from their kids only to be fair to the others.-1

Table 2. 20 survey forms were returned for derby held on 7-16, 2011**1. How did you hear about the derby?**

DAWR staff-III
 Family- II
 PDN-II
 DAWR flyer-II
 Participated before-II
 Media-III
 Hit Radio-I
 Internet-I
 Maybe the newspaper-I
 Friends-I
 Newspaper-I

2. What other areas would you like to have the Kids Fishing Derby at? Name at least two other areas if possible.

Tagachang Beach-II
 Gab Gab beach- II
 Fish Eye Park- I
 Tumon-III
 Preserves-III
 Can't think of any-I
 Here is just fine. Central for people south and north.-I
 Ypao-III
 Gun Beach-I
 Asan is perfect.-I
 Current location is safe and ideal.-I
 Matapang.-I
 Port Beach-I

What do you think would make the derby better?

Pretty good so far.-I
 So far so good. Great turn out. -I
 Derby itself was great.-II
 PA system.-I
 Fish earlier-I
 Another hour fishing time-I
 More fishing time- I
 No changes-II
 Change the location.-II
 We thought it was great. Very well done.-I
 I thought it was great. My kids love it. Thanks for the hot dogs and drinks. -I

You guys are doing a good job.-I
 More staff out by the shore.-I
 Music, tent.-I
 Day and night-I
 Nothing. Excellent work DAWR.-I

Did you learn anything about conservation? And if so, what?

Yes- I
 That we need catch and release for future generations-I
 Yes, release until bigger and meatier-IIIIIIII
 Tag and release-II
 Recycling and keeping our environment clean-III
 Me and my kid picked up more trash than we came with. War stuff was great. -I
 Different kinds of fishes.-I

Other comments, recommendations, and suggestions?

Microphone-II
 T shirts for coaches and parents, awesome fun day.-I
 Very good-I
 We loved the presentation by the ranger, great history lesson-I
 Big thanks to Dept. of Agriculture staff. It's an experience for all da kids.-I
 Please choose another location. This place is not giving the children a real experience due to lack of marine life. -I
 More water stations.-I
 We live on Andersen and would love to help spread the word.I
 We were impressed by al the food, gifts, conservation officers. Very well done.-I
 Thanks for what you do.-I
 You guys are all great. A bad day of fishing is better than my son playing video games.
 Thanks. -I
 Why can't they open the preserves more often, at least just for fishing rods only but catch whatever fish and size. -I
 Thank you from parents and kids-I