

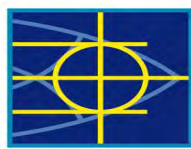


**Natural Resource Survey Report in Support
of the Environmental Impact Statement
for the Marine Corps Relocation Initiative to
Various Locations on Guam**

Final

December 23, 2010

Department of the Navy
Naval Facilities Engineering Command, Pacific
258 Makalapa Drive, Suite 100
Pearl Harbor, HI 96860-3134



NAVFAC

Naval Facilities Engineering Command

NAVFAC PACIFIC

AE Services for Environmental Planning to Support Strategic Forward Basing
Initiatives Contract Number N62742-06-D-1870, TO 0016 and TO 0007 Mod 4

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List of Acronyms and Abbreviations

AAFB	Andersen Air Force Base
ac	acre
AFB	Air Force Base
°C	Celsius
cm	centimeter
CNMI	Commonwealth of the Northern Mariana Islands
dbh	diameter at breast height
DoD	Department of Defense
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EOD	Explosive Ordnance Disposal
ERA	Ecological Reserve Area
ESA	Endangered Species Act
FAA	Federal Aviation Administration
GCWCS	Guam Comprehensive Wildlife Conservation Strategy
GDAWR	Guam Division of Aquatic and Wildlife Resources
GEDCA	Guam Economic Development and Commerce Authority
GPS	Global Positioning System
ha	hectare
HAPC	Habitat Area of Particular Concern
JGPO	Joint Guam Program Office
km	kilometer
m	meter
m ²	square meter
m/ha	meter per hectare
NAVFAC	Naval Facilities Engineering Command
NCTS	Naval Computer and Telecommunications Station
NMD	Non-metric Multidimensional Scaling
NMS	Naval Munitions Site
NR	Natural Resources
PVC	polyvinyl chloride
RH	relative humidity
sq cm	square centimeter
sq m/ha	square meter per hectare
SOGCN	Species of Greatest Conservation Need
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
UTM	Universal Transverse Mercator
VCP	variable circular plot
yr	year

1 Introduction

Under a Naval Facilities Engineering Command (NAVFAC) contract for Architect-Engineer Services for Environmental Planning to Support Strategic Forward Basing Initiatives and in support of the Marine Corps Relocation Initiative to Various Locations on Guam, the TEC Joint Venture received Task Order (TO) 0016 with subsequent modifications and TO 0007 Mod 04 for Natural Resources (NR) Surveys on Guam. The purpose of these TOs is to provide the necessary data to support the Environmental Impact Statement (EIS) for the Joint Guam Program Office actions relating to the relocation of the Marines by filling existing data gaps identified in the *Final Natural Resources Survey and Assessment Report of Guam and Certain Islands of the Northern Mariana Islands* (NAVFAC, 2007). Natural resource surveys were conducted on Department of Defense (DoD) and non-DoD lands on Guam (Figure 1-1).

This report provides a summary of the natural resource surveys performed under the TOs. The detailed survey reports developed by the TEC JV team members are found in this report's appendices.

1.1 DoD Lands and non-DoD Lands Considered

To meet the anticipated increase in personnel and to support proposed training activities, construction is planned at numerous military properties and non-DoD lands on Guam. DoD lands included the following: Andersen Air Force Base (AAFB), including AAFB Finegayan and Potts Junction; Andersen South; Air Force Barrigada; Navy Barrigada; North Finegayan; South Finegayan; Navy Main Base, including Inner Apra Harbor, Camp Covington, and Orote Point; and the Naval Munitions Site (NMS). Non-DoD lands included the Harmon Annex, Route 1 River Crossings, Route 15 Lands, Proposed Option Road A, and the former Federal Aviation Administration (FAA) Parcel. Figure 1-2 identifies the locations of these parcels on Guam.

1.2 Natural Resources Surveys

In order to assess the potential impacts to natural resources resulting from the buildup on DoD lands and non-DoD lands, a variety of natural resource surveys were conducted. These surveys included avian, butterfly, fruit bat, reptiles and amphibians (herpetofauna), marine waters, tree snail, and vegetation. Appendix A contains the descriptions of many species that were observed during the surveys. Table 1-1 identifies the surveys that were performed at each location. For each survey type a detailed technical report was prepared and these are provided in Appendices B through I.

1.3 Structure of the Report

Chapter 1 is this introduction. Chapter 2 identifies the methodologies that were utilized for each survey. Survey methodologies were generally conducted in an identical manner on each parcel; although, if there was a change in methodologies, the differences are noted. Chapters 3 through 13 provide a summary of the results of the natural resources surveys that were conducted on each

Location of Guam and Northern Mariana Islands



Philippine Sea

Mariana Islands

PAGAN

SARIGAN

FARALLON DE MEDINILLA

SAIPAN

TINIAN

AGUIJAN

ROTA

GUAM

60 0 60



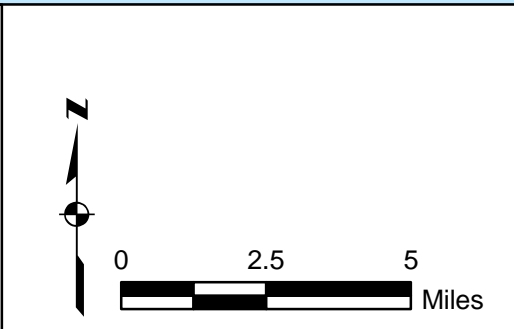
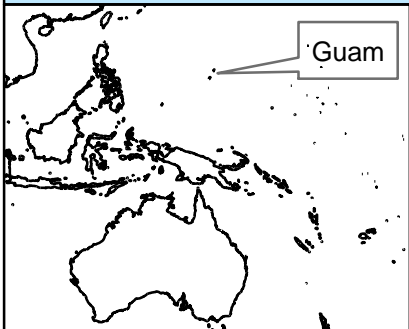
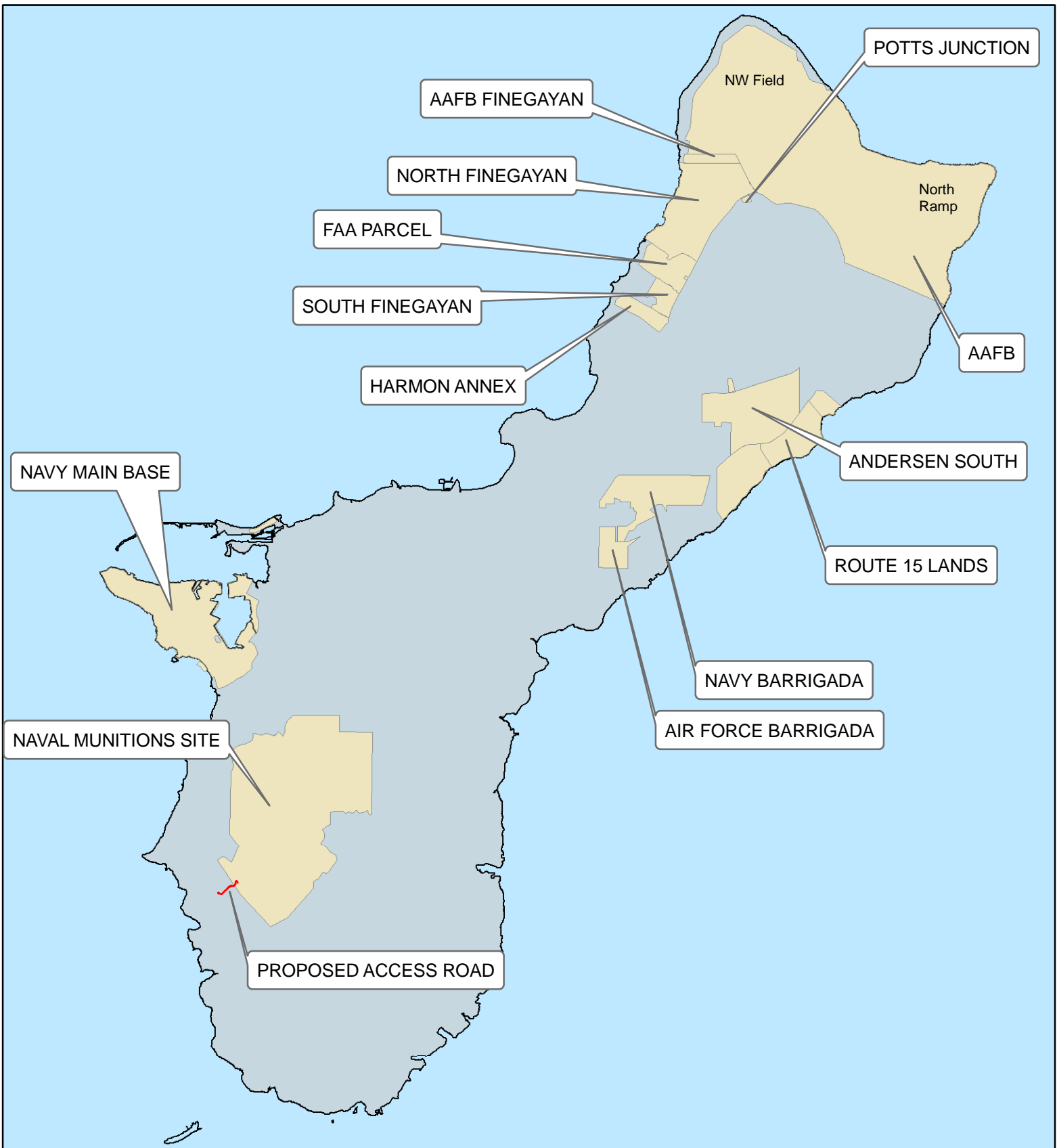
Scale in Miles




Scale in Kilometers

Figure 1-1





DoD Lands & Non DoD Lands

Prepared By:  Prepared For: 

APPENDIX E

Butterfly Surveys

Butterfly Survey Report. Andersen Air Force Base, Andersen South, and Navy Barrigada. AECOM. June 28, 2010; and

Survey for the Mariana eight spot butterfly, *Hypolimnas octocula marianensis* (Lepidoptera: Nymphalidae), in the Pagat Route 15 area of Yigo Village, Guam. NAVFAC Pacific, Pearl Harbor, HI August 2009.

BUTTERFLY SURVEY REPORT

Andersen Air Force Base

Andersen South

Navy Barrigada



June 28, 2010



**Department of the Navy
Naval Facilities Engineering Command,
258 Makalapa Drive, Suite 100
Pacific Pearl Harbor, HI 96860-3134**

**AE Services for Environmental Planning to Support Strategic Forward Basing Initiatives
Contract Number N62742-06-D-1870, TO 0016**

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1 Introduction

Under a NAVFAC contract for AE Services for Environmental Planning to Support Strategic Forward Basing Initiatives and in support of the “Marine Corps Relocation Initiative to Various Locations on Guam”, the TEC JV received Task Order 0016 with subsequent modifications 1 & 2 and TO 0007 Mod 04 for Natural Resource (NR) Surveys on Guam. The basis for this assignment is to provide the necessary data to support the Environmental Impact Statement (EIS) for the Joint Guam Program Office actions relating to the relocation of the Marines by filling existing data gaps identified in the Final Natural Resources Survey and Assessment Report of Guam and Certain Islands of the Northern Mariana Islands (NAVFAC 2007).

As part of the natural resource surveys, investigations for the presence of the Mariana Eight-Spot Butterfly (*Hypolimnys octucula mariannensis*) and the Mariana wandering butterfly (*Vagrans egistina*) were conducted on three DoD parcels on Guam: Andersen Air Force Base (AAFB), Andersen South and Navy Barrigada. Both species are candidate species for listing by the United States Fish and Wildlife Service (USFWS) under the Endangered Species Act of 1973 (USFWS, 2010). The Mariana Wandering Butterfly is also considered a Species of Greatest Conservation Need (GDAWR, 2005).

1.1 Mariana Eight-Spot Butterfly

The Mariana Eight-Spot Butterfly (Photo 1) is a nymphalid butterfly, feeds upon two host plants, *Procris pedunculata* and *Elatostema calcareum*, which are indigenous succulent herbs that grow in limited habitats over limestone rock outcrops in moist limestone forest. The butterfly is endemic to the islands of Guam and Saipan, and the species is now known from ten populations on Guam. This species is currently threatened by predation and parasitism. The Mariana Eight-Spot Butterfly has extremely high mortality of eggs and larvae due to predation by alien ants and wasps. Because the threat of parasitism and predation by nonnative insects occurs range-wide and can cause significant population declines to this species, they are high in magnitude. The threats are imminent because they are ongoing (USFWS, 2010).

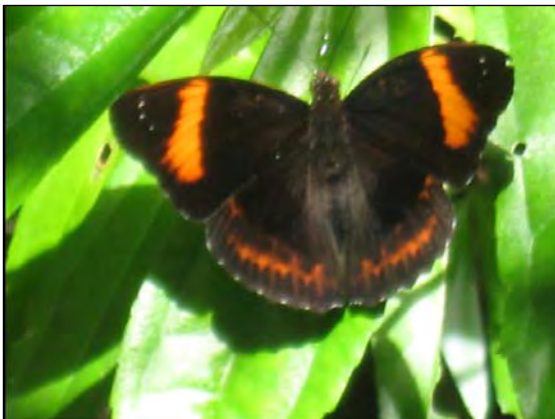


Photo 1 Mariana Eight-Spot Butterfly
(*Hypolimnys octucula mariannensis*)

Surveys on the Rt 15 properties (Figure 1) identified the host plants: *Elatostema calcareum* (Urticaceae) and *Procris pedunculata* (Urticaceae) and observed Mariana Eight-Spot Butterfly

along Transect 2. Also, evidence of eggs was found in other locations throughout the investigated areas (Figure 1).

1.2 Mariana Wandering Butterfly

A very rare butterfly, endemic to the islands of Guam and Rota. Although, historically found on Guam and CNMI (Rota), the species now occurs with any certainty only on Rota (USFWS, 2010a).

Body color is primarily orange and black, with black bordering the wings. A large orange irregular shape extends from the forewings to the hindwings. Females and males are similar in body color and size. Larvae feed on a plant species (*Maytenus thompsonii*) that is endemic to the Mariana Islands. Adults are good fliers and can move considerable distances (USFWS, 2008).

2 Methods

During September 28– October 2, 2009 and January 25-31, 2010 a butterfly survey was conducted on three transects at Andersen AFB, one transect on Andersen South, and one transect on Navy Barrigada. The butterfly survey consisted of two methods: timed counts and baited traps. Descriptions of these methods are provided in the sections below.

2.1 Timed Counts

Timed counts were conducted along linear transects within each of the three parcels. At every 30-m, two scientists would stand back-to-back and enumerate the observations of all butterfly species within a 5-minute period. The areas investigated along the transect consisted of 20-m diameter circle plots. The biologists communicated with each other frequently throughout the survey period so as not to count the same individual butterfly twice. A total of five transects were studied. Three transects were located on AAFB (Figure 2) and one transect was located on Andersen South (Figure 3) and Navy Barrigada (Figure 4).

2.1.1 Andersen AFB

On AAFB, the butterfly survey occurred on Transects 5, 6, and 7 (Figure 2), which are all located in the southern portion of AAFB. Each transect was 400 m in length. The transects were located in forested areas with a canopy of 6-12 m in height with moderate to dense undergrowth. On Transect 5, between 130 m and 190 m, an open area dominated by herbaceous vegetation, grasses, and a few small isolated trees results in a break in the forest canopy.

2.1.2 Andersen South

On Andersen South, the butterfly survey was conducted on Transect 7 (Figure 3), which is 500-m long and located in a forested area. The forest canopy is approximately 10 m in height, with moderate to heavy undergrowth. The undergrowth often occurred in the form of smaller saplings and numerous vines.

2.1.3 Navy Barrigada

On Navy Barrigada, the butterfly survey was conducted on Transect 3, which measured 250-m in length (Figure 4). The transect is located in a forested area with a canopy of approximately 6-8 m in height with several small clearings on and/or near the transect. The forested area is located adjacent to a large, maintained grass field associated with communication towers. The survey began approximately 15 m from the forest's edge.

2.2 Baited Traps

Two baited traps were placed on each transect during daylight hours. The bait consisted of a mixture of mashed ripe bananas, apple cider, sugar, and yeast (Photo 2). At the end of the trapping period, which lasted approximately 6 hours, the traps were checked, and captured butterflies were noted and then released.



Photo 2 Butterfly Trap. The bait is placed in the white dish. Butterflies land on the edge of the dish and consume the bait. When the butterflies initiate their next flight they instinctively fly upwards and become trapped in the mesh cylinder.

2.2.1 Andersen AFB

Two baited traps were placed on each transect (Transects 5, 6, and 7) in the morning and retrieved in the late afternoon. On Transect 5, the traps were placed within a forested area in the beginning of the transect (September and January) and a second trap was placed within a clearing in the September survey and near the end of the transect in the January survey. On Transect 6 and Transect 7, the traps were placed in forested areas at the beginning and the end of each transect in both the September and January surveys.

2.2.2 Andersen South

Butterfly traps were set at the 0 and 470 meter mark on Transect 7. The baited traps were placed on each transect during daylight hours.

2.2.3 Navy Barrigada

Two baited traps were placed on Transect 3 during daylight hours. The trap was placed at the start of the transect, and at approximately the 60 meter mark near a clearing.

3 Results

3.1 Description of Species Observed

A total of six butterfly species were identified during the surveys. The descriptions of the species are based on Schreiner and Haus, 1997.

- Lemon Emigrant, *Catopsilia pomona*. The species is found in the Marianas and Palau. The larvae feed on various species of *Cassia* sp. The species is often found in moist open areas and engages in migratory flights.
- Monarch, *Danaus plexippus*. This species' range includes the America, Australia and numerous pacific Islands – including the Marianas. In Micronesia, the species feeds on *Asclepias curassavica* and crown flower, *Caltopis gigantean*. The species is a known migrant capable of flying thousands of miles.
- Blue-branded King Crow, *Euploea Eunice*. This species' range extends from India to Micronesia. The larvae feed on *Ficus* sp., edible figs, and oleander. They are often sighted hanging on aerial roots of fig trees, other vegetation, or structures.
- Blue Moon, *Hypolimnas bolina*. This species ranges from Madagascar to New Zealand; moreover, the species is considered the most widely distributed butterfly in the world. The species is recorded as taking migratory flights from Australia to New Zealand.
- Common Evening Brown, *Melanitis leda*. In the Pacific, the Common Evening Brown butterfly occurs within the Marianas and Caroline Island Chains. On Guam, the species has been found on corn, Guinea grass, and Napier grasses. The larvae also feed on grasses.
- Common Mormon, *Papilio polytes*. This species is found throughout southeast Asia, Philippines, Palau, Yap, and the Marianas Islands; although, the species is thought to be a recent arrival to the Marianas. The butterflies are attracted to salt and frequently found at puddles. Food plants include citrus and other Rutaceae plants.

The Mariana Eight-Spot Butterfly and the Mariana Wandering Butterfly were not observed on any transect.

3.2 Timed Counts

Tables 1, 2, and 3 identify the number of individuals and species observed within the various sampling plots on AAFB, Andersen South, and Navy Barrigada, respectively.

3.2.1 Andersen AFB

In September 2009, the Common Mormon and Blue-banded King Crow were the two most common butterflies sighted and comprised 46 and 43.6 percent of the total sightings at AAFB, respectively (Table 1). Approximately 62 percent (57 of 92 sightings) of the total sightings of the Blue-banded King Crow occurred within two plots along Transect 5 associated with a road cut.

In January 2010, the Blue-banded King Crow and the Common Mormon were the two most common butterflies sighted, comprising 64.5 and 24.5 percent of the total sightings, respectively. Similar to the September findings, a majority of the total sightings on the Blue-banded King Crow (152 of 160 [95 percent]) occurred within the first 120 m of Transect 5.

The January sightings total of 282 individuals is approximately one-third higher than the September total of 211. Although there were two additional species sighted in September (Blue Moon and Monarch), the total number of individuals of these two species was only three. All of the species sighted are widely distributed in the Mariana Islands.

3.2.2 Andersen South

Table 2 identifies the numbers of individuals and species observed within the various sampling plots on Andersen South in September 2009 and February, 2010. None of the species that were observed on Andersen South are considered endangered or threatened and all are widely distributed in the Mariana Islands.

On Andersen South the Common Mormon was the most numerous sighted butterfly in both September 2009 and January 2010, comprising 88.8 and 56.3 percent of the total sightings, respectively. The numbers of butterflies sighted, on average, also decreased between September and January. This reduction in abundance may be the result may be the result of natural cycles in butterfly population, the relatively short observation periods involved, or other factors.

3.2.3 Navy Barrigada

On Navy Barrigada, the Common Mormon was the most frequently observed butterfly in September and January, comprising 73.2 and 52.5 percent of the total sightings, respectively (table 3). The numbers of individuals and species showed little variation between September and January.

Table 1										
Butterfly Sightings on AAFB										
Transect	September 2009						January 2010			
	Meter Dist. On Transect	Species					Meter Dist. On Transect	Species		
		Common Mormon	Blue-banded King Crow	Lemon Emigrant	Blue Moon	Monarch		Common Mormon	Blue-banded King Crow	Lemon Emigrant
5	10		1				0		40	
	40						30	1	9	
	70	1	4				60		28	
	100	2	6				90	1	24	
	130	2	29	2	2		120		51	
	160	3	28	4		1	180	2		
	190						220	1	1	
	230						250	1		
	260						280	3		
	290	1					310	3	1	
	320	1					340	2	2	
	350						370	2		
	380	2					400	2	4	
	TOTAL SIGHTINGS	12	68	6	2	1	TOTAL SIGHTINGS	18	160	
	Percent of Sightings	13.48	76.40	6.74	2.25	1.12	Percent of Sightings	10.1	89.8	0
6	0									
	30						20	1		
	60	2					50	2		1
	90	8	2	3			80	2		
	120	8		1			110	2	1	
	150	3		2			140	1		
	180	5		1			170	3		6
	210		3	1			200	3		3

Table 1										
Butterfly Sightings on AAFB										
Transect	September 2009						January 2010			
	Meter Dist. On Transect	Species					Meter Dist. On Transect	Species		
		Common Mormon	Blue-banded King Crow	Lemon Emigrant	Blue Moon	Monarch		Common Mormon	Blue-banded King Crow	Lemon Emigrant
	240	1		3			230	2		7
	270	2					260		1	
	300	3		1			290	2		1
	330	2					320	2		4
	360	6					350	2		6
	390	5	17				380	3	1	1
	TOTAL SIGHTINGS	45	22	12	0	0	TOTAL SIGHTINGS	25	3	29
	Percent of Sightings	56.96	27.85	15.19	0.00	0.00	Percent of Sightings	43.9	5.3	50.9
7	0	2		1			0	3		
	30						30	2	1	
	60	1					60	2	2	
	90	1					90	5		
	120	3					120	1		
	150	2					150	2	4	
	180	3	2				180	1	6	
	210	4					210	4	1	
	240	4					240	1	1	
	270						270	4		1
	300	8					300	2		
	330	6					340		1	
	360	4					370			
	390	2					400		3	
TOTAL SIGHTINGS	40	2	1	0	0	TOTAL SIGHTINGS	27	19	1	

Table 1										
Butterfly Sightings on AAFB										
Transect	September 2009						January 2010			
	Meter Dist. On Transect	Species					Meter Dist. On Transect	Species		
		Common Mormon	Blue-banded King Crow	Lemon Emigrant	Blue Moon	Monarch		Common Mormon	Blue-banded King Crow	Lemon Emigrant
Percent of Sightings	93	5	2	0	0	Percent of Sightings	61.36	36.36	2.27	

Table 2							
Butterfly Sightings Andersen South							
September 2009				January 2010			
Meter Dist. On Transect	Species			Meter Dist. On Transect	Species		
	Common Mormon	Blue-banded King Crow	Lemon Emigrant		Common Mormon	Blue-banded King Crow	Lemon Emigrant
0	3			0	3	3	
20	4			30		1	
40	2			60			
60	4			90	3		1
80	4	1	2	120	3	1	
100			1	150	1		
120	6			180			
140	16			210	2		
160	10	1		240	1	1	1
180	2			270		2	
200	4			300			
220	4			330		1	
240	4			360	1		
260	1			390	2		
280	3			420	1	2	
300	3	2		450	1		
320	3		1	480		1	
340	4						
360	3						
380	3	2	1				
400	2						
420	1		1				
440	3						
460	1						
480	3						
500	2						
TOTAL SIGHTINGS	95	6	6	TOTAL SIGHTINGS	18	12	2
Percent of Sightings	88.79	5.61	5.61	Percent of Sightings	56.3	37.5	6.3

Table 3								
Butterfly Sightings at Navy Barrigada – September 2009 and January 2010								
Survey Plot - Meter Distance on Transect	Species			Survey Plot - Meter Distance on Transect	Species			
	Common Mormon	Blue- banded King Crow	Blue Moon		Common Mormon	Blue- banded King Crow	Blue Moon	Common Evening Brown
0	2	6		0	2	6		1
30	2	2		30	3			
60	7			60	2	1		
90	7	2	1	90	7		1	
120	3			120	1	2		
150	2			150	4	3		
180	2			180		4		
210	1			210				
240	4			240	2	1		
TOTAL SIGHTINGS	30	10	1	TOTAL SIGHTINGS	21	17	1	1
Percent of Sightings	73.2	24.4	2.4	Percent of Sightings	52.5	42.5	2.5	2.5

3.3 Baited Traps

3.3.1 Andersen AFB

No butterflies were captured in the baited traps on AAFB in September 2009. In January 2010, one Blue-banded King Crow was captured in a trap on Transect 6.

3.3.2 Andersen South

Butterfly traps were set at the 0 and 470 meter mark on the transect. The baited traps were placed on each transect during daylight hours. No butterflies were captured on Andersen South during the butterfly surveys.

3.3.3 Navy Barrigada

Two individuals of Common Evening Brown butterfly were captured in September 2009. In January 2010, one Common Evening Brown was captured.

4 Summary

Six butterfly species were observed or trapped as part of this study. Table 4 identifies species observed within the various transects on AAFB, Andersen South, and Navy Barrigada. None of the six species are considered endangered or threatened and are fairly well-distributed throughout Guam and portions of the Mariana Islands (Schreiner and Nafus, 1997). The number of sightings

of butterflies within forested areas was generally low. Sightings typically increased dramatically in areas dominated by grasses or wooded areas with less understory vegetation.

Table 4					
Butterfly Species Identified at AAFB, Andersen South, and Navy Barrigada					
Species	AAFB Transects			Andersen South	Navy Barrigada
	5	6	7		
Blue-branded king crow	x	x	x	x	x
Blue Moon*	x				x
Common Mormon	x	x	x	x	x
Common Evening Brown**					x
Lemon Emigrant	x	x	x	x	
Monarch	x				

Notes: *Observed several times along the road on Andersen South.
**Although not observed on the transects or during the survey, the species was observed on AAFB and Andersen South.

The Mariana Eight-Spot Butterfly and Mariana Wandering Butterfly were not observed on any transect. Moreover, the host plants for the Mariana Eight-Spot Butterfly were also not observed on AAFB, Andersen South, or Navy Barrigada. The plant (*Maytenus thompsonii*) for the Marianas Wandering Butterfly was observed on Andersen South.

5 References:

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Survey for the Mariana eight spot butterfly, *Hypolimnas octocula marianensis* (Lepidoptera: Nymphalidae), in the Pagat Route 15 area of Yigo Village, Guam

August 2009

Prepared by Cory Campora and Stephan Lee
NAVFAC Pacific

Summary

Surveys were performed for all life stages of the Mariana eight spot butterfly, *Hypolimnas octocula marianensis* Fruhstorfer, and its two documented host plant species along three transects (Rt 15 North, Rt 15 South, and Pagat Cave) in the Pagat area south of Route 15, in the southern corner of Yigo Village, Guam during the time period from July 15 to July 24, 2009. Host plants of *H. octocula marianensis* were sparse except for two areas, one on the Rt 15 North transect and one on the Rt 15 South transect, which contained large groups of both plant species. One adult *H. octocula marianensis* was seen in the large host plant area on the Rt 15 North transect. Other life stages (e.g. egg, larvae, pupae) were found on host plants in all three transects, however, without rearing these stages to the adult form they cannot be identified with complete certainty as *H. octocula marianensis*. Geographic locations are provided for all locations of *H. octocula marianensis* and host plants.

Introduction

Hypolimnas octocula marianensis Fruhstorfer, also known as the Mariana eight spot butterfly or forest flicker, is one of eight subspecies in the *Hypolimnas octocula* complex (Tennent 2006) and is currently classified as a candidate species for listing as endangered by United States Fish and Wildlife Service (FWS). It is reported to occur on the islands of Guam and Saipan (Tennent 2006); however, it may have been extirpated from Saipan (Hawley and Castro 2008, Schreiner and Nafus 1997). The status of *H. octocula marianensis* on Guam is also unclear. It was described as scarce during a 1936 Lepidoptera survey, with only one specimen collected from the Piti area (Swezey 1942). According to the Guam Agricultural Experiment Station collection, three specimens were collected at Hilaan Point in 1975, one specimen was collected from Anderson Air Force Base in 1982, and two more specimens were collected from Hilaan Point in 2001 (GDAWR 2005). Results from surveys conducted in 1996 for the FWS by Schreiner and Nafus indicated that there were 10 populations of the butterfly on Guam (Hawley and Castro 2008). The locations of these populations were as follows: Fadian Cove (1), Hilaan (2), Mangilao golf course (2), Orote (1), Pagat (2), and Tweeds Cove (2). No quantitative estimates of population sizes were provided, but it was noted that the highest number of individuals seen in one day was six (USFWS 2008). The two known host plants of *H. octocula marianensis* are *Elatostema calcareum* and *Procris pedunculata*

(Schreiner and Nafus 1997). Both host plants are from the family Urticaceae and occur in wet, native forest areas with exposed limestone karst.

The current survey was conducted in the Pagat area south of Route 15, near the Guam International Raceway in the southern corner of Yigo Village. One adult *H. octocula marianensis* was observed in this area during recent biological surveys for the Guam and Commonwealth of the Northern Mariana Islands (CNMI) Military Relocation Environmental Impact Statement (EIS) (M. Moese, personal communication, 5 Jan. 2009). The purpose of this survey was to gather more information on *H. octocula marianensis* in this area.

Methods

Two primary transects used were used to survey the butterfly and host plants. These were established by biologists from TEC Inc. and SWCA Environmental Consultants and are referred to as Route 15 North and Route 15 South. A third transect, the trail leading to Pagat Cave, was surveyed only once. Personnel participating in the surveys consisted of two entomologists from NAVFAC Pacific and one biologist from NAVFAC Marianas. All transects were surveyed during the period from 15 to 24 July, 2009. Surveys were generally conducted from late morning (~ 9:00-10:00 am) to late afternoon (~ 2:00-4:00 pm); however on 17 July the survey was conducted one hour before and after sunrise (~ 5:30 am to 7:30 am) and one hour before and after sunset (~ 7:00 pm to 9:00 pm) to determine if larvae were active during these time periods. A handheld GPS (Garmin GPSMap60Csx) was used to track all movement and record geographical locations of host plants and all observed life stages of *H. octocula marianensis*.

Transects were first surveyed over their entire length for host plants. Once the most probable areas of butterfly habitat (i.e. areas with a high density of host plants) were identified, efforts were then focused on those sites. This consisted of searching host plants for eggs, larvae, and pupae, monitoring the understory and upper forest canopy for adults, and monitoring bait pans. A digital camera (Canon 30D) was used to capture images of host plants and all butterfly life stages. Field binoculars were used to identify adult butterflies from long distances. Bait pans consisted of aluminum pie tins and were suspended approximately five to six feet from the ground. Banana and pieces of fish were used as bait. Bananas were prepared one day in advance by mashing and mixing with cane sugar and water and leaving at room temperature in a sealed bag for 24 hours. Fish pieces were obtained from a local market and placed in bait stations on the same day of purchase. Three bait pans were used in each area of butterfly habitat for a period of two days.

Results

Two areas were identified which contained numerous plants of both host plant species. These areas were near the beginning of the Route 15 North and Route

15 South transects and are shown respectively (sites N01 and S03) in Figures 1 and 2. A description of the search effort in these areas is provided in Table 1. Other host plants sighted on occurred in small isolated groups and were represented as discrete points in Figures 1, 2, and 3. All host plant locations are listed in Table 1, and images of host plants are included as appendix A.

Sightings of *H. octocula marianensis* are listed in Table 2, and displayed in Figures 1, 2, and 3. No butterflies of any species were observed at the bait pans. With the exception of the site on the Pagat Cave trail where three larvae were found, all sightings occurred within sites N01 and S03. One adult male *H. octocula marianensis* was seen and photographed within N01. The following day, an identical butterfly was seen at the same location and was presumed to be the same individual. There was a possible sighting of an adult female *H. octocula marianensis* within S03, but it passed quickly out of sight and could not be positively identified. A total of 7 *Hypolimnas* larva were found at 5 different locations on both *E. calcareum* and *P. pedunculata*. *Hypolimnas* eggs were found only on *E. calcareum*, with a total of 19 eggs at 5 different locations. One viable *Hypolimnas* chrysalis was found on *E. calcareum* within site N01, and three empty *Hypolimnas* chrysalides were found on *P. pedunculata* within site S03.

Discussion

Results from this survey and others conducted in the Pagat area of Route 15 indicate that there are at least two areas of habitat that are supporting *H. octocula marianensis*. The sighting of the adult butterfly within N01 during the current survey and the sighting of the adult butterfly in the vicinity of S03 by TEC Inc. (M. Moese, personal communication, 5 Jan 2009) are evidence that the species is present in these two areas. The site on the lower shelf down by Pagat Cave may represent a third area with *H. octocula marianensis*, but it cannot be confirmed without the presence of adults. These findings support the results from surveys conducted in 1996 by Schreiner and Nafus who reported 2 populations of *H. octocula marianensis* in the Pagat area (USFWS 2008). Whether or not the two confirmed areas support a single population or two separate populations is unclear. The habitat sites on the north and south transects are separated by approximately 1.5 kilometers. The Pagat Cave Trail site is approximately 1.5 kilometers from the south transect site and 3 kilometers from the north transect site, but it was at a much lower elevation than the other two sites. The cave trail site was on the lower island shelf at about 82 meters above sea level compared to approximately 166 m and 185 m above sea level for the north and south transect sites. If it is assumed that the larva found near Pagat cave were *H. octocula marianensis*, it would seem more likely that they would represent a separate population from the butterflies seen at the other two sites.

Unfortunately there is some uncertainty regarding the identification of immature life stages of *H. octocula marianensis*. These stages are not easily distinguishable from other *Hypolimnas* species unless they are successfully reared to the adult form. While the larva found on *E. calcareum* and *P. pedunculata* fit Schreiner and Nafus' (1997) description (black with reddish orange spines and a black head), there are two other *Hypolimnas* species, *H. anomala* and *H. bolina*, which look similar during their immature stages. Schreiner and Nafus (1997) describe *H. anomala* larva as black with black spines and greasy in appearance when they are younger, and black with orange spines when they are older. *Hypolimnas bolina* is described as similar to *H. anomala* but with a "diffuse brownish orange stripe down each side". The younger larvae also differ from *H. anomala* in that they have orange spines rather than black and they do not have a greasy appearance (Schreiner and Nafus 1997). All larva seen during the current survey were black or blackish gray with black heads and orange spines. Differentiating these from *H. anomala* is not easy since the amount of red in the orange spines is listed as the primary distinguishing factor (Schreiner and Nafus 1997) and is difficult to characterize. Based on Schreiner and Nafus' (1997) descriptions, it would seem unlikely that these larva were *H. bolina* since there was no evidence of a lateral stripe. However, they cannot be completely discounted as *H. bolina* because images of larva were also sent to Chris Samson, a lepidopterist who has worked with *H. octocula* complex (Sampson 1986), and his opinion was that some of them could be *H. bolina* or *H. anomala*, while others could be *H. octocula marianensis* (C. Samson and J. Tennent, personal communication, 21 July 2009).

Images of larvae were also sent to Ilse Schreiner, a former entomologist at the University of Guam and coauthor of Butterflies of Micronesia (Schreiner and Nafus 1997). Her comment was that while it is difficult to identify the immature stages, if they were on either of the known host plants, then they were probably *H. octocula marianensis* (I. H. Schreiner, personal communication, 17 July 2009). The only host plant listed for *H. anomala* is *Pipturus argenteus* (Wright et al. 1977, Schreiner and Nafus 1997). *Hypolimnas bolina* has also not been documented to feed on *E. calcareum* or *P. pedunculata*, but, unlike *H. anomala*, it has an extensive list of foodplants, including other species of *Elatostema* (Wright et al. 1977, Parsons 1991). It is consequently not implausible that *H. bolina* could be found on *E. calcareum*. Adult butterflies of both *H. anomala* and *H. bolina* were seen flying within the large host plant areas on the north and south transects; however, they were not common. The most common butterfly species seen flying in these areas were *Euploea eunice* (Danaiidae) and *Papilio polytes* (Papilionidae).

Eggs of *H. bolina*, *H. anomala*, and *H. octocula marianensis* are also very similar in appearance and very difficult, if not impossible, to differentiate in the field (C. Samson and J. Tennent, personal communication, 21 July 2009). It is interesting to note, however, that out of 19 *Hypolimnas* eggs found during this survey, all of them were black (Appendix B, Images 7, 10, 11, and 13) except for two, which

were green (Appendix B, image 12). Healthy, viable eggs should be green in color, and eggs which have been parasitized are black (I. H. Schreiner, personal communication, 17 July 2009). Egg parasitism of *H. bolina* and *H. anomala* on Guam was reported by Donald Nafus in 1993 (Nafus 1993); however, it was found that *H. bolina* was parasitized more frequently during the egg stage than *H. anomala*. The majority of egg parasitism on both butterfly species was carried out by three parasitoids: 1) *Telenomus* sp. 2) *Oencyrtus* sp. and 3) *Trichogramma chilonus*. This study did not include Guam's endemic nymphalid species (*Vagrans egista* (Latreille and Godart)) and subspecies (*H. octocula marianensis*), however, given that the three parasitoids listed above show a lack of host specificity, it is highly probably that the native nymphalids are also attacked.

The adult *H. octocula marianensis* that were observed on July 22 and 23 were probably the same individual. The butterflies were identical in appearance and were seen roosting in the same location on the same tree at approximately the same time. On both occasions the butterfly remained in the upper, sunlit canopy and spent the majority of its time perched. This is consistent with behavior documented for *H. octocula elsina* on New Caledonia: "*Octocula* favors well-developed rainforest, emerging from the undergrowth to sun itself on leaves, especially in the morning. It is very much commoner on the wetter, eastern side of New Caledonia (Holloway and Peters 1976)." The pattern and coloration of this butterfly alone do not provide enough information to assess the gender of the butterfly - male and female *H. octocula marianensis* are very similar in appearance, unlike other subspecies show strong sexual dimorphism (Wright et al. 1977, Schreiner and Nafus 1997). However, judging from the behavior it displayed, it was probably a male. Males are generally less active and fly about with no obvious sense of purpose while females are much more businesslike, flying from hostplant to hostplant in their quest to oviposit (I. H. Schreiner, personal communication, 17 July 2009). It also appeared to exhibit some territorialism, never flying far from its roost and chasing other butterflies which entered its air space.

In summary, there is at least one population of the Mariana eight spot butterfly in the Pagat area. There are two areas that contain relatively high numbers of both host plants for the butterfly, and which appear to be sustaining the butterfly population. Any negative impact on these areas would have a direct effect on the butterfly population. The population in these areas already appears to be under stress from parasitization, and any further pressures from habitat degradation could potentially be very damaging. Other areas of habitat for *H. octocula marianensis*, similar to the Pagat Cave trail site, may exist on the lower limestone shelf; however, these would probably support separate populations from the Route 15 area. Additional surveys would be required to identify these habitat areas at lower elevations.

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Table 1. *Hypolimnas octocula marianensis* host plant sites and search effort.

Site	Transect & Coordinates	Elev (ft)	Species	Date & Time Searching for <i>H. octocula</i>	Date & No. People ¹ Searching for <i>H. octocula</i>	Total Search Time (m)	Notes
N01	Rt 15 North N/A ²	545	<i>Elatostema calcareum</i> and <i>Procris pedunculata</i>	15JUL09 0948-1033 20JUL09 0900-1015 22JUL09 1030-1220 23JUL09 1000-1100	15JUL09 2 (CC, SL) 20JUL09 3 (CC, SL, MS) 22JUL09 2 (CC, MS) 23JUL09 2 (CC, SL)	290	Mostly <i>P. pedunculata</i> , some <i>E. calcareum</i> . (Appendix A, images 1-3, 5, 7-10)
N02	Rt 15 North N13 30.759 E144 53.660	563	<i>Procris pedunculata</i>	15JUL09 1100-1105	15JUL09 2 (CC, SL)	5	Small group of plants in a patch of limestone forest just after a cleared area.
N03	Rt 15 North N13 30.763 E144 53.661	570	<i>Procris pedunculata</i>	15JUL09 1130-1135	15JUL09 2 (CC, SL)	5	Small group of plants in a patch of limestone forest just after a cleared area.
N04	Rt 15 North N13 30.794 E144 53.640	576	<i>Procris pedunculata</i>	15JUL09 1150-1153	15JUL09 1 (CC)	3	Small group of plants
N05	Rt 15 North N13 30.809 E144 53.633	565	<i>Procris pedunculata</i>	15JUL09 1200-1203	15JUL09 1 (CC)	3	Small group of plants
S01	Rt15 South N13 30.144 E144 53.202	593	<i>Elatostema calcareum</i>	16JUL09 0950-0955	16JUL09 2 (CC, SL)	5	Small group of plants
S02	Rt15 South N13 30.143 E144 53.199	603	<i>Procris pedunculata</i>	16JUL09 0955-1000	16JUL09 2 (CC, SL)	5	Small group of plants
S03	Rt 15 South N/A ²	N/A ³	<i>Elatostema calcareum</i> and <i>Procris pedunculata</i>	16JUL09 1002-1138 17JUL09 0538-0745 17JUL09 1900-2034 20JUL09 1430-1545 21JUL09 1000-1200 22JUL09 1245-1315 23JUL09 1120-1220 23JUL09 1430-1600 24JUL09 1000-1115	16JUL09 2 (CC, SL) 17JUL09 2 (CC, SL) 17JUL09 2 (CC, SL) 20JUL09 2 (CC, MS) 21JUL09 2 (CC, MS) 22JUL09 2 (CC, MS) 23JUL09 2 (CC, SL) 23JUL09 2 (CC, SL) 24JUL09 2 (CC, SL)	767	Very large stands of <i>E. calcareum</i> and <i>P. pedunculata</i> . (Appendix A, images 4, 6, and 11)

Site	Transect & Coordinates	Elev (ft)	Species	Date & Time Searching for <i>H. octocula</i>	Date & No. People ¹ Searching for <i>H. octocula</i>	Total Search Time (m)	Notes
S04	Rt 15 South N13 30.123 E144 53.147	615	<i>Elatostema calcareum</i>	16JUL09 1207-1220	16JUL09 2 (CC, SL)	13	Small group of <i>E. calcareum</i> .
S05	Rt 15 South N13 30.115 E144 53.110	600	<i>Procris pedunculata</i>	16JUL09 1220-1227	16JUL09 2 (CC, SL)	7	Small group of <i>P. pedunculata</i> .
S06	Rt 15 South N13 30.095 E144 53.092	600	<i>Elatostema calcareum</i>	16JUL09 1240-1245	16JUL09 2 (CC, SL)	5	Small group of <i>E. calcareum</i> .
S07	Rt 15 South N13 30.100 E144 53.079	600	<i>Elatostema calcareum</i>	16JUL09 1247-1252	16JUL09 2 (CC, SL)	5	Small group of <i>E. calcareum</i> .
S08	Rt 15 South N13 30.106 E144 53.091	589	<i>Elatostema calcareum</i>	16JUL09 1342-1400	16JUL09 2 (CC, SL)	8	Small group of <i>E. calcareum</i> .
S09	Rt 15 South N13 30.164 E144 53.183	-	N/A ⁴	24 JUL09 1100-1130	24 JUL09 1 (CC)	30	Used binoculars to search top of canopy covering site S03.
P01	Pagat Cave Trail N13 29.524 E144 52.643	268	<i>Elatostema calcareum</i>	22JUL09 1550-1610	22JUL09 1 (CC)	20	Medium sized group of <i>E. calcareum</i> . (Appendix A, image 12)

¹CC = Cory Campora, SL = Stephan Lee, MS = Maria Santos

²This site consists of a large area and cannot be defined accurately by a single point.

³Elevation was variable within this area.

⁴This site was an observation point for looking at upper canopy.

Table 2. Observed life stages of *Hypolimnas octocula marianensis*.

Date & Time	Site	Transect & Coordinates	Elev (ft)	Life Stage (quantity)	Host Plant	Weather - Cloud Cover (%):Wind (1-3):Rain (Y/N)	Notes
15JUL09 1050	N01	Rt 15 North N13 30.819 E 144 53.651	545	Chrysalis (1)	<i>Elatostema calcareum</i>	20:1:N	Signs of feeding on leaves <i>E. calcareum</i> near the chrysalis. (Appendix B, image 1.)
16JUL09 1030	S03	Rt 15 South N13 30.157 E144 53.164	615	Larvae (1)	<i>Procris pedunculata</i>	70:2:N	Late instar, actively feeding during part of the time it was observed, large green frass pellets seen nearby. (Appendix B, images 2-4.)
16JUL09 1138	S03	Rt 15 South N13 30.132 E144 53.164	621	Larvae (1)	<i>Elatostema calcareum</i>	70:2:N	Late instar. (Appendix B, images 5 and 6.)
16JUL09 1135	S03	Rt 15 South N13 30.132 E144 53.164	621	Egg (3)	<i>Elatostema calcareum</i>	70:2:N	Located in same location as larvae, but on a separate plant. All three eggs were black. (Appendix B, image 7.)
17JUL09 1915	S03	Rt 15 South N13 30.141 E144 53.167	580	Chrysalis (2)	<i>Procris pedunculata</i>	80:0:Y	Both chrysalides were empty.
17JUL09 0630	S03	Rt 15 South N13 30.141 E144 53.167	580	Egg (4)	<i>Elatostema calcareum</i>	80:0:Y	All four eggs were black.
17JUL09 0550	S03	Rt15 South N13 30.134 E144 53.160	609	Larvae (1)	<i>Procris pedunculata</i>	80:0:Y	Very late instar, actively feeding. (Appendix B, image 8.)
17JUL09 1955	S03	Rt15 South N13 30.138 E144 53.165	589	Larvae (1)	<i>Elatostema calcareum</i>	10:0:N	Very late instar, actively feeding, large green frass pellets seen nearby. (Appendix B, image 9.)
20JUL09 0915	N01	Rt 15 North N13 30.819 E144 53.651	545	Egg (5)	<i>Elatostema calcareum</i>	80:1:N	Near the same plant we found the chrysalis 15 July. (Appendix B, images 10 and 11.)
21JUL09 1130	S03	Rt 15 South N13 30.140 E144 53.167	607	Egg (6)	<i>Elatostema calcareum</i>	70:1:N	Two eggs green, 4 eggs black. (Appendix B, images 12 and 13.)

Date & Time	Site	Transect & Coordinates	Elev (ft)	Life Stage (quantity)	Host Plant	Weather - Cloud Cover (%):Wind (1-3):Rain (Y/N)	Notes
21JUL09 1027	S03	Rt 15 South N13 30.143 E144 53.163	624	Chrysalis (1)	<i>Procris pedunculata</i>	70:1:N	Empty. (Appendix B, image 14.)
22JUL09 1130	N01	Rt 15 North N13 30.818 E144 53.653	567	Adult (1)	N/A (<i>Macaranga thompsonii</i>)	80:0:N	Was flying up in a small clearing within the canopy, but seemed to prefer resting on the leaves of the <i>M. thompsonii</i> . (Appendix B, images 15 and 16.)
22JUL09 1600	P01	Pagat Cave Trail N13 29.524 E144 52.643	268	Larvae (3)	<i>Elatostema calcareum</i>	50:1:N	One late instar, two earlier instars.
23JUL09 1145	S03	Rt 15 South N13 30.156 E144 53.174	620	Chrysalis (1)	<i>Procris pedunculata</i>	20:2:N	Empty.
23JUL09 1045	N01	Rt 15 North N13 30.818 E144 53.653	567	Adult (1)	N/A (<i>Macaranga thompsonii</i>)	30:2:N	Was in the same location as the adult butterfly seen on 22 July – appeared to be the same individual. (Appendix B, image 17.)
24JUL09 1050	S03	Rt 15 South N13 30.129 E144 53.159	606	Egg (1)	<i>Elatostema calcareum</i>	20:2:N	Egg was black.

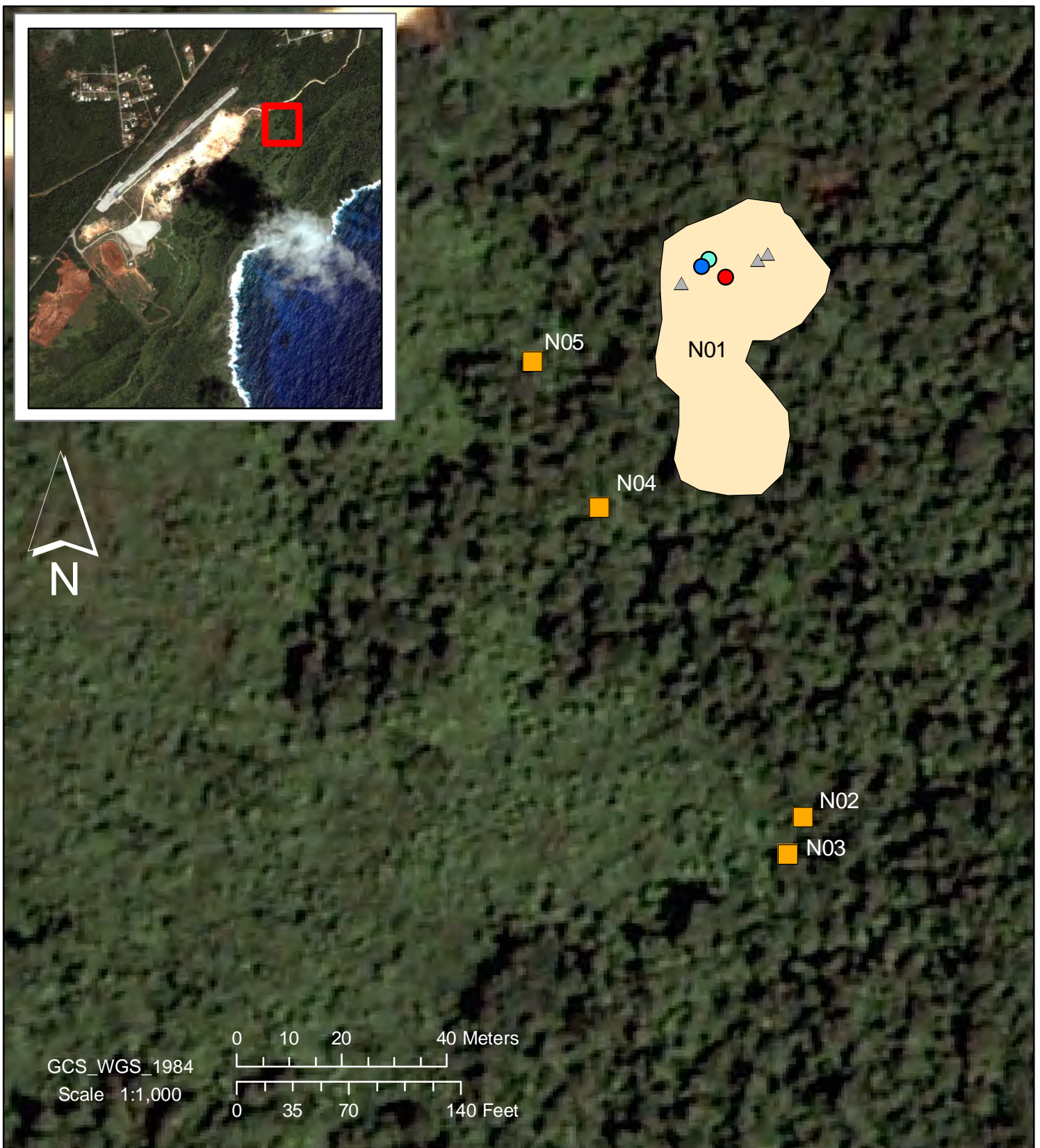


Figure 1
 Hypolimnast octocula
 and host plant sites
 RT 15 North Transect
 15 -24 July, Guam

Hypolimnast octocula

Type

- Butterfly
- Chrysalis
- Caterpillar
- Egg

▲ Bait_pans

■ Mixed host plant area

Host plant individual

Species

- *Elatostema calcareum*
- *Procris pedunculata*

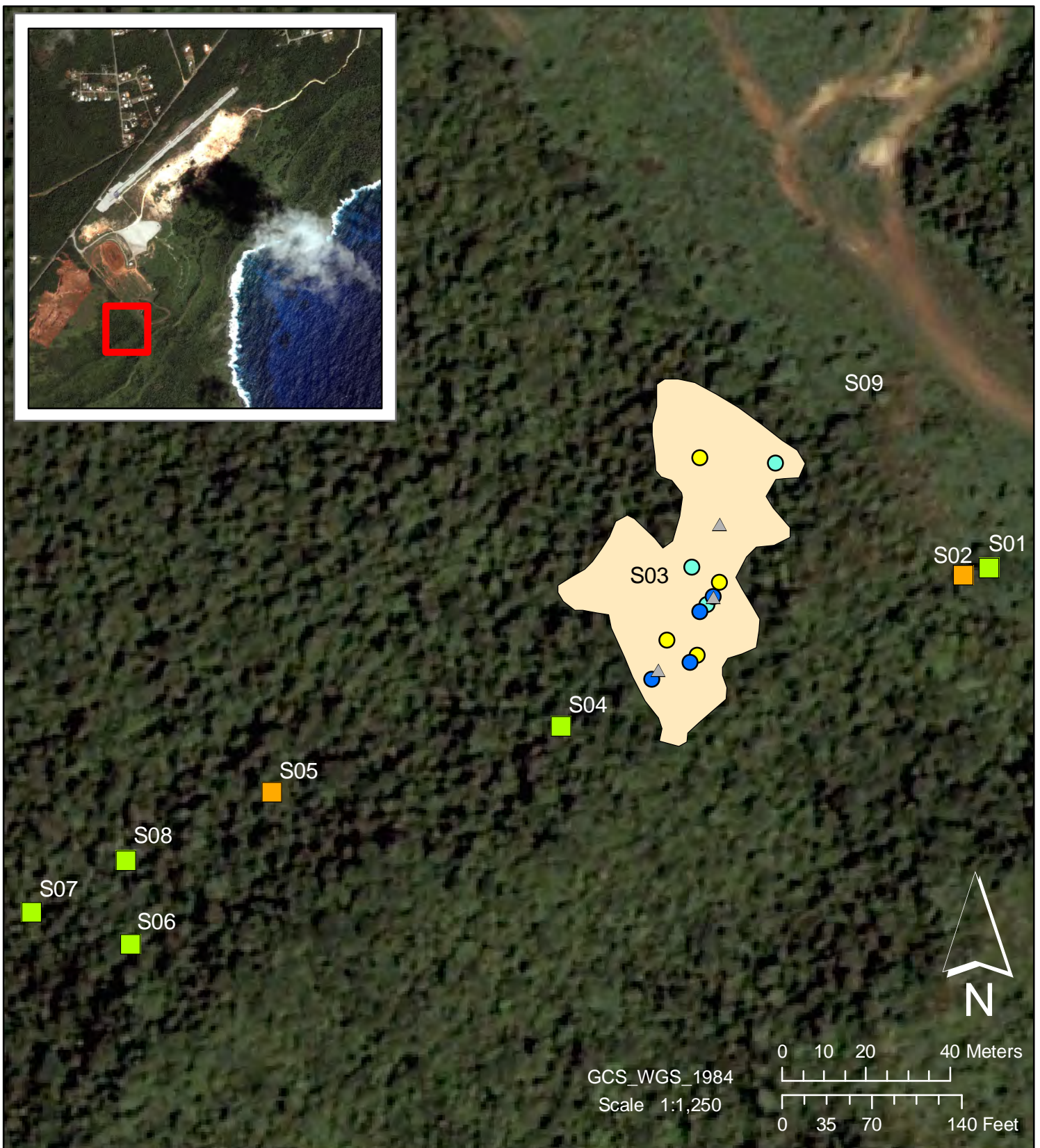


Figure 2
 Hypolimnas octocula
 and host plant sites
 RT 15 South Transect
 15 -24 July, Guam

Hypolimnas_octocula

Type

- Butterfly
- Chrysalis
- Caterpillar
- Egg

- ▲ Bait_pans

- Mixed host plant area

Host plant individual

Species

- Elatostema calcareum
- Procris pedunculata



Figure 3
 Hypolimnast octocula
 and host plant sites
 RT 15 Pagat Cave Trail
 15 -24 July, Guam

Hypolimnast octocula

Type

- Butterfly
- Chrysalis
- Caterpillar
- Egg

Host plant individual

Species

- *Elatostema calcareum*
- *Procris pedunculata*

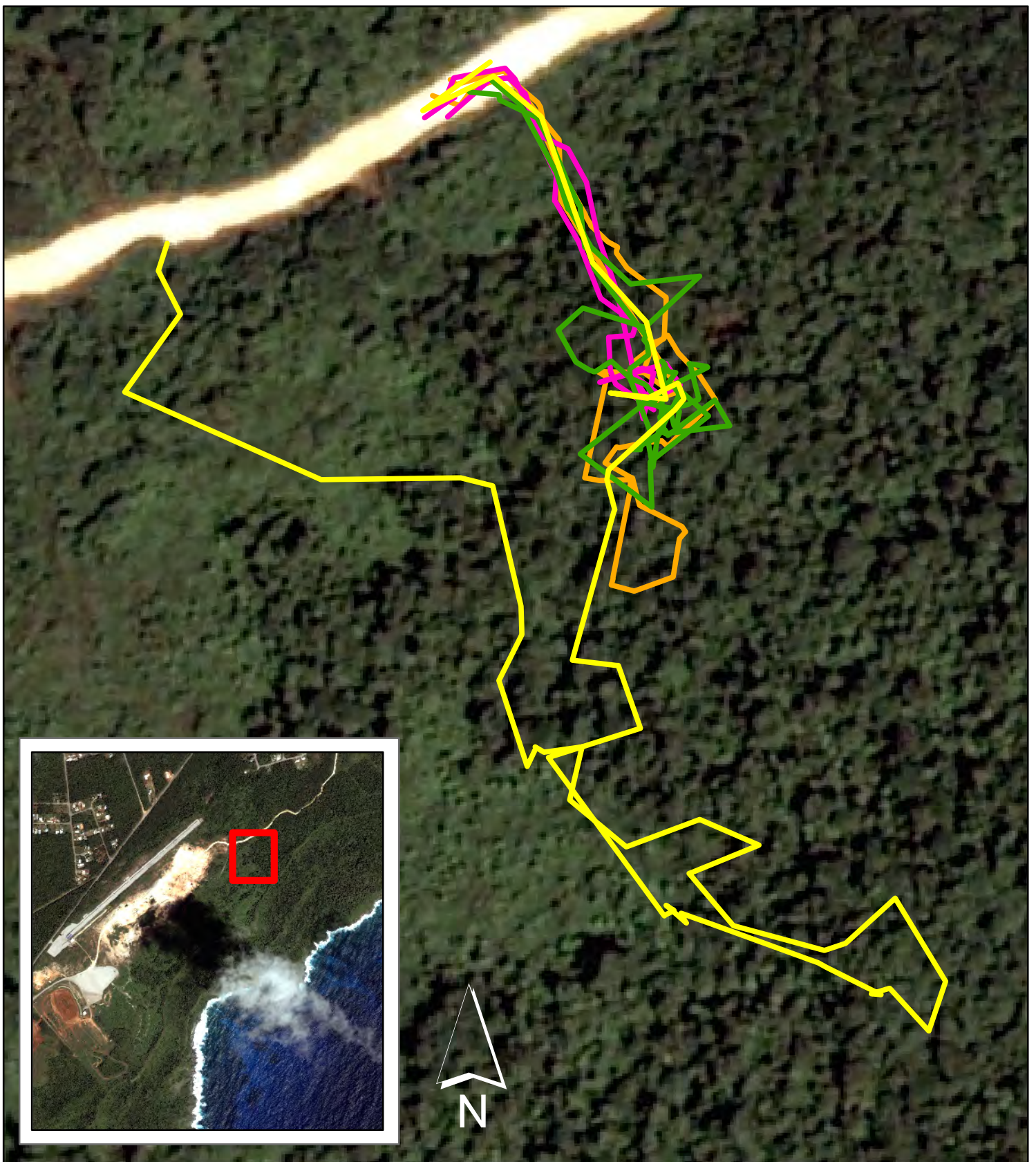
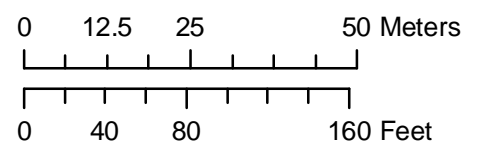


Figure 4
 RT 15 North Transect
 Survey Routes
 15 -24 July, Guam

- 15 July 2009
- 20 July 2009
- 22 July 2009
- 23 July 2009

GCS_WGS_1984
 Scale 1:1,133



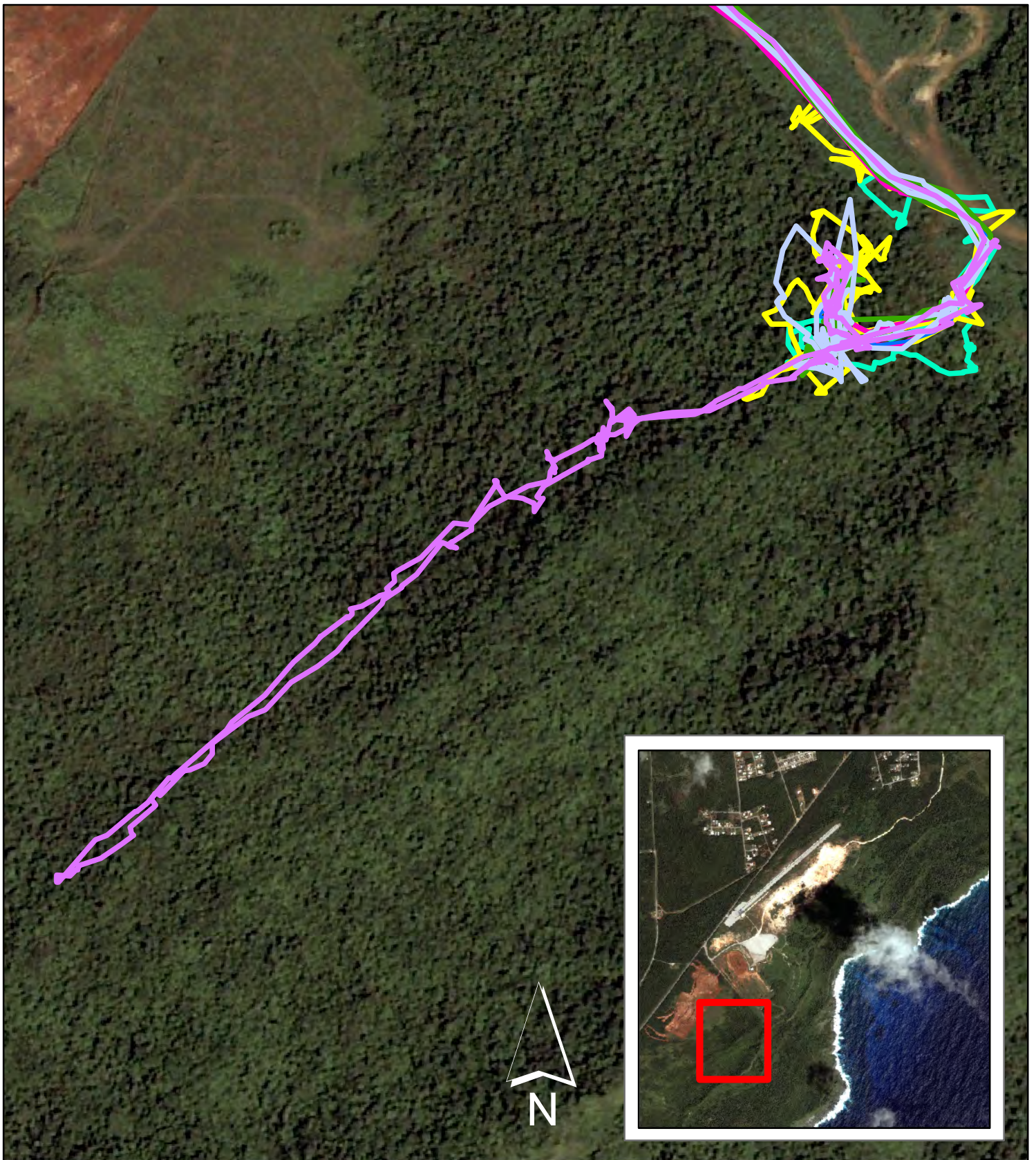
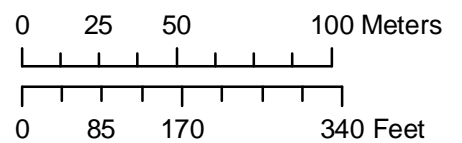


Figure 5
 RT 15 South Transect
 Survey Routes
 15 -24 July, Guam

- 16 July 2009
- 17 July 2009
- 20 July 2009
- 21 July 2009
- 22 July 2009
- 23 July 2009
- 24 July 2009

GCS_WGS_1984
 Scale 1:2,444



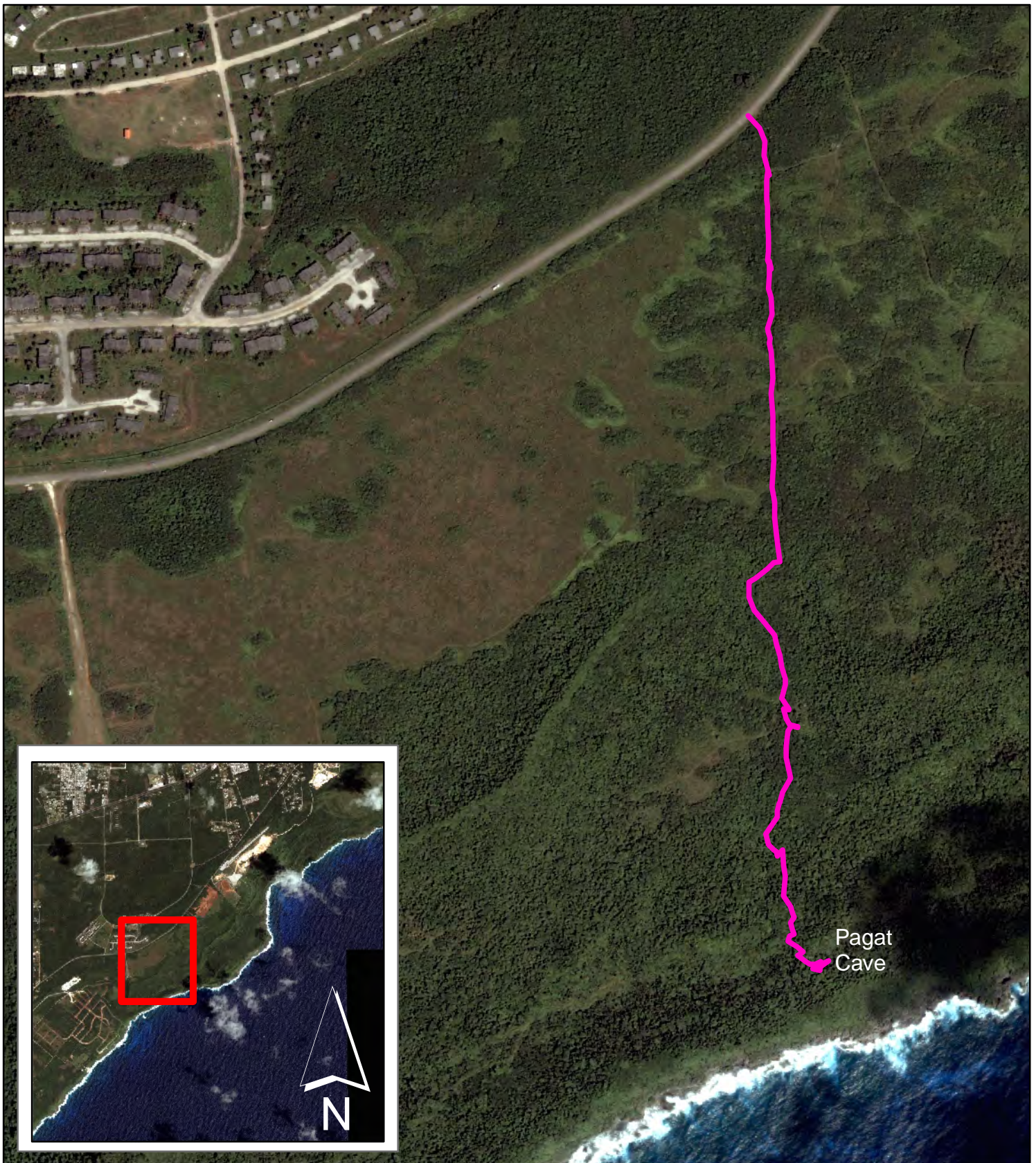
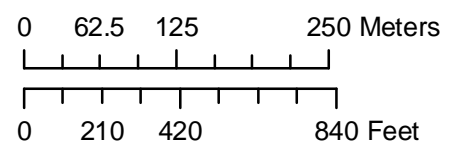


Figure 6
 RT 15 Pagat Cave Trail
 Survey Route
 15 -24 July, Guam

— 22 July 2009

GCS_WGS_1984
 Scale 1:6,200



Appendix A
Host Plant Images



1. Leaves of *Elatostema calcareum*. (Rt 15 North transect, site N01, 15 July 2009)



2. Leaves of *Procris pedunculata*. (Rt 15 North transect, site N01, 15 July 2009)

Appendix A



3. *Procris pedunculata*. (Rt 15 North transect, site N01, 15 July 2009)



4. *Elatostema calcareum*. (Rt 15 South transect, site S03, 16 July 2009)

Appendix A



5. Flowers of *Procris pedunculata*. (Rt 15
North transect, site N01, 15 July 2009)



6. Flowers of *Elatostema calcareum*. (Rt 15
South transect, site S03, 16 July 2009)

Appendix A



Appendix A



9. *Elatostema calcareum*. (Rt 15 North transect, site N01, 15 July 2009)



10. *Procris pedunculata*. (Rt 15 North transect, site N01, 15 July 2009)

Appendix A



11. *Elatostema calcareum* with bait pan. (Rt 15 South transect, site S03, 20 July 2009)



12. *Elatostema calcareum*. (Pagat Cave Trail, site P01, 22 July 2009)

Appendix B
Hypolimnas octocula marianensis Images



1. *Hypolimnas* sp.
chrysalis on *Elatostema
calcareum* . (Rt 15 North
transect, site N01, 15 July
2009)



2. *Hypolimnas* sp.
larvae on *Procris
pedunculata* . (Rt 15
South transect, site
S03, 16 July 2009)

Appendix B



3. *Hypolimnas* sp.
larvae on *Procris*
pedunculata. (Rt 15
South transect, site
S03, 16 July 2009)

Appendix B



4. *Hypolimnas* sp.
frass and larvae on
Procris pedunculata .
(Rt 15 South transect,
site S03, 16 July 2009)



5. *Hypolimnas* sp.
larvae on *Elatostema*
calcareum . (Rt 15
South transect, site
S03, 16 July 2009)

Appendix B



6. *Hypolimnas* sp.
larvae on *Elatostema*
calcareum. (Rt 15
South transect, site
S03, 16 July 2009)



7. *Hypolimnas* sp.
eggs on *Elatostema*
calcareum. (Rt 15
South transect, site
S03, 16 July 2009)

Appendix B



8. *Hypolimnas* sp.
larvae on *Procris*
pedunculata. (Rt 15
South transect, site
S03, 17 July 2009)



9. *Hypolimnas* sp.
larvae on *Elatostema*
calcareum. (Rt 15
South transect, site
S03, 17 July 2009)

Appendix B



Appendix B



Appendix B



14. *Hypolimnas* sp.
chrysalis on *Procris*
pedunculata. (Rt 15
South transect, site
S03, 21 July 2009)



15. *Hypolimnas*
octocula marianensis
adult. (Rt 15 North
transect, site N01, 22
July 2009)

Appendix B

