2000 Technical Report #2

Wildlife and Vegetation Surveys

AGUIGUAN 2000

Performed
By

CNMI Division of Fish and Wildlife
Wildlife Section

and

Tinian Department of Lands and Natural Resources
Fish and Wildlife and Conservation Sections

MARCH 31-APRIL 8, 2000

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SUMMARY OF WILDLIFE SURVEYS AGUIGUAN ISLAND

MARCH 31-APRIL 8, 2000

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Executive Summary

Aguiguan is a unique and important island in terms of its native wildlife. It is the southern most island inhabited by the endangered Micronesian megapode (*sasangat*) and maintains about 10% of the archipelago-wide population of endangered Guam swiftlet (*chachaguak*). It is the only island other than Saipan to support Golden white-eyes (*canario*) in the Marianas. In the past, low numbers of the endangered Nightingale reed-warbler (*gaga karisu*) lived on the island as well.

During the surveys of birds, lizards, mammals, and crabs conducted in April 2000 by Fish and Wildlife staff from Rota, Tinian, and Saipan, we did not detect any Nightingale reed-warblers on Aguiguan. It is possible that the reed-warbler is colonizing Aguiguan from a source population such as Saipan's and then going locally extinct, as is often the case with small populations. Although Micronesian megapodes are still not numerous on the island, apparently numbers have been slowly increasing and we estimate that there is an island-wide population of about 51. Guam swiftlet numbers have remained fairly stable over the last 15 years. New swiftlet caves are being found and investigated with every extended visit to Aguiguan, and undoubtedly more swiftlet roosts will be discovered in the future.

Generally, however, forest bird populations (such as starlings, fantails, and white-eyes) are not doing well on Aguiguan. Their populations remained stable between 1982 and 1992, but, with the exception of White-throated ground-doves and Philippine turtle-doves, there were far fewer forest birds detected in 2000 than previously. This may correlate with low levels of forest regeneration due to over-browsing by feral goats. No feral animal surveys were performed, however, effects of goat grazing were observed throughout the native forest. Several parts of the island no longer support ground cover and *Lantana camara* has become more widespread in the upper reaches of the island and in the open field regions. Evidence of goats is obvious in the native limestone forest on the north side of the island, where there is practically no understory or ground cover. With less habitat and lower food supplies, fewer forest birds can survive.

Photo: Overgrazing by numerous feral goats has wiped out the young plants in Aguiguan's forest that would ordinarily replace older trees as they senesce and die.

Coconut crabs were surveyed by our Conservation Officers. Crab size appears to remain small, in keeping with previous observations, and there is no reason to suspect that hunting pressure on large sized crabs has lessened in the recent past. Mariana fruit bats were also surveyed. From individual fruit bat sightings, evening station counts, and finding two small aggregations, we estimate the fruit bat population on Aguiguan is 150-200. It appears that fruit bat numbers increased during the late 1980's after a hunting moratorium was imposed, and have remained stable on Aguiguan for the last 10 years.

Seven species of lizards were documented. The blue-tailed skink was the most abundant one. Monitor lizards were also abundant: a total of 18 lizards were captured using snare traps and an average of 9 lizards were observed per hour during visual surveys. Monitor lizards seemed to be more abundant in introduced forest. The only species of rat captured on Aguiguan was the Pacific rat. Rat capture rates have increased since the last survey in 1995. The cause of the increase may be seasonal population fluctuations.

Recommendations for managing the wildlife and habitat on Aguiguan include control of feral animals via increased hunting, removal of the noxious weed *Lantana camara*, maintaining the moratorium on hunting fruit bats, and restoration of degraded areas with native plantings.

Introduction

Aguiguan and its small companion, Naftan Island, are part of the southern arc of the Marianas archipelago along with Guam, Rota, Tinian, and Saipan. In recent years, Aguiguan has received very little attention from the scientific community. However, the U.S. Department of Agriculture Soil Conservation Service surveyed and classified the soils there in 1985 (Young 1989). Archaeological surveys were conducted in 1990 (Butler 1992), and the birds were surveyed in 1982 (Engbring *et al.* 1986) and 1992 (Craig and Chandran 1992). Several field trips by CNMI biologists have documented the kinds of seabirds, lizards, bats, and forest birds that inhabit the island, as well as persistent problems with large numbers of feral goats (*e.g.*, Kosaka *et al.* 1983; Reichel *et al.* 1987; Worthington and Taisacan 1995). People from Tinian visit Aguiguan periodically to hunt goats and capture Coconut crabs. A hunting moratorium on fruit bats has been in effect since 1985.

Aguiguan alone of the southern Mariana islands is uninhabited and has remained so since 1945. It is locally called Goat Island reflecting the large population of feral goats that occupy it. Native limestone forest still covers a portion of the island, although damage by feral goats is obvious. Much of the vegetation on the island's upper reaches has been severely degraded causing extensive erosion and unimpeded growth of the noxious weed *Lantana camara*. Administered by the municipality of Tinian, permission to land on the island is required from the Mayor's Office.

The CNMI-Division of Fish and Wildlife in conjunction with the Tinian Department of Lands and Natural Resources conducted forest bird, reptile, rodent, bat, and crab surveys on Aguiguan from 31 March until 8 April in 2000. The purpose of the surveys was to assess the status of the island's wildlife populations in preparation for improving management of the island's resources. The results of these surveys is reported below.

Forest Bird Surveys

Forest birds were surveyed using Variable Circular Plot (VCP) methodology on 1 April, 2000. Teams of two to three people followed four (4) transects described by Engbring *et al.* (1986) that had been used for similar forest bird surveys in 1982 and 1992 (Fig. 1). Listening stations were located 150 m distant from each other along each transect. One person from each team counted birds both visually and by song, estimating the distance for each detection. Because the Nightingale reed-warbler (*Acrocephalus luscinia*), an endangered species, was observed in very small numbers on the island in 1992, we also employed play-back methodology to try and elicit a response from this species. After a 5-minute count, a tape recording of the reed-warbler was played for one minute and then a further two minutes was spent at each station listening for a response.

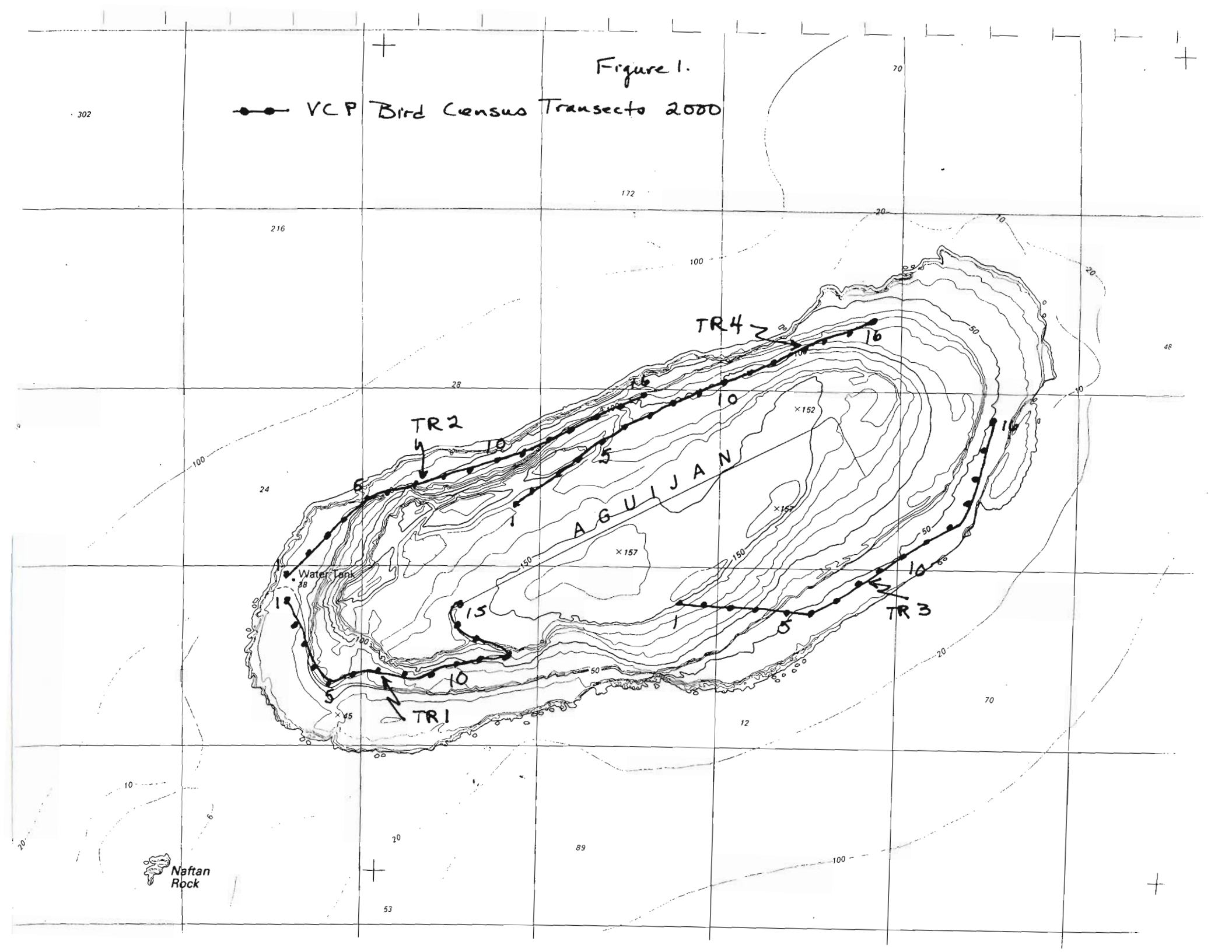
Fourteen species of birds totaling 924 individuals were counted during the survey. Density was approximately 14.7 birds per station, but no Nightingale reed-warblers were observed (Table 1). One seabird species, the Great frigatebird (*Fregata minor*) was counted incidentally and two descendents from domestic roosters were recorded. Guam swiftlets (*Collocalia bartschi*) were detected while foraging, but more accurate estimates of their numbers are available from departure/arrival counts at their nesting caves in the evenings (see report of this survey below). Of the remaining forest birds, the most common was the Bridled white-eye (*Zosterops conspicillatus*). Rufous fantails (*Rhipidura fufifrons*), Golden white-eyes (*Cleptornis marchei*), and Micronesian honeyeaters (*Myzomela rubratra*) were also numerous. Mariana fruit-doves (*Ptilinopus roseicapilla*), Micronesian starlings (*Apolis opaca*), White terns (*Gygis alba*), and Collared kingfishers (*Halcyon chloris*) were plentiful. White-throated ground-doves (*Gallicolumba xanthonura*), Micronesian megapodes (*Megapodius laperouse*), and Philippine turtle-doves (*Streptopelia bitorquata*) were uncommon to rare.

Table 1. Numbers of forest birds detected along 4 transects on Aguiguan, 1 April 2000.

Bird Species	Transect (Number of Stations)				Total	# birds/ Station
	1 (15)	2 (16)	3 (16)	4 (16)		
Bridled white-eye	60	33	73	51	217	3.44
Rufous fantail	17	48	26	59	150	2.38
Golden white-eye	16	47	20	60	143	2.27
Micronesian honeyeater	19	27	49	29	124	1.97
Mariana fruit-dove	16	17	16	27	76	1.21
Micronesian starling	20	31	16	7	74	1.17
Collared kingfisher	11	12	14	20	57	0.90
White tern	5	20	13	4	42	0.67
White-throated ground-dove	15	1	0	0	16	0.25
Micronesian megapode	2	9	0	1	12	0.19
Philippine turtle-dove	3	0	0	0	3	0.5

Figure 1.

VCP Bird Census Transects 2000



Comparing the numbers of birds/count station that we recorded on Aguiguan in April 2000 with those detected in March 1982 and April 1992 (Table 2) revealed that the relative abundance of all but the rarest of species have declined on Aguiguan since 1992. The number of birds detected on Aguiguan was significantly lower in 2000 than in 1992 (t test = 2.62, $P < 0.01$). This is in contrast to earlier findings. Raw totals and abundance of birds/station are very similar between 1982 and 1992. Craig *et al.* (1992) concluded that most populations had remained stable for that 10 year period with a possible decline in populations of Mariana fruit-doves and Micronesian honeyeaters. Presently, all populations with the exception of White-throated ground-doves, Philippine turtle-doves, and Micronesian megapodes were detected far less frequently than previously.

Table 2. Comparison of relative abundance at count stations and density estimates from 1982 (Engbring *et al.* 1986), 1992 (Craig *et al.* 1992) and 2000 (this study). The symbol ‡ represents species for which insufficient data were available for use in the VCP analysis.

Bird Species	# birds/ station 1982	# birds/ station 1992	# birds/ station 2000	Birds/ha 1982	Birds/ha 1992	Birds/ha 2000
Bridled white-eye	6.23	7.79	3.44	19.30	219.3	14.74
Rufous fantail	3.45	4.14	2.38	3.82	52.81	10.97
Golden white-eye	3.39	3.71	2.27	6.15	49.70	‡
Micronesian honeyeater	5.65	3.06	1.97	5.70	23.88	5.58
Mariana fruit-dove	5.77	2.09	1.21	0.76	2.68	0.40
Micronesian starling	1.58	1.92	1.17	1.11	4.92	4.40
Collared kingfisher	1.20	1.26	0.90	0.11	0.62	0.49
White tern	1.72	1.71	0.67	--	--	--
White-throated ground-dove	0.14	0.12	0.25	0.09	0.42	‡
Micronesian megapode	0.11	0.17	0.19	0.03	0.04	‡
Philippine turtle-dove	0.11	0.17	0.50	--	--	--

It was possible to calculate the density (birds/ha) for six species on Aguiguan in April 2000 (Table 2) using the computer program DISTANCE. The same analytical techniques were applied to the data from 1982 and 1992 by other researchers. The results of the three analyses are widely disparate. In one case the density estimate in 1992 was an order of magnitude higher than that in 1982 while the 2000 estimate was more in line with that of 1982 (*e.g.* Bridled white-eyes). In other cases the 2000 density

estimate and the 1992 estimate were very similar (*e.g.*, Micronesian starlings) but quite different from the 1982 estimated density. These examples highlight the limited utility of this analytical technique with VCP data as a useful tool for helping to track bird numbers for management purposes. The relative abundance of birds at each count station is probably more illustrative of current population trends than the density estimates. Unfortunately, these trends are distinctly downward for most bird species (Fig. 2).

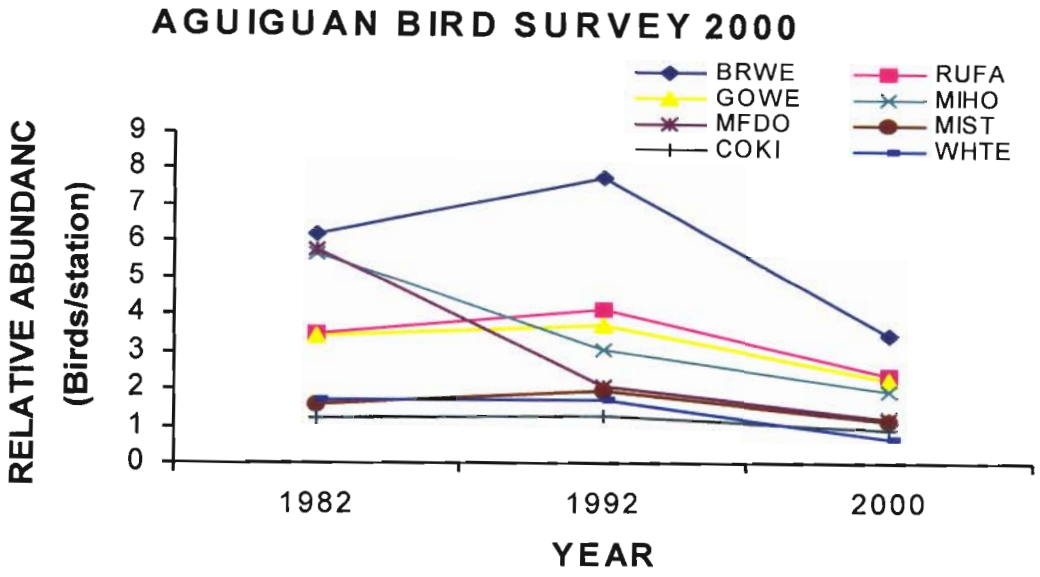


Figure 2. Decline of bird species over an 18 year period on Aguiguan Island.

The Micronesian Megapode was observed or heard calling on a regular basis during the field trip. Areas of observation or vocalization included Transect 3 & 4, in camp, the south and north sides of the island, and within 300 m north of camp (Fig. 3). Only adults were observed during these surveys.

Although megapodes are still not numerous on the island, apparently numbers have been slowly increasing (Table 2) since 1982 when the total population was estimated to be 14 (Engbring *et al.* 1986). We calculate that if Aguiguan has 475 ha of forested area (out of 718 ha), and with 0.19 detections in a 75 m radius circle, then there is an island-wide population of about 51 megapodes.

Nightingale Reed-warbler Survey

During the forest bird survey each team of observers played tape recorded calls of Nightingale reed-warblers to try and elicit a response from birds that were not necessarily vocalizing on their own. Tapes were played for one minute after each 5

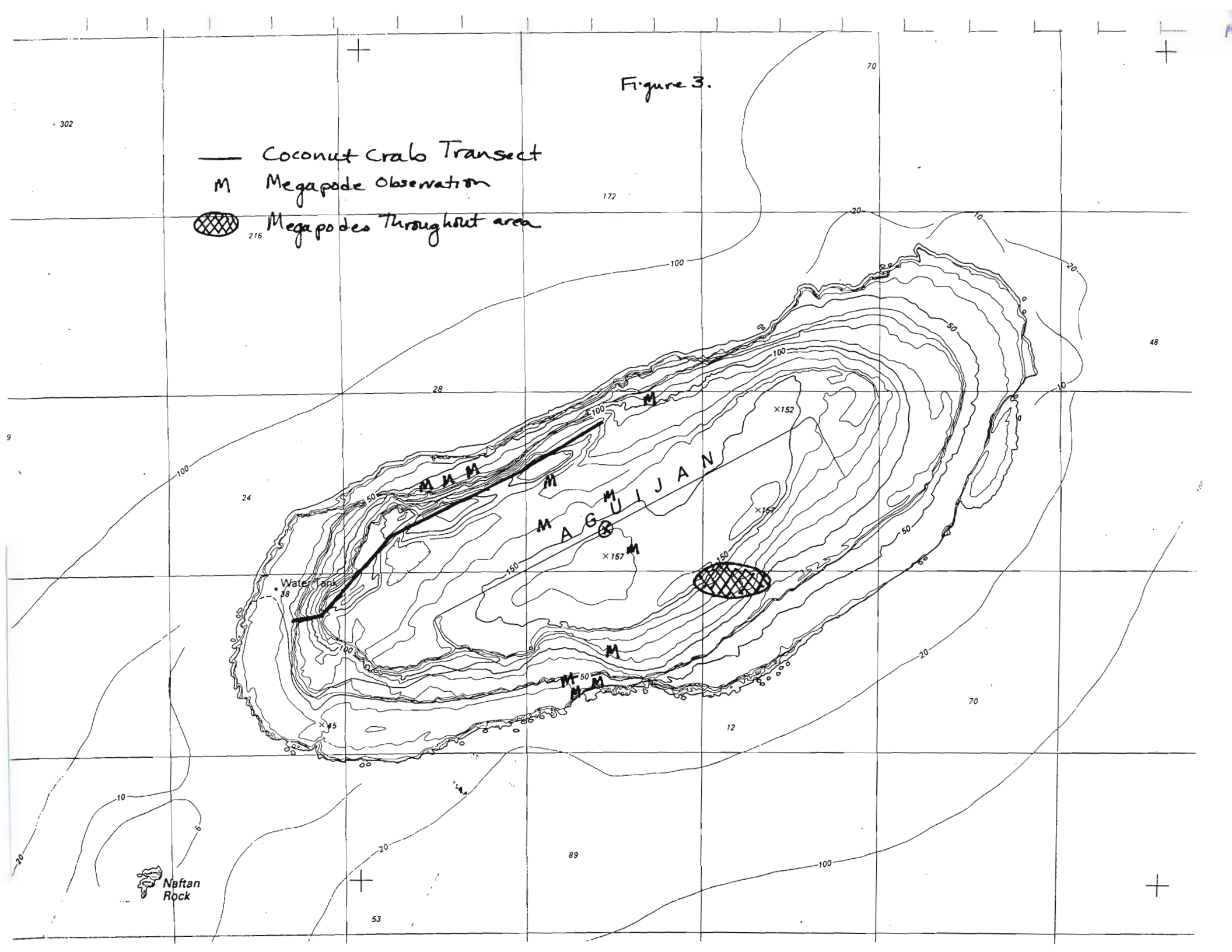


Figure 3.
Coconut Crab Transect
M Megapode Observation
Megapodes Throughout area
MAGUIJAN
Water Tank
Naftan Rock
302
172
216
28
24
48
70
89
53
12
100
50
20
10
150
×152
×157
×155
38

minute point count and then an extra two minutes was spent listening for a response. Tape recorded calls were also played opportunistically as survey teams performed other work, as when hiking to swiftlet caves when areas that had not been systematically surveyed were traversed. However, no reed-warblers were heard either during formal surveys or at any other time.

Nightingale reed-warblers (NIRW) were documented in low numbers in 1982 (Engbring *et al.* 1986) along a 1 km stretch of cliffs extending NE of the Winch. A bird survey in July 1983 recorded NIRW in the same area as well as in the southwestern most point of the plateau (Kosaka *et al.* 1983). In June 1984, three NIRW were located using similar methods to our present survey (Lemke *et al.* 1984). No NIRW were heard during visits in Jan.-Feb. 1985 (Lemke *et al.* 1985), but 5 were heard in Feb.-Mar. 1987, mostly centered around the NW side of the island (Reichel *et al.* 1987). It was later supposed (by the same observers) that the long song of the Golden white-eye had been mistaken for that of NIRW. Again in June 1988 and Sept. 1989, no NIRW were seen or heard despite playing tapes near most locations where the birds had been reported in previous years (Reichel *et al.* 1988; Rice and Reichel 1989). NIRW were not detected again until May 1992 when two birds were both seen and heard on the southeastern slope of the island (Craig and Chandran 1992).

This apparent pattern of "winking in and winking out" again is reminiscent of the behavior of small populations nestled in a matrix of other populations, or a metapopulation. It is possible that we are observing a situation where NIRW may be colonizing Aguiguan from a source population such as Saipan's and then going locally extinct, as is often the case with small or founder populations.

Swiftlet Surveys

DFW staff performed counts of the endangered Guam swiftlet in the evenings as the birds entered caves to roost for the night. Also, to help prevent depredation on swiftlet nests, 104 plastic bait stations of Combat™ cockroach bait were placed in 4 caves: Pillar, Black Noddy, Guano, and Landing. The placement of baits is a continuation of our program aimed at reducing the loss of nests that are displaced from their foundations due to insect damage. Bait replacement can only be implemented opportunistically on Aguiguan.

Counts of the Guam swiftlet were performed from 17:00 to 19:10 as they entered five roosting caves on 2 and 5 April, 2000. Ten other caves were checked during the day for nests, guano or other signs of swiftlet use. No signs of the presence of swiftlets were found, so entrance counts were not performed at these 10 caves. Caves where entrance counts were performed included: Black Noddy, Cliff, Pillar, Guano, and Landing. Caves where daytime searches for swiftlet sign were conducted but no entrance counts were performed included: New, Crevice, Dangkulo, Krisidu, Stairway,

and the caves labeled A,B,C,D, and E on Figure 4. Entrance counts documented at least 408 individuals using the five well known caves.

Photo: Cliff Cave, Aguiguan 2000

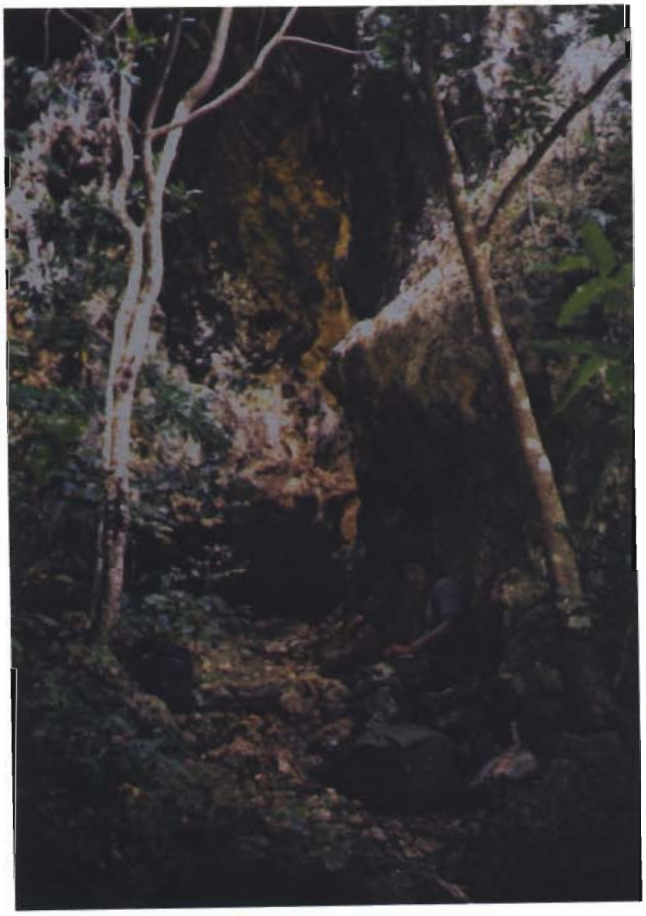
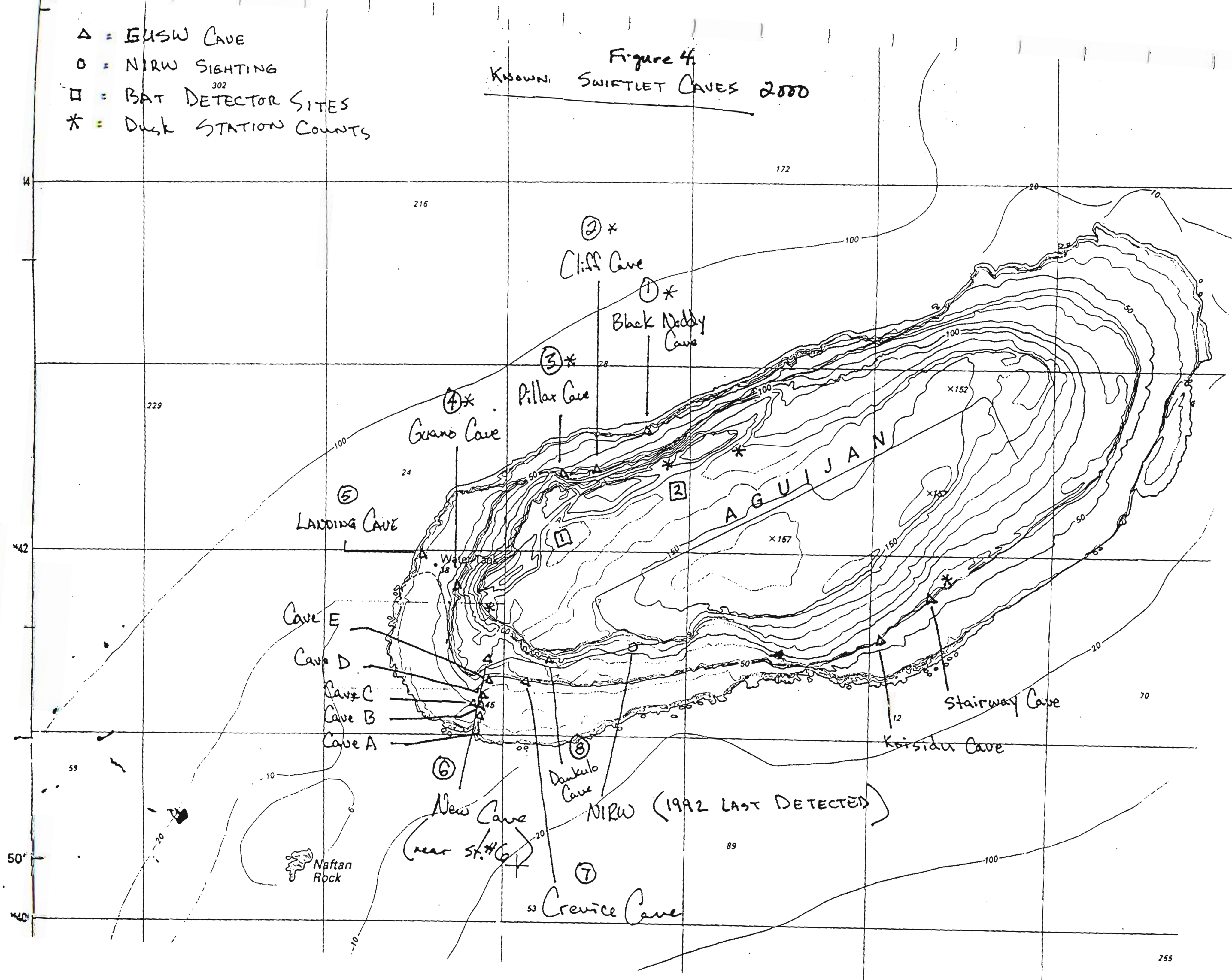


Photo: Elvin Masga, a Tinian Conservation Officer, is setting up to conduct a swiftlet arrival count at Pillar Cave on 2 April 2000.



Δ = EUSW Cave
o = NIRW Sighting
□ = Bat Detector Sites
* = Dusk Station Counts
Figure 4.
Known Swiftlet Caves 2000
① * Black Noddy Cave
② * Cliff Cave
③ * Pillar Cave
④ * Grand Cave
⑤ Landing Cave
⑥ New Cave (near st. #6)
⑦ Crevice Cave
⑧ Dankulo Cave
AGUIJAN
Water Tank
Cave E
Cave D
Cave C
Cave B
Cave A
NIRW (1992 Last Detected)
Stairway Cave
Karsidu Cave
Naftan Rock
1
2

Cave entrance counts of swiftlets have been performed on Aguiguan since 1985 (Table 3). If the incomplete count in 1992 is excluded from the trend, it appears that total numbers of swiftlets counted on Aguiguan has remained remarkably stable since 1987. The number of swiftlets counted in 1985 is more than twice as high as counts since then, with the number of birds detected in Black Noddy and Guano caves being the most variable. Clearly, with new caves being found and investigated with every extended visit to Aguiguan, more swiftlet roosts will be discovered in the future. The number of swiftlets detected in April 2000 is consistent with the majority of earlier counts—certainly no precipitous decline of this endangered species was indicated.

Table 3. Cave entrance counts of Guam Swiftlets on Aguiguan 1985-2000. Caves not surveyed are represented by dashes (--). Caves not discovered until recent years are represented by an asterisk (*).

Location	1985[a]	1987[a]	1988[b]	1992[c]	1995[d]	2000[e]
Guano Cave	750	321	332	--	123	337
Pillar Cave	100?	89	34	60	65	53
Landing Cave	10	16	13	--	2	2
New Cave (#6)	*	*	39	--	0	0
Black Noddy Cave	10?	--	--	--	145	7
Cliff Cave	100?	--	--	40	26	9
TOTAL	970	426	418	100	361	408

[a]Reichel, J.D. and P.O. Glass 1988.
[b]Reichel, J.D. *et al.* 1988
[c]Rice 1992.
[d]Arriola 1998
[e]current survey

Coconut Crab Surveys

Coconut crabs (*Birgus latro*) were lured to baits, captured and measured during one night (April 4) on Aguiguan by Conservation Officers from Saipan and Tinian. Meat from coconuts that had been ground up and then fermented was placed in 15 rocky crevices along a transect located on the northwestern plateau of the island (Fig. 3). In areas with no rocky crevices, the bait was placed on the ground and covered with rocks. Baits were set out 150 m apart in limestone forest during the day and the transect was checked repeatedly between 10 p.m. and 2 a.m. that night.

A total of 58 crabs weighing between 50 and 1,100 g were captured. Average mass was 293 g (± 207.1 g SD), average carapace length was 69 mm (± 13.8 mm SD) and average carapace width was 66 mm (± 17.6 mm SD). Up to nine crabs were caught at a single bait station (mean 3.7 crabs ± 2.74 crabs per station), with two stations failing to attract any crabs.

Photo: Conservation Officers setting up the Coconut crab survey transect on Aguiguan, 2000.

Female crabs (n = 13) were significantly smaller than male crabs (n = 41) both in terms of carapace length (female mean = 61 mm ± 10.4 mm SD vs. male mean = 72 mm ±13.8 mm SD, t-test = -3.09, $P_{\text{two-tailed}} < 0.004$) and width (female mean = 57 mm ± 12.0 mm SD vs. male mean = 69 mm ± 18.3 mm SD, t-test = -2.56, $P_{\text{two-tailed}} < 0.015$). Female crabs were also lighter than male crabs (female mean = 199 g ± 137.9 g SD vs. male mean = 324 g ± 217.9 g SD, t-test = -2.38, $P_{\text{two tailed}} < 0.02$).

In 1954, when the island was under sugar cane and pineapple production, the population of Coconut crabs was estimated to be about 620-750 (Davis 1954). In September 1990, after agricultural practices had ceased, Conservation Officers from DFW counted "125 crabs of small size" near the Winch camping area, although their report does not detail how the count was done (H. Cabrera 1990 unpubl. trip report). Our data do not allow an estimate of the size of the population remaining on the island. However, we have recorded for the first time the gender of the crab and so now we are able to make a comparison between their morphologies. Overall, crabs were small in size (range of carapace width 46-150 mm) in keeping with previous observations, and there is no reason to suspect that hunting pressure on large sized crabs has lessened in recent years.

Herpetological Surveys

The purpose of the herpetological surveys on Aguiguan was to document reptile species present on the island, to assess the relative abundance of monitor lizards (*Varanus indicus*) on the island, and to collect monitor lizard gut contents for analysis of diet.

Diurnal lizards were sampled using adhesive mouse traps (Bauer and Sadlier, 1992; Rodda *et al.*, 1993). Three transects were sampled, one each in savanna, introduced forest dominated by tangantangan (*Leuceana leucocephela*), and native limestone forest (Fig. 5). Twelve traps were placed flush with the ground every 25 meters along each transect. Traps were placed in the morning (0700-0900) and run for 4-6 hours on 3 consecutive days.

Nocturnal lizards were also sampled using adhesive mouse traps. Two transects were sampled, one each in introduced forest and native limestone forest. Twelve traps were set along each transect, spaced every 25 meters, and were stapled to the trunks of trees 0.5-2.0 meters above the ground. Traps were placed 1 hour prior to sunset and checked the following morning. Traps were run for 3 consecutive nights.

Monitor lizards were sampled using loop-snare traps and also using visual surveys. Eight traps were placed along a transect in introduced forest while seven traps were placed on a transect in native forest. Traps were spaced at 50 meter intervals and were stapled to trees from 0-1 meter off the ground. Traps were baited with rotten meat or dead rats. Traps were run for 3 days.

In an attempt to detect the presence of the snake-eyed skink (*Cryptoblepharus poecilopleurus*) and the tidepool skink (*Emoia atrocostata*), 13 adhesive traps were placed in sites likely to capture these species in rocky strand and grassy habitat at the lower camp landing point between 0600 and 1300 hours on 1 April 2000.

All lizards captured were taken back to base camp, euthanized, measured, field-tagged, and preserved. Monitor lizards had their gastrointestinal tract removed and preserved for later analysis of diet. Upon returning to Saipan, all specimen identification was verified and specimens were catalogued and placed in the DFW collection.

Tables 4 and 5 show the results of adhesive trapping for skinks and geckos. Seven species of lizards were documented. The blue-tailed skink (*Emoia caeruleocauda*) was the most abundant lizard captured (n = 56). In 1995, Campbell reported having trapped the mutilating gecko (*Gehyra mutilata*), the house gecko (*Hemidactylus frenatus*), and the tidepool skink for the first time on Aguiguan. Of these 3 species, *G. mutilata* and *H. frenatus* were trapped again in 2000, but *E. atrocostata* was not. The absence of *E. atrocostata* may be due to the fact that we placed only 13 traps for one morning at the landing beach whereas Campbell placed 50 traps in 1995.

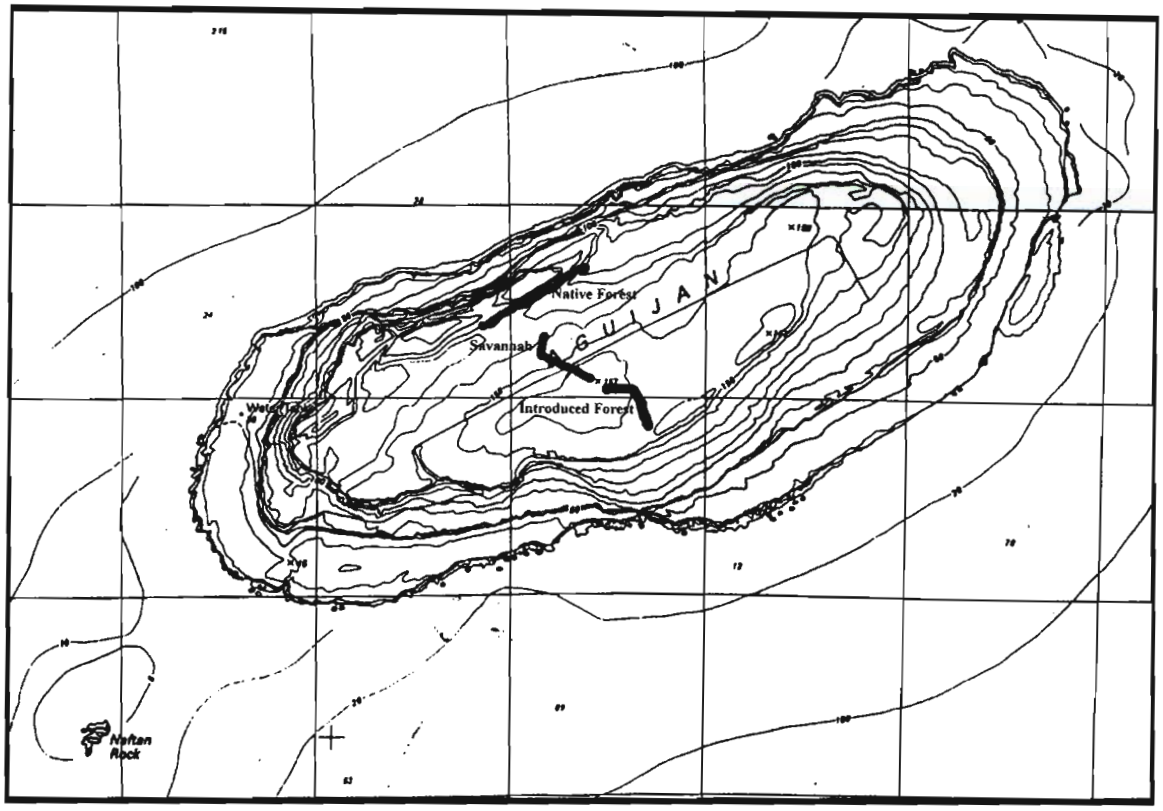


Figure 5. Aguiguan Island showing transects used to sample reptiles in savannah, introduced forest, and native forest, 1-5 April, 2000.

Table 4. Results of adhesive trapping to determine lizard presence and abundance on Aguiguan, 1-4 April, 2000.

Habitat	#Traps	#Hours	Trap Hours	#Lizards	Lizards/ 100 Tr Hrs
Ground Trapping					
Rocky Beach	13	6.50	84.50	2	2.37
Savanna	36	15.00	540.00	18	3.33
Introduced Forest	36	16.75	603.00	40	6.63
Native Limestone Forest	36	15.70	565.20	14	2.48
Total	121	53.95	1792.70	74	4.13
Tree Trapping					
Introduced Forest	36	39.80	1432.80	8	0.56
Native Limestone Forest	36	39.80	1432.80	4	0.28
Total	72	79.60	2865.60	12	0.42
Aguiguan Total	193	133.55	4658.30	86	1.85

Monitor lizards were very abundant on Aguiguan (Table 6). A total of 18 lizards were captured using snare traps (34 lizards per 100 trap days), and an average of 8.9 lizards were observed per hour during visual surveys. Monitors seemed to be more abundant in introduced forest, but additional data needs to be collected to confirm this. Gut contents have not been analyzed as of the writing of this report. Anecdotally, a monitor lizard was observed eating a Golden white-eye chick that it had retrieved from its nest in a *Guamia* tree. The nest was about 8 feet off the ground.

Table 5. Presence and abundance of lizards trapped on Aguiguan, 1 - 4 April, 2000.

	HABITAT				
	Rocky Beach	Savanna	Introduced Forest	Native Limestone Forest	Total
Family Gekkonidae					
Mutilating gecko	0	0	3	0	3
Oceanic gecko	0	0	1	4	5
House gecko	0	0	2	0	2
Mourning gecko	0	0	1	0	1
Family Scincidae					
Snake-eyed skink	1	0	0	0	1
Blue-tailed skink	1	12	29	14	56
Family Varanidae					
Monitor lizard	0	0	12	10	22
Totals	2	12	48	28	90

Table 6. Results of monitor lizard snare-trapping and visual surveys conducted on Aguiguan, 1 - 5 April, 2000.

Habitat	# Trap Days	# Lizards	Lizards/ 100 trap days
Introduced Forest	32	11	34.38
Native Limestone Forest	21	7	33.33
Total	53	18	33.96

	Hours of Survey	# Observations	Lizards/Hr.Obs.
Introduced Forest	0.47	5	10.64
Native Limestone Forest	2.23	19	8.52
Total	2.7	24	8.89

Small Mammal Surveys

The purpose of rodent trapping on Aguiguan was to assess the relative abundance of rats.

Rats were sampled using snap traps on 3 different transects, one each in savannah, introduced forest, and native limestone forest. Twenty-five trap stations were placed along each transect at 25 meter intervals. Two traps were placed at each station, one on the ground, and one on a tree between 0.5 and 2.0 meters above the ground. In savannah habitat only ground traps were used. Traps were baited with peanut butter 1-2 hours prior to sunset and checked the following morning. Traps were then disabled and set the next night. Traps were baited for 3 consecutive nights. Captured rats were taken back to base camp for identification to species and morphological measurements. The number of trap nights calculated were corrected for unavailable traps (Nelson and Clark 1973).

Table 7. Results of snap-trapping to assess rat abundance on Aguiguan, 2 - 5 April, 2000.

Habitat	Trap Placement	Trap Nights*	# Rats Captured	Rats/100 trap nights
Savannah	ground	51.0	5	9.8
Introduced Forest	ground	54.0	7	13.0
	tree	73.5	9	12.2
		127.5	16	12.5
Native Limestone Forest	ground	41.0	6	14.6
	tree	68.0	12	17.6
		109.0	18	16.5
TOTAL AGUIGUAN		287.5	39	13.6

*Corrected for unavailable traps (Nelson and Clark 1973).

The only species of rat captured on Aguiguan was the Pacific rat *Rattus exulans* (Table 7). Rat capture rate increased from 10.7 rats/100 trap for native limestone forest in 1995 to 16.5 rats/100 trap-nights in 2000. For savanna habitat, trapping rate increased

from 5.3 rats/100 trap-nights in 1995 to 9.8 rats/100 trap-nights in 2000. The cause of the increase in capture rate may be due to seasonal population fluctuations. Campbell conducted his trapping in May-June of 1995 whereas our trapping occurred in early April. Additional data needs to be collected in order to determine if the increase is due to seasonal changes or some other factor. Rats were most abundant in native limestone forest (16.5 rats/100 trap-nights) and least abundant in savanna (9.8 rats/100 trap-nights). This pattern is similar to that observed by Campbell in 1995.

Bat Surveys

The Mariana fruit bat (*Pteropus mariannus*) was observed opportunistically throughout the trip. Solitary bats were mostly seen flying in the evenings during the station counts. Two small aggregations of fruit bats were discovered: one on Transect 1 (about 20 roosting in ironwood [*Casuarina equisetifolia*] trees), the other (about 20 bats) on the north side of the island roosting in gulos (*Cynometra ramiflora*) and umumu (*Pisonia grandis*) trees (Fig. 6).

Photo: Wildlife Technician Steve Camacho stands beside a very large example of a *Cynometra* or gulos tree.

MARIANA FRUIT BAT LOCATIONS, EVENING STATION COUNT LOCATIONS (3/31/00 - 4/5/00)

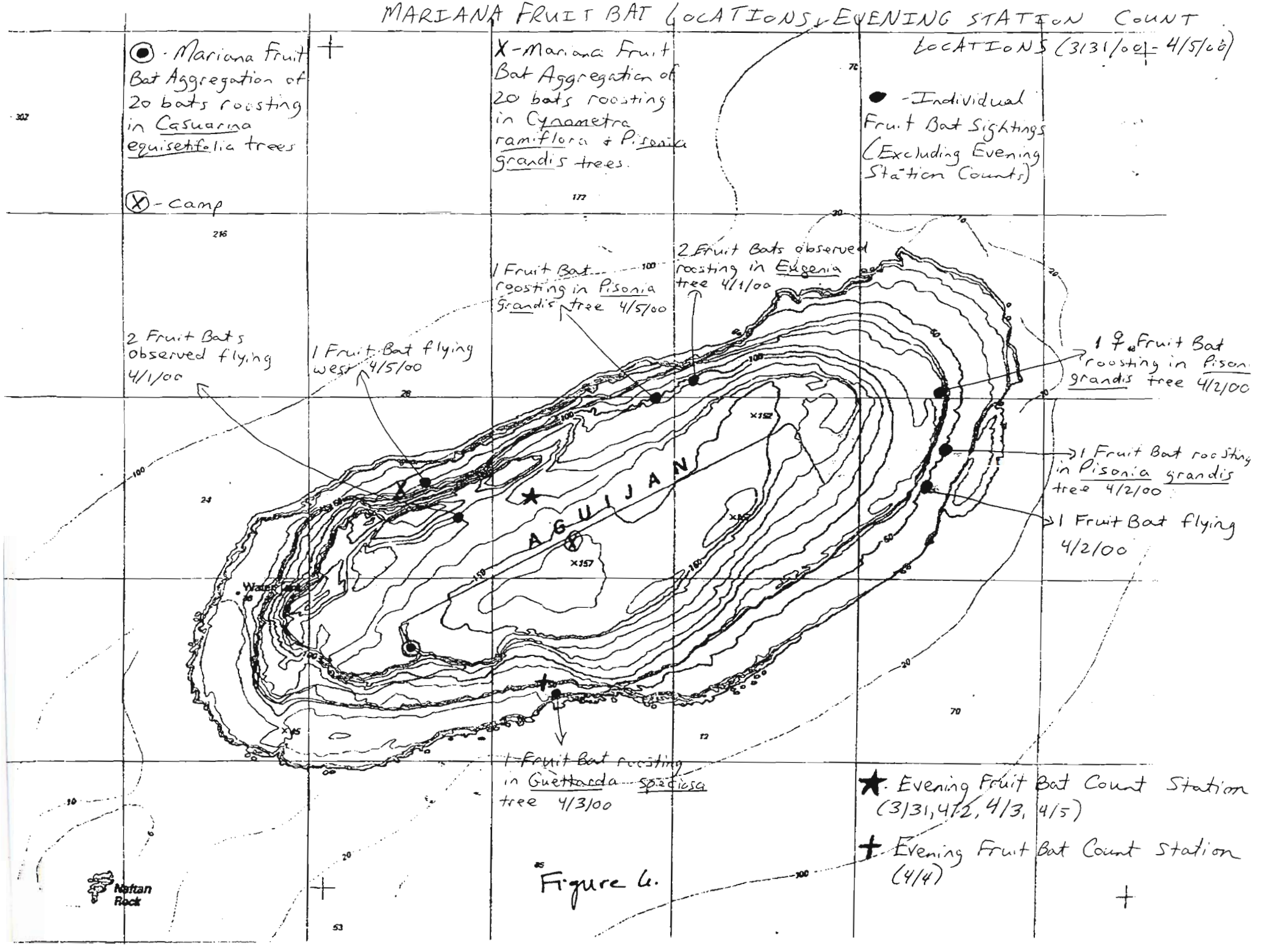


Figure 6.

We recorded behaviors observed at the bat aggregation roosting in the *Casuarina* trees three times (once in early morning, once at mid-day, and once in early evening) using a high-powered zoom spotting scope set up 50 meters away for clarity. We also searched for fruit bat roosts during the day by scanning from overlooks and hiking through known fruit bat roosting sites. In addition, five evening station counts were conducted from two different locations on the island. Four of the counts were conducted from an open field ~200 meters north of camp; the other count was conducted from a ridgeline on the south side of the island (Fig. 6). Counts started at 5:00 p.m. and lasted until dark (~7:00 p.m.). We counted the number of fruit bats flying and their flight direction (Table 8).

Photo: Example of a very old umumu tree (*Pisonia grandis*) on Aguiguan 2000.

Table 8. Numbers and flight direction of Mariana fruit bats observed during evening station counts on Aguiguan, 31 March-5 April 2000.

Date	Number of Bats	Flight Direction
31 March	3	East, west, northwest
2 April	8	West, east, southeast, north
3 April	6	West, southwest, east
4 April	2	Northwest, west
5 April	4	West, southeast

On 1 April, early evening behavioral observations of the bat aggregation roosting in the *Casuarina* trees along transect 1 were performed between 16:00-18:30 hours. Twenty fruit bats were observed roosting in two different *Casuarina* trees: eighteen bats were observed roosting close together and the other two were roosting in a different tree 15 meters away. At least one female and six males were roosting 17-18 meters off of the ground and 0.5-1.0 meters from one another. The males possessed quite prominent blonde manes, while the female possessed a darker head and face and her mane was not as blonde in color as the males. Playful behavior was observed in three of the males. Also, the female roosted in the middle of all of the males. By 18:30, most of the fruit bats were wrapped up in their wings and sleeping.

On April 3, early morning behavioral observations from 7:00-10:15 documented twelve fruit bats roosting in four different *Casuarina* trees. Grooming and playful behaviors were observed in three males. Five of the roosting bats hung by only one leg. Most of the bats were sleeping, but some wing flapping and vocalizations were also recorded.

Mid-day behavioral observations were made between 11:30 and 13:45 on 4 April. Only two male fruit bats were observed roosting in the same *Casuarina* tree while other fruit bats were heard but not seen throughout the *Casuarina* grove. The two bats exhibited such behaviors as sleeping, grooming, scratching, stretching, and wing-flapping. The head and face of one of the fruit bats was a little darker brown than the other; also the mane was a brown-black color with patches of blonde. The head and face of the other bat appeared lighter brown and the mane was distinctly blonde. It is possible that coloration of the head, face, and mane becomes lighter with age.

We also observed the behavior of bats in the aggregation roosting in *Cynometra* and *Pisonia* on the north side of the island. Observations were made between 9:00-10:30 on 5 April. We observed a total of about twenty fruit bats flying east, west, overhead, and from the roosting trees. One of the flying bats was a female with a 1-2 week old pup in tow on her underside. The pup was wrapped tightly around the mother's underside.

Table 9. Roosting and food trees for fruit bats on Aguiguan, April 2000

Fruit Bat Roosting Trees	Fruiting or Flowering Flora on Aguiguan 31 Mar-8 April, 2000
Guettarda speciosa	*Cynometra*-fruiting
Pisonia grandis	*Psychotria*-fruiting & flowering.
Cynometra ramiflora	*Ochrosia*-fruiting
Ficus prolixa	*Morinda*-fruiting & flowering
Casuarina equisetifolia	*Triphasia*-fruiting
	Artocarpus-fruiting
	Carica-fruiting & flowering
	Cerbera-fruiting & flowering

Fruit bats on Aguiguan appeared slightly larger than the fruit bats we have observed on Saipan and Rota. But, the number of fruiting trees available for foraging was minimal. There were not many fruiting trees observed throughout the island (Table 9). Therefore, it may be that some of Aguiguan's fruit bats are flying to Tinian to feed at night. The people of Tinian have mentioned that they have observed fruit bats flying in from Aguiguan at night.

From all of the individual fruit bat sightings, along with the evening station count results and the two small aggregations, we estimate the fruit bat population on Aguiguan to be 150-200 bats. Our findings are consistent with earlier reports of four roosts and at least 50 bats in May 1992 (Craig and Chandran 1992), and 100-125 fruit bats estimated as the island population in June 1995 (Worthington and Taisacan 1995). Most counts of fruit bats reported in DFW field trip reports in the 1980's were lower than recent records: 25 fruit bats in 1984 (Lemke *et al.* 1984), 40 in 1987 (Reichel *et al.* 1987), and 30 in 1989 (Rice and Reichel 1989). The exception to this pattern were the 200 bats counted in 1988 (Reichel *et al.* 1988). Observers felt that the highly anomalous count in that year was due to immigration from Rota where disturbances at colonies also appeared to cause immigration to Guam at approximately the same period of time (Wiles *et al.* 1989). It appears that fruit bat numbers increased in the late 1980's and then remained stable on Aguiguan for about the last 10 years.

The Sheath-tailed Bat (*Emballonura semicaudata*) does not appear to have fared as well as the Mariana fruit bat. We were unable to detect a single individual during this set of surveys, despite repeated searches for guano or other evidence of bats in 15 caves.

The first reports of this small insectivorous cave dweller were in 1984 in Landing Cave when two were collected for a positive identification. A small group was observed in Guano Cave in 1985, three were counted there in 1987, five in 1988 and 13 in 1989. In May 1992, two sheath-tailed bats were again reported in Landing Cave. By 1995, the combined count from Black Noddy, Guano, Crevice, Cliff and Pillar caves was 97-99 bats. It is possible that we failed to detect the sheath-tailed bat during this visit because they have moved to different localities or to roosts that were inaccessible during our cave searches.

Other Notes

Very large trees of *Cynometra ramiflora*, *Pisonia grandis*, *Guamia mariannae*, *Eugenia reinwardtiana* were observed. *Cordia subcordata* was observed on the southeastern side of the island. The understory of the native forest has been severely depleted by grazing goats, although intact seedlings of *Psychotria* and *Aglaia* were observed on the north side of the island. Generally, the most disturbed areas are now dominated by *Lantana camara* (a thorny introduced plant with no known wildlife or economic value)

with some islands of *Erythrina* and *Pisonia* trees. In places, the *Lantana* reaches 2.5 m in height.

Photo: Conservation Officer Alvin Fitial gets equipment ready for a survey in the overbrowsed native forest of Aguiguan. Note the open nature of the understory and lack of regenerating plants.

Management Recommendations

- It is impossible to talk about managing the resources of Aguiguan without talking about control of the feral animal population. The environmental damage from these animals has been severe. Although goat populations are difficult to survey, whatever the actual number is, there are far too many goats on Aguiguan. There is, as a consequence, very little regeneration of trees, bushes, or herbaceous vegetation with the notable exception of *Lantana camara*. Without a drastic goat population reduction, soil erosion will become even more severe and invading plants will take over more of the island. Aguiguan is at high risk of turning into a near desert, similar to Anatahan. We therefore recommend that the CNMI-Division of Fish and Wildlife develop a program to reduce the number of goats on Aguiguan

over the next 5-10 years. The Mayor of Tinian can help this effort by lengthening the now restricted hunting seasons, increasing bag limits, and encouraging sport harvests.

- We recommend that the CNMI-Forestry Section in cooperation with the Mayor of Tinian develop a plan to remove *Lantana camara* from portions of the island and replant those areas with native tree species. Suggestions for restoration of forest in *Lantana* areas and lists of native wildlife trees and shrubs are discussed in Appendix I.

- The increase in rat numbers and the abundance of monitor lizards on Aguiguan is cause for concern as they may have a future impact on native bird species. Their ample presence, plus the number of feral animals encountered, could impede recovery efforts. Monitoring these populations should be done every two years at the very least.

- We recommend continued monitoring of Guam swiftlets via arrival counts on an annual basis and continued cockroach bait placement in as many swiftlet caves as can be accessed as frequently as possible.

- As Aguiguan's natural resources recover from feral animal damage, we understand that eco-toursim enterprises are being considered as a reasonable use of the island. Once the island's ecosystem returns to a healthy equilibrium, we recommend the following in regards to developing this idea:
    1. Day-trips only, in small boats based out of Tinian, to limit the negative impact that tourists can cause to such a fragile ecosystem.
    2. Adequate refuse and waste disposal systems including: (a) regulations requiring tourists to carry small litter bags with them, (b) no smoking while on the island (to reduce the chance of igniting fires), and (c) self-composting toilets.
    3. Visitors should be required to use pre-constructed trails and these should be well marked.
    4. Tourists should be accompanied by a "naturalist guide" at all times while on land (people from Tinian interested in becoming guides should be trained and licensed by the Tinian Department of Lands and Natural Resources).
    5. No camping or over-night stays except for licensed hunting and scientific groups.
    6. Carrying capacity of 20 persons per day.

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We are grateful to the Mayor of Tinian for permission to work on Aguiguan and to Mr. Bill Cing who discussed plans for Aguiguan's future in detail. We look forward to

continued cooperation between local and municipal offices from all of the islands on projects focused on Aguiguan and on Tinian.

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Appendix I
Trees and Shrubs for Restoration Of *Lantana camara* Fields

The activities of feral animals have led to the encroachment of large fields of dense *Lantana camara* on Aguiguan. These fields could be restored to native forests that would enable Aguiguan to maintain and possibly even to increase its wildlife populations. At the onset, before any restoration activities begin, it is important to develop a restoration plan. A plan is needed because several elements and components need co-ordination and preparation. Successful restoration of a habitat is a long-term conservation activity, not a singular planting of various plant species. In order for the process to succeed three elements are essential: a long-term plan, commitment of personnel/labor, and time.

Restoration components:

- **Plant species that will be used in restoration:** It is very important when restoring wildlife habitat to use native species and resist the temptation to used introduced trees. It is harmful to use introduced species because it decreases the value of the forest for wildlife. Forest trees and shrubs are sources of food (with fruits and flowers) for wildlife. They are homes to insects, which are also wildlife food. In addition, native trees are used by wildlife for nests, burrows and roosts. Native trees fulfill many roles for native wildlife because they co-evolved together in a unique environment. Trees introduced from other places do not fulfill the same roles for native wildlife. They are from foreign environments, and therefore, they cannot provide all the same wildlife requirements. One result of using introduced species is that wildlife populations are not as robust. It is also important to know which native species are utilized for habitat or food by wildlife and which species are the most important.

- **Clearing schedule, erosion and weed control:** Clearing needs to be completed in small segments (probably no larger than half a hectare at a time). This will control erosion of topsoil, and allow for a reasonable area in which it is possible to control weeds and care for seedlings. If the area is too large it will be hard to control soil erosion. It will also be immensely difficult to plant enough seedlings and control weeds in an area that is too large.

- **Seedling outplanting, propagation and scheduling:** Seedling outplanting has to be co-ordinated with the clearing so that soil does not succumb to

heavy erosion. Native species need to be collected and nurtured in a nursery or seedlings need to be collected and propagated allowing enough time to be able to plant them when the area is cleared. In addition, it is necessary to understand which species can be planted out in direct sunlight--some species will not tolerate direct sun while others will not grow in the shade.

- **Maintenance of seedlings and restored areas:** this includes ensuring that young seedlings are of species that can tolerate the conditions, appropriately spaced, planted out at the right time of year, and weeded regularly until established.

Native tree and shrub species that are appropriate to use in restoring wildlife habitat.

A. Sun tolerant/secondary species appropriate for initial outplanting

* Asteriks indicates these plants are easy to propagate and/or are used by several wildlife species. They are probably the best plants to use at the beginning of a restoration project.

Scientific name	Common name	Comments
**Aidia cochinchinensis*	sumak	Indigenous[1], berries used by wildlife, fruits and flowers all year, can tolerate direct sun.
Erythrina variegata var. *orientalis*	gaogao	Endemic variety, flowers produce nectar for bats, Golden white-eyes, honeyeaters
Ficus prolixa	nunu	Indigenous, provides habitat and food, tolerates sun
Ficus tinctoria	hoda	Indigenous, provides habitat, fruit is bird food
Maytenus thompsonii	lulujut	Endemic, bird food especially for Golden white-eyes
**Melanolepis multiglandulosa* var. *glabrata*	alum	Endemic variety, habitat for Golden white-eyes, Nightingale reed-warblers, and Starlings, fruits eaten by all
**Morinda citrifolia*	lada	Indigenous, supports many insect species, fast growing, sun tolerant
Neisosperma oppositifolia	fagot	Indigenous, crab and bat food, flower pollinated by insects, insect habitat
**Ochrosia mariannensis*	langiti	Endemic, fruit eaten by coconut crabs and maybe bats, insect pollinated, sun tolerant, very important to plant
Pandanus tectorius	kafu	Endemic, coconut crab habitat and bat food
Pipturus argenteus	amahadyan	Indigenous, partially sun tolerant, insect pollinated and insect habitat
Pisonia grandis	umumu	Indigenous, large upper canopy tree, although stunted and gnarled on Aguiguan, general wildlife tree
**Premna obtusifolia*	ahgao	Indigenous, fruit foraged on by all species, tree utilized as habitat by all birds
**Psychotria mariana*	aploghating	Endemic, fruit important bird food, can tolerate partial sun
Trema orientalis	tal amama	Indigenous, fruit is bird food, sun tolerant

*Note: Endemic means the species is found only in the Mariana Islands. Indigenous means that the species is found over a larger area (throughout the tropical Pacific), however it came to the Mariana Islands on its own without human intervention. Native refers to all species endemic or indigenous that arrived in the Mariana Islands without assistance from man and is capable of reproduction in the wild.

B. Shade/ understory species

These species should generally be planted under at least a partial canopy, as they cannot withstand direct sunlight. They can be planted in the shade of the sun tolerant trees.

Scientific name	Common name	Comments
Pouteria obovata	lalaha	Indigenous, fruit is wildlife food, may be okay in direct sunlight
Drypetes dolichocarpa	mwelel	Endemic, fruit may be wildlife food, bird nesting tree
Guamia mariannae	paipai	Endemic, pollinated by insects/moths, possibly fruit is crab or bat food. Feral animals may not favor, must grow in shade
Cynometra ramiflora	gulos	Indigenous, bird habitat tree for several species including Golden white-eyes and fantails
Cerbera dilatata	chiute	Endemic, very fragrant flower, bird pollinated, large fruit is crab food. Maybe able to handle partial sun
Eugenia palumbis	agatelang	Endemic large shrub, berries are bird food. Seedlings need shade for growth
Aglaia mariannensis	mapunyao	Endemic, seedlings need shade, fruit is wildlife food for birds, crabs, maybe bats
Artocarpus sp.	lemai, or dukduk	Seedlings sprout in shade but partial sun may be okay, very important bat feeding tree

C. Coastal species

Coastline forests are usually different from inland forests and therefore are comprised of different species.

Scientific name	Common name	Comments
Barringtonia asiatica	puting	Indigenous, Food and habitat tree
Cordia subcordata	niyoron	Indigenous, Bird habitat and food tree
Guettarda speciosa	panao	Indigenous, flowers utilized by insects, fruit may be bird food
Hernandia sonora	nonak	Indigenous, bird and crab habitat tree, fruit. bird food
Intsia bijuga	ifit	Indigenous, flowers utilized by insects and birds.
Thespesia populnea	banalo	Indigenous, Bird habitat tree
Tournefortia argentea	hunik	Indigenous, Insect and butterfly habitat

D. Species that should be avoided

These species are mostly introduced and cause a variety of different problems in native forest ecosystems.

Scientific name	Common name	Comments
Acacia aciculatus		Introduced, not appropriate for native forests, will grow in clumps and out compete native trees. A large problem in Hawaii
Acacia confusa	sosugi, koa	Introduced, despite their heavy use for erosion control these are invasive and not good for native forest.
Casuarina equisetifolia	gagu	Introduced, two or more in a forest do not allow for growth of many native species
Fruit species		Introduced, in general these take the place of the native wildlife food. Agricultural forests and wild native forests should be kept separated
Hibiscus tiliaceus	pago	Indigenous, can become weedy over running a whole area
Ornamentals		Introduced, in general no ornamental/garden plants should be put into a natural forest area
Pithecellobium sp.	kamachile	Introduced, competes with native species
Psidium guajava	guava	Introduced, invasive and weedy, Hawaii has terrible problems with Guava in their forests.
Spathodia campanulata	apar/african tulip tree	Introduced, grows in clumps and tends to escape from cultivation, destroying forests.