RECOVERY PLAN

Mariana Islands Population of the
VANIKORO SWIFTLET

Aerodramus vanikorensis bartschi

U.S. DEPARTMENT OF THE INTERIOR
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Recovery Plan for the

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THIS IS THE COMPLETED VANIKORO SWIFTLET RECOVERY PLAN. IT DELINEATES REASONABLE ACTIONS WHICH ARE BELIEVED TO BE REQUIRED TO RECOVER AND/OR PROTECT THE SPECIES. OBJECTIVES WILL BE ATTAINED AND ANY NECESSARY FUNDS MADE AVAILABLE SUBJECT TO BUDGETARY AND OTHER CONSTRAINTS AFFECTING THE PARTIES INVOLVED, AS WELL AS THE NEED TO ADDRESS OTHER PRIORITIES. THIS RECOVERY PLAN DOES NOT NECESSARILY REPRESENT OFFICIAL POSITIONS OR APPROVALS OF THE COOPERATING AGENCIES, AND IT DOES NOT NECESSARILY REPRESENT THE VIEWS OF ALL INDIVIDUALS WHO PLAYED A ROLE IN PREPARING THIS PLAN. IT IS SUBJECT TO MODIFICATION AS DICTATED BY NEW FINDINGS, CHANGES IN SPECIES STATUS, AND COMPLETION OF TASKS DESCRIBED IN THE PLAN.

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EXECUTIVE SUMMARY OF THE RECOVERY PLAN FOR VANIKORO SWIFTLET

Current Status: This species is federally listed as endangered. Eleven colonies are known from Guam, Aguijan and Saipan. Current population estimates are 400 individuals in one colony on Guam, 970 in five colonies on Aguijan, and 3,160 in five colonies on Saipan.

Habitat Requirements and Limiting Factors: Vanikoro swiftlets nest and roost in limestone caves with entrances that are typically 2 m high or higher and chambers with dark zones where the birds nest. Swiftlets leave the cave to feed and drink, and, although they may forage over a wide variety of terrain and vegetation, they seem to favor ridge crests and open grassy areas where they capture small insects while flying. Current information documents the decline of swiftlet populations on the islands of Guam, Rota and possibly Saipan; however, there is no direct evidence of factors causing the recent decline. This species is believed to be threatened by various activities, including guano mining and vandalism, that result in disturbance of caves.

Recovery Objective: Downlisting to Threatened.

Recovery Criteria: The existing 11 colonies and their habitat must be protected and managed, and an additional 9 colonies established on Guam and Rota. The total population numbers then must be increased by about 50 percent and sustained over 3 consecutive years.

Actions Needed:

1. Permanently secure and manage the 11 known active swiftlet caves, one formerly active cave on Rota, and the immediately surrounding "buffer" habitat.
2. Survey for, secure, and manage additional colonies of swiftlets and potentially usable caves.
3. Conduct specific research on population biology and suspected limiting factors.
4. Promote population expansion into suitable historical habitat.
5. Develop and implement techniques for reintroduction of swiftlets into suitable habitat, as needed.
6. Monitor populations and develop criteria for delisting.

Total Estimated Cost of Recovery:

Costs ($000's)

Year	Need 1	Need 2	Need 3	Need 4	Need 5	Need 6	Total
1992	0	20	25	0	0	11	56
1993	26	20	60	10	10	7	133
1994	20	0	78	10	10	7	125
1995	25	5	53	10	20	7	120
1996	25	5	53	10	10	7	110
1997	25	5	25	10	10	11	86
1998	23	5	25	5	10	7	75
1999	23	5	10	5	10	7	60
2000	23	5	10	5	0	7	50
2001	23	5	10	5	0	7	50
2002	23	5	0	5	20	11	64
2003	23	5	0	5	20	7	60
2004	23	5	0	5	20	7	60
2005	23	5	0	5	0	7	40
Total	305	95	349	90	140	110	1089

Date of Recovery: Downlisting to Threatened should be initiated in 2005.

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I. INTRODUCTION

Description and Taxonomy

The Vanikoro swiftlet (Aerodramus vanikorensis bartschi, Mearns 1909) is a small swift with dark grayish brown plumage that is paler on the bird's underparts. The face is marked by a dark line through the eye. The tail is squared and without spines. Both sexes look alike. This is the only resident swift in the Mariana Islands, where it could be confused with migratory swallows and a rare vagrant, the fork-tailed swift (Apus pacificus).

This species belongs to a genus of swiftlets having the unusual ability of echolocation, which allows it to nest in deep caves. Aerodramus, a name adopted by Oberholser (1906) and Brooke (1972), contains many confusingly similar and closely related taxa. Kittlitz (1836) originally described the Mariana population of the Vanikoro swiftlet as a subspecies of A. inquietus of the eastern Carolines, then later considered it a separate species restricted to Micronesia (see the discussions by Baker 1951 and Pratt 1986). The Mariana population was later determined to belong with A. vanikorensis, based on similarities of nest structure and morphology (Medway 1966).

The taxonomy of this form is still debated. Some authors maintain this group of swiftlets belongs in the genus Collocalia, while others contend that A. v. bartschi is a distinct species (which would increase the priority for recovery of this form). Nonetheless, based upon the American Ornithologist's Union classification, this bird was listed as A. v. bartschi and is referred to as such in this recovery plan.

Distribution

The Vanikoro swiftlet inhabits lowlands and foothills on many islands of the western Pacific, ranging from the Philippine and Greater Sunda Islands eastward through the New Guinea region and Bismarck Islands to the New Hebrides, and northward to Micronesia. A. v. bartschi is endemic to the Mariana Islands of Guam, Rota, Aguijan, Tinian, and Saipan (Figure 1). The species has never been reported from the islands north of Saipan (Baker 1951, Pratt 1984). In 1962 the Hawaii State Division of Fish and Game imported swiftlets from Guam and released them on Oahu where they survive today as a small breeding colony of perhaps fewer than 100 birds (Berger 1981).

Natural History of Cave Swiftlets

Importance of nesting and roosting caves.--Aerodramus swiftlets nest and roost in caves. In the total darkness of their nesting chambers, cave swiftlets navigate by echolocation, an adaptation shared, among birds, only with the Oilbird (Steatornis caripensis) of the Neotropics. Echolocating swiftlets give a rapid, monotonic, clicking signal that can be heard by humans. By nesting in total darkness, the birds escape harassment from visually oriented predators. Swiftlets usually select nest sites on the highest parts of the cave, often choosing clefts in the cave roof, overhanging walls, or stalactites. In so doing, they generally keep beyond the reach of snakes, rodents, and other predators that find their way into caves. Caves are occupied throughout the year; movement among caves has not been studied.

Physical characteristics of swiftlet caves.--Of the 11 caves now known to be occupied by swiftlets in the Marianas (Table 1), all are solution cavities in limestone; all have entrances at least 2 m high; all have chambers with dark zones where swiftlets nest; and most have fresh, breathable air. A number have two entrances.

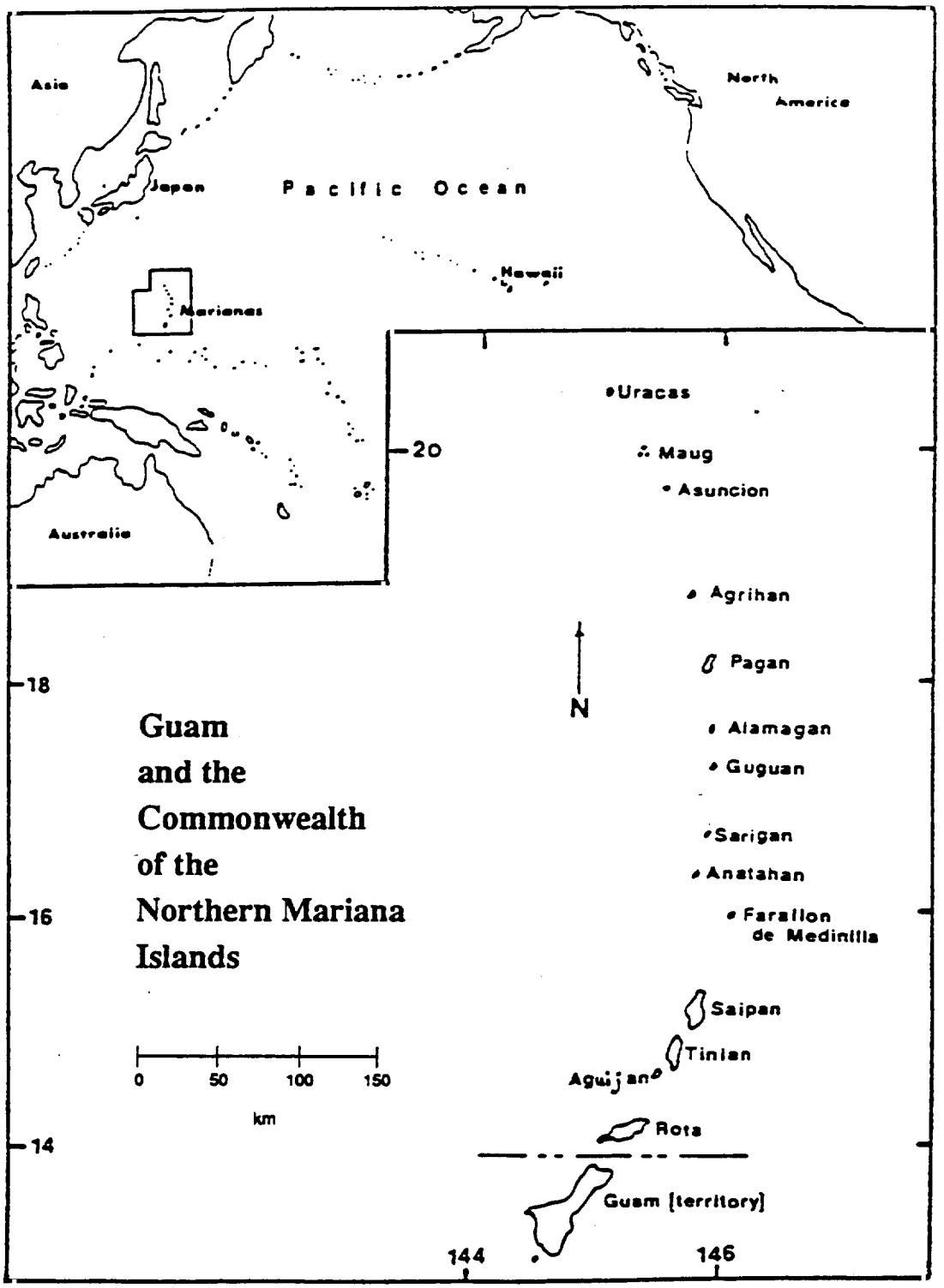

Figure 1. Map of the Mariana Islands.

Table 1. Swiftlet caves surveyed in the Mariana Islands by the Commonwealth of the Northern Mariana Islands Division of Fish and Wildlife and the Guam Division of Aquatic and Wildlife Resources. All caves were surveyed in 1983-85, except for Mahlac Cave on Guam, which was surveyed in 1986-87. The ownership of some caves is uncertain; these sites are marked with a "?."

Cave	Island	Population estimate	Land Ownership
Mahlac	Guam	400	US Navy
Vampire Bat	Rota	0	CNMI?
Guano	Aguijan	750	CNMI
Pillar	Aguijan	100*	CNMI
Cliff	Aguijan	100*	CNMI
Landing	Aguijan	10*	CNMI
Black Noddy	Aguijan	10*	CNMI
Subtotal	Aguijan	970	
Takpochao	Saipan	1,800	Vicente S. Guerrero?
Hour Glass	Saipan	625	CNMI?
Tin Can	Saipan	525	Jose C. Cabera?
Navy Hill	Saipan	160	CNMI
Celis	Saipan	50*	Manuel Celis
Subtotal	Saipan	3,160	
Total	Marianas	4,530	

* Uncensused estimates.

For eight caves, the entrances are obscured completely by forest, including tangantangan (Leucaena leucocephala) forest. Of the eight caves that were entered by Commonwealth biologists in 1983-85, seven contained abundant human refuse dating from the Japanese occupation of the islands before and during World War II. Old tin cans, remains of military equipment, and shelters indicated that temporary human habitation of the caves had occurred. Caves examined after heavy rains often dripped water from the ceiling. At least two caves were being exploited for guano in 1983-85.

Breeding habits.--The cup-shaped nests of the Vanikoro swiftlet are composed of moss or other plant material glued together with the bird's sticky saliva. The related edible-nest swiftlet of southeast Asia has abandoned the practice of using plant material and instead weaves its nest of translucent threads of saliva. These nests are collected commercially and constitute the special ingredient of "bird's nest soup." Nests of Vanikoro swiftlets are not edible because of the mossy matrix. Jenkins (1983, pg. 19) summarizes the nesting biology of swiftlets on Guam:

> At three colonies observed by DAWR [Division of Aquatic and Wildlife Resources] staff (Drahos 1977), clutches consisted of single white eggs laid sometime between January and July. No records exist of this species nesting from July through December, although this possibility cannot be discounted. Harrisson (1972) reported that Aerodramus species in Borneo have 5- to 7-month breeding seasons. No second clutches or renesting attempts have been observed for A. v. bartschi on Guam. Two eggs measured were 17 by 11 mm, and one was 18 by 11 mm. The incubation period of the species is at least 12 days, and probably longer. The young are highly altricial. They require 2 to 3 weeks to open their eyes and develop rudimentary feather tracts. One nestling took 35 days to fledge. Within a colony, some nests contain eggs, and

others have nestlings at different stages of development. Whether one or both adults participate in incubation, brooding, and feeding of the young is unknown.

Additional information on the breeding biology of the Vanikoro swiftlet is not known.

Roosting habits.--Swiftlets roost as well as nest in caves. Spectacular evening flights gather over the cave entrance, the swiftlets circling about and twittering excitedly. At first only a few birds dive into the cave, passing others that are flying out for a last foraging flight. In the final moments of twilight the flock begins streaming into the entrance. As the birds fly in, a deafening chorus of clicking swells from within the cave, each bird searching for a place to roost. All swiftlets have returned by the time the night sky is completely dark. These evening flights provide the best opportunity to count swiftlet populations. Birds are counted in groups and as singles against the light of the twilight sky as they fly into the cave.

Swiftlets often return from foraging to roost in caves during the daytime. When a human enters a swiftlet cave most birds leave, yet a few remain clinging to the cave walls. These individuals are very slow to awaken, as though coming out of torpor. If swiftlets indeed go into torpor while sleeping, then their roosting in caves takes on additional significance; it would be essential that birds are not disturbed while in such a highly vulnerable state.

Feeding habits and habitat use.--Swiftlets leave the cave to feed and drink. Although swiftlets forage over a wide variety of terrain and vegetation, they seem to favor ridge crests and open grassy areas. Here they capture small insects while flying. No information exists regarding the type of insects that swiftlets

feed upon in the Marianas. Swiftlets have not been observed to alight on trees or other perches away from caves.

Historical and Current Population Status

Most historical information on Vanikoro swiftlets in the Marianas comes from Guam. Historical data for the Northern Marianas are incomplete or altogether lacking. Quantitative surveys of those islands were not attempted until 1977 (Ralph and Sakai 1979) by which time swiftlet populations had about reached their present numbers. The Micronesian Forest Bird Survey of 1982 (Engbring *et al.* 1986) provides the most complete data available and serves as the best comparison with the cave counts conducted in 1983-85 by the Division of Fish and Wildlife, Commonwealth of the Northern Mariana Islands (Table 1).

Guam (550 km²).--Jenkins (1983, pg.19) summarizes the recent decline of swiftlets on Guam:

> Many authors have referred to the past abundance of *A. v. bartschi* on Guam (Seale 1901; Safford 1901; Bryan 1936; Marshall 1949; Hartin 1961). Baker (1947) found the bird to be the third most abundant species during roadside counts made in 1945. Even as late as 1965, the species was described as common around Amantes Point (Tubb 1966). Beginning in the mid-1960's and continuing through the early 1970's, this swiftlet underwent one of the most precipitous declines of any of the native birds (Drahos 1977).

All known swiftlet caves were deserted by the late 1970's, although occasional sightings indicated that a few swiftlets survived at unknown sites. Over the past 10 years swiftlets have been seen mostly in southern Guam. Rare sightings along the north coast may represent a small local population or foraging birds from southern Guam. In 1983-84, the Guam Division of Aquatic and Wildlife Resources surveyed all the caves they could locate on

Guam (C. Aguon and G. Wiles, personal communications 1987). Of the 24 caves visited, 8 showed evidence of former occupation by swiftlets (Figure 2). Only one, Mahlac Cave, still harbored a swiftlet population. Based on rare sightings of swiftlets in the Geus River Valley of southern Guam, a small colony may survive in this area also.

Mahlac Cave is located in southern Guam on the Naval Magazine near the base's eastern boundary. The cave measures 47 m long, 6 m high, and 15 m wide. There are two entrances to the cave; the most used entrance measures 8.7 x 8 m and the "rear" entrance is 6 x 6 m. The cave is a sinkhole in limestone substrate. The surrounding area is forested. There were about 300 active and inactive nests located on the ceiling of the central portion of the cave as of 1984. Counts conducted by Guam biologists in 1986-87 place the population at about 400 birds.

Rota (85 km²).--Swiftlets were abundant on Rota at least until the 1940's (Baker 1951), but declined and disappeared by the 1970's (Engbring et al. 1986). The latest sightings, which occurred in 1976, were of small numbers at three widely separated sites on the island (Pratt et al. 1979). Commonwealth biologists surveyed Rota in 1983-85. Swiftlets were not seen on ten field trips to the island, nor were there any reliable reports from residents of Rota that swiftlets had been seen during those years. One huge, abandoned nesting cave, Vampire Bat Cave, is known (Figure 3). However, several caves were probably once occupied on Rota, but have not been examined or described.

Vampire Bat Cave at one time harbored hundreds, if not many thousands, of Vanikoro swiftlets and, according to local information, small bats, probably sheath-tailed bats (Emballonura semicaudata). Located at the foot of a cliff in limestone forest,

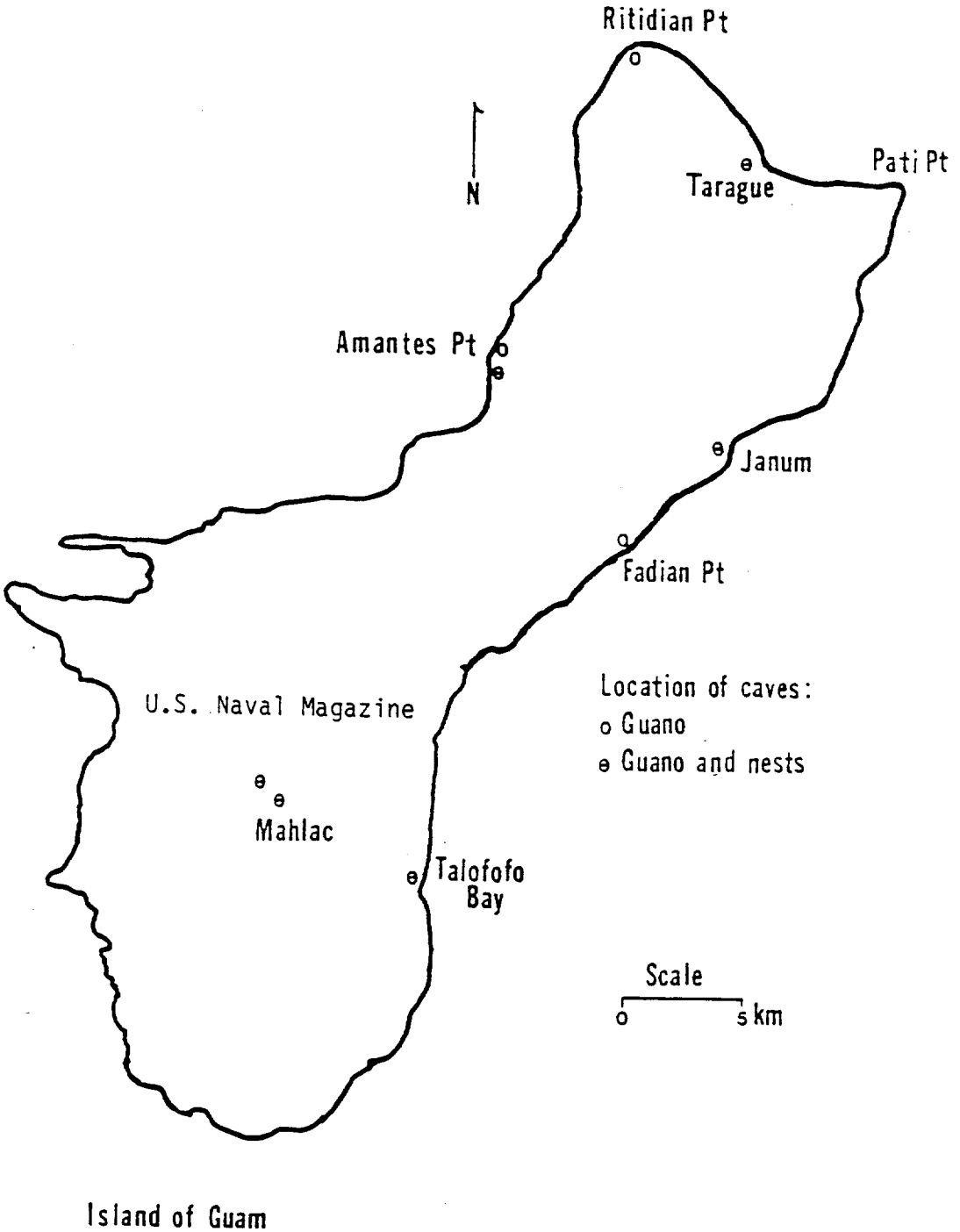

Figure 2. Location on Guam of caves which contained guano or swiftlet nests. Only Mahlac Cave supports an active swiftlet colony.

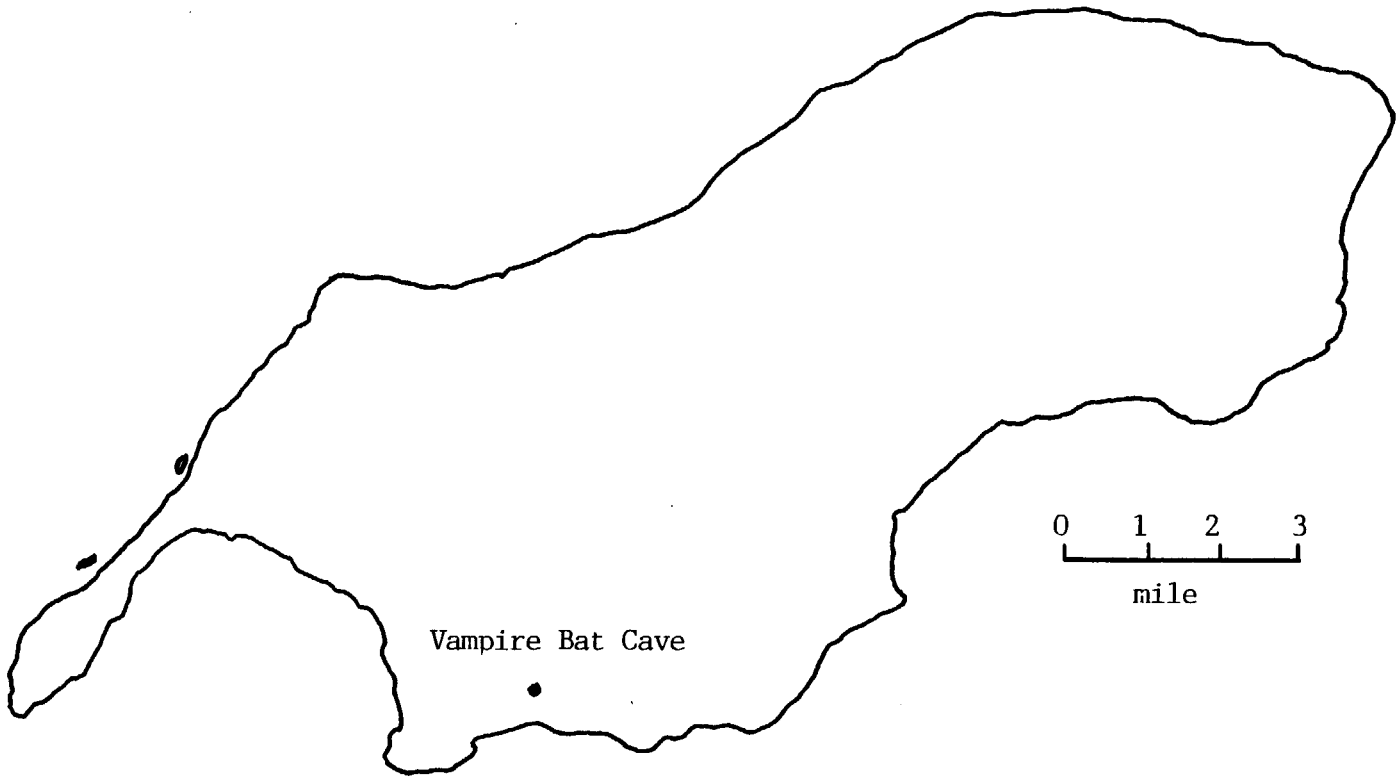

Figure 3. Location of the vampire bat cave on Rota.

the cave opens into a huge chamber with a ceiling 15 m high. The cave has two entrances close together. Large quantities of guano still cover the cave floor, but according to local information, most of the guano has been mined. Ten old nests, still intact, were found in this cave in 1984. One had the disintegrating remains of a fledgling in it. The lower levels of the cave appear to be trampled by cattle and possibly deer.

Aguijan (also known as Agiguan) (7.2 km²).--The status of the Aguijan population was first described by Engbring et al. (1986). They estimated 1,022 birds for the island at a density of 265 birds per km², which is the highest density of swiftlets in the Marianas. Swiftlets were observed throughout Aguijan but were most common along cliffs at the island's summit. Aguijan was resurveyed in 1984-85 by Commonwealth biologists. A total estimate of 970 birds was obtained by conducting counts at the five known active caves (Figure 4). Even though this estimate matched closely the 1982 figure, there was no way of knowing whether all swiftlet caves were surveyed. Parts of Aguijan remain to be explored for caves. The five active nesting caves known from Aguijan, Guano, Pillar, Cliff, Landing, and Black Noddy caves, were described by Commonwealth biologists following their 1984-85 survey.

Guano Cave is the largest cave on Aguijan, and probably houses most of the swiftlets on the island; an estimated 700-800 swiftlets occupied the cave in 1984. The cave entrance consists of a cleft about 7 m high in the face of a cliff. Inside the entrance are two passageways. The passage to the left is the larger of the two and has a ceiling about 12 m high at the end of its 20 m length. Most of the swiftlets occupy this passage. Swiftlets nest on all wall surfaces down to within 2 m of the cave floor. The cave appears to have about 80 nests. Sheath-tailed

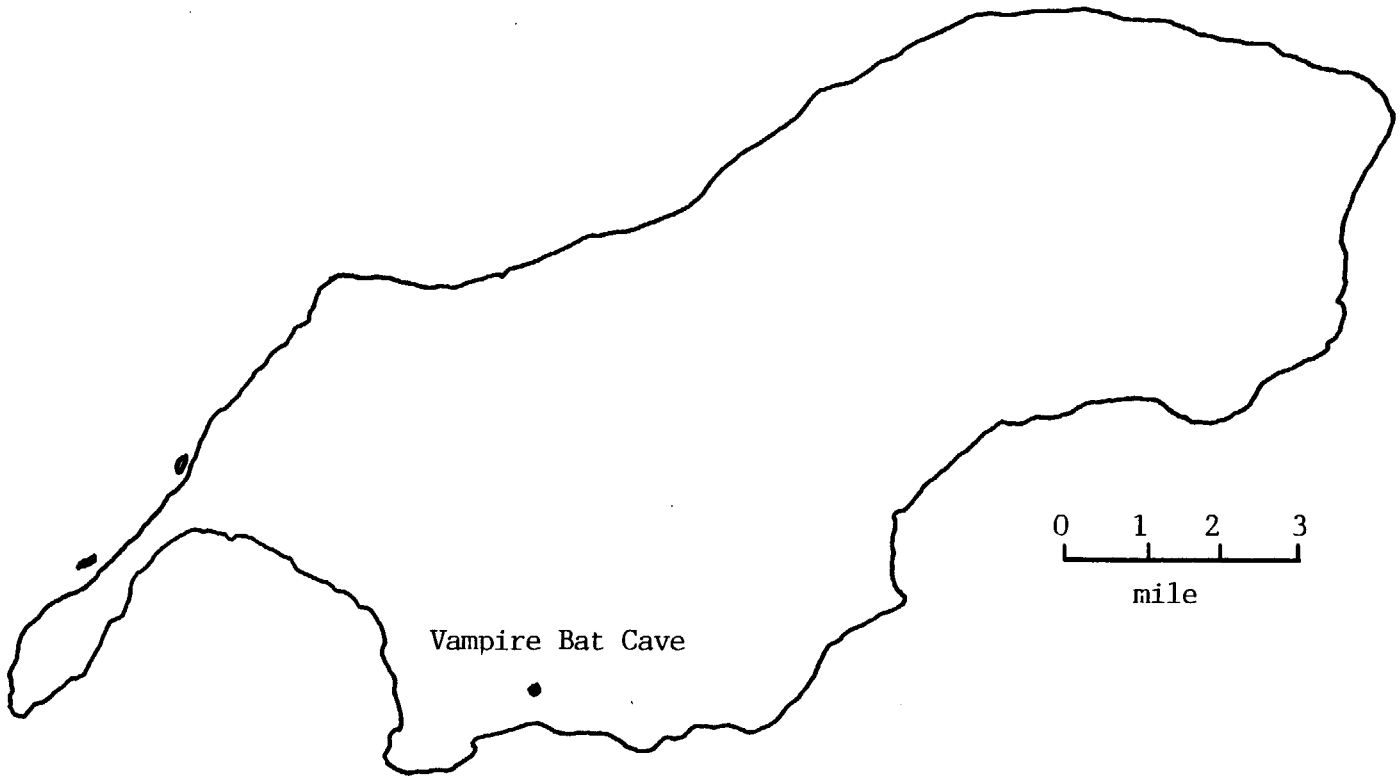

Figure 3. Location of the vampire bat cave on Rota.

bats also roost on the ceiling of the cave. Goats can easily enter both passages and may sometimes disrupt the colony.

Pillar Cave is located on the steep north slope of the island about 100 m west of Cliff Cave. It is located on the face of a cliff and features a stalactite pillar dividing a large entrance. The main passage opens then narrows, but its ceiling remains at least 7 m high. An estimated 100 birds occupy the cave, and a maximum of 19 nests have been counted. All nests were located in the dark zone.

Cliff Cave is an inaccessible cave high on the same cliff as Pillar Cave. Swiftlets could often be seen entering the cave in 1984-85. Although no census of the population was made, an estimated 100 birds used the cave.

Landing Cave is near the shoreline on the west end of the island. It has a large entrance, about 12 x 12 m. Immediately inside is a high pile of jumbled boulders and fallen stalactites. Above and beyond the boulder pile is a first chamber with two thick stalactites. At its largest, the main passage is about 4 x 4 m, with complex surfaces marked by solution pits and stalactites. Swiftlets occupy only the dark interior chambers. Brief visits to the cave have resulted in counts of six swiftlets and three nests.

Black Noddy Cave is near Pillar and Cliff caves. The cave itself is very steep and difficult to enter. The entrance is about 2 x 3 m, but the length of the passage is not known. Biologists estimated that ten or more swiftlets used this cave in 1983-85. There is also a narrow passage under the northern overhang of Black Noddy Cave which harbors a few swiftlets.

Tinian (102 km²).--Swiftlets have been reported sporadically from Tinian (Gleize 1945, Downs 1946, Marshall 1949, P. Bruner personal communications 1986 in Engbring *et al*. 1986). These swiftlets are

believed to have been visiting temporarily from Aguijan or Saipan. Swiftlets were not seen during nine trips to Tinian conducted in 1983-85 by Commonwealth biologists, nor were there any reports of swiftlets from Tinian residents during this period. A faunal survey of Tinian in 1984-85 also failed to locate swiftlets on the island (Beck et al., in prep.).

Saipan (123 km²).--Within the past decade, swiftlets have been described as being either uncommon or common on Saipan, where they inhabit the mountainous center of the island (Pratt et al. 1979, Ralph and Sakai 1979, Jenkins and Aguon 1981). Although swiftlets have been observed mostly in the mountains, they occasionally appear in the coastal districts (Pratt 1984). Swiftlets are normally absent from northern Saipan, and no caves are known from here. However, small flocks range into this part of the island during the wet season from July to December.

In 1982, using the variable circular plot survey method, the swiftlet population on Saipan was estimated to be 9,100 birds (Engbring et al. 1986). In 1983-85, Commonwealth biologists censused swiftlets at the five active caves known from Saipan (Figure 5). Birds were counted as they returned to roost at cave entrances at dusk, and an estimated 3,160 birds were recorded (Table 2).

It is unknown whether the discrepancy in the 1982 estimates reflects differences between the two sampling techniques, unknown cave populations that were missed during the 1983-85 cave survey, or real differences between the two sampling periods. Counting pre-roosting flights of swiftlets is probably a more accurate survey technique than the variable circular plot method used in 1982, and the estimate of 3,160 swiftlets is considered to be the best baseline data available. With the variable circular plot

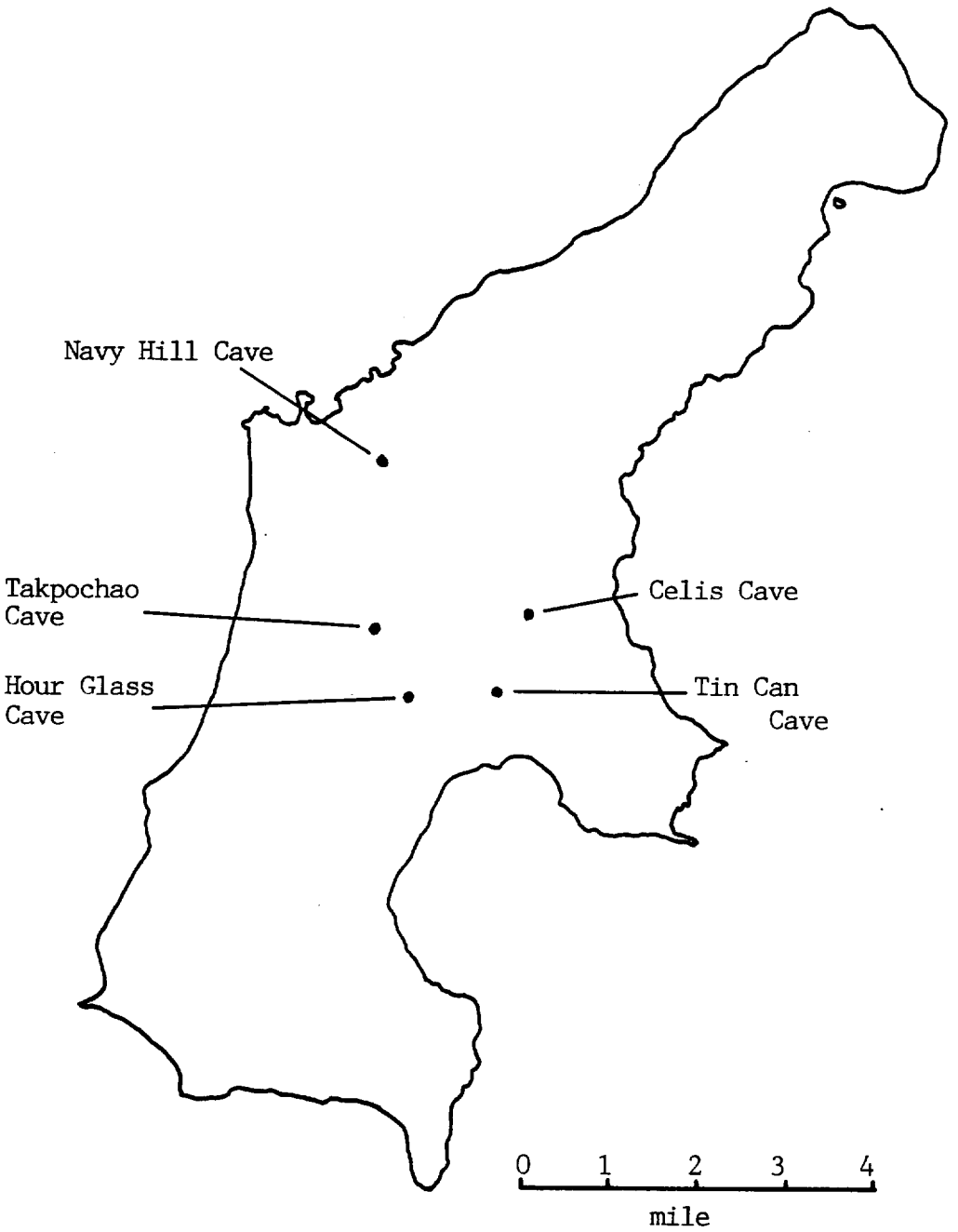

Figure 5. Location of active swiftlet caves on Saipan.

Table 2. Swiftlet caves surveyed on Saipan in 1983-85 and in 1986.

Cave	Population estimate 1983-85	1986
Takpochao	1,800	560
Hour Glass	625	480
Tin Can	525	790
Navy Hill	160	300
Celis	50	25+
Total	3,160	2,155

method, birds are recorded during an 8-minute count period at each of many stations along a transect. There are several sources of error that could bias results with this method, and the problem is magnified by species such as the swiftlet that move rapidly during a count. A disadvantage of counting swiftlets coming to roost at caves is that all caves must be censused. Although it is not certain that the five caves surveyed represented all active caves, Commonwealth biologists believed that there were no major populations elsewhere on Saipan. To locate caves, biologists relied on local informants, including farmers who mined guano, deer hunters, bottle collectors, and others who regularly hiked through uninhabited parts of Saipan. It is unlikely that a large cave would go unnoticed on this relatively small island.

Swiftlets at the five active caves were surveyed again by Commonwealth biologists in 1986, when a total of 2,155 birds were recorded (Table 2) (P. Glass, personal communication 1987). These counts suggest a decrease of about a third of the Saipan population since the 1983-85 counts. Most of the decline was noted at Takpochao Cave; higher numbers were recorded at three of

the five caves. Distribution of swiftlets among the caves was different during the two surveys, suggesting that there is movement among the various cave populations.

The five active swiftlet caves on Saipan, all situated in the interior of the island, are Takpochao, Hour Glass, Tin Can, Navy Hill, and Celis caves. They were examined and described in 1983-85. At least two other large caves, Calaberra Cave and Cave of the Sinking Waters, were also visited during this period, but neither showed evidence of swiftlets.

Takpochao Cave is a sinkhole in the hills behind the town of Gualo Rai. It is 7-10 m deep and completely covered by tangantangan trees. Swiftlets fly in a downward spiral to enter the main vertical shaft. It appears that two separate, horizontal passages lead away at the bottom. Swiftlets fly into and out of both passages and into a shallow niche, where many birds appear to roost. A unique historical feature of this cave is a small concrete niche, perhaps an altar, built into a limestone outcrop at the top of the shaft. The site may at one time have been a Japanese shrine. In 1984, Commonwealth biologists counted 1,780 birds returning to the cave at dusk and estimated the population to be 1,500-2,000. This cave harbors the largest population of swiftlets in the Marianas.

Hour Glass Cave is located about 1.5 km southeast of Takpochao Cave on relatively flat ground in dense secondary forest of tangantangan and native trees. The entrance is about 5 m across, opening into a large, roughly spherical chamber 8 m deep. At the bottom of the chamber is a hole about 6 m across. This entrance opens into a second chamber 4-6 m deep. The cave is accessible only by ropes. Swiftlets use the bottom chamber only. Population estimates for this cave based on 1983-85 counts are 600-650 birds.

Tin Can Cave is in the mountains of east central Saipan on a steep slope in limestone forest adjacent to a clearing with tall grass. The entrance is narrow but high, allowing the birds ample room to come and go. From the entrance, the floor of the cave slopes downward at a steep angle all the way back to the last passage. Beyond a minor constriction, the main chamber opens to a diameter of about 12 m with two pockets in the wall at ceiling level. Swiftlets use only the dark ceiling and two lateral pockets of the main chamber. Small accumulations of guano are present. The air in the cave is stagnant and barely breathable, although it is not known how this affects the swiftlets using the cave. The population estimate from 1986 suggests that almost 800 birds use the privately owned cave.

Navy Hill Cave is located on a steep slope in a mixed forest of tangantangan and native trees, about 1 km southeast of Garapan Village. A short passage opens into a simple circular chamber 25 m long by 20 m wide and 5 m high. The cave floor is littered with debris from the Japanese occupation. A thin layer of guano has accumulated on the cave floor. The air is stagnant but breathable. In 1984 it was estimated that 160 birds used the cave; in 1986 the estimate was 300 birds.

Celis Cave, privately owned, is located 350 m north of Papago Stream. Two jagged ramparts of limestone are at the entrance. The short entry passage curves to the right and ends in a small chamber with a ceiling about 5 m high. The floor is jumbled rock; the walls and ceiling are cracked and pocked. Swiftlets apparently enter the cave only from the main entrance and nest in the back chamber. The total population of this cave is probably fewer than 50 birds.

Threats to Survival

Current information documents the decline of swiftlet populations on the islands of Guam, Rota, and possibly Saipan. Yet for none

of these islands is there direct evidence of factors causing the recent decline. Below are listed hypothetical limiting factors.

Disturbance of Caves.--For millions of years, caves harboring swiftlets have remained isolated and undisturbed. Only with the advent of man has the swiftlet's sanctuary been disrupted. In their caves, swiftlets are highly vulnerable to disturbance from people. This disturbance has included:

(1) occupation of swiftlet caves by the Japanese during World War II and the bombing of caves by American troops;

(2) guano mining practiced by the present indigenous population and perhaps formerly by the Japanese;

(3) visits by deer hunters, collectors of old bottles and WW II memorabilia, hikers, wildlife biologists, and others;

(4) vandalism, such as children swatting swiftlets with sticks;

(5) feral mammals, which may use some caves as shelter and cause the same type of disturbance that guano mining or temporary camping by humans could cause.

Of these types of disturbance, guano mining and vandalism are potentially a serious problem today. Guano accumulates in all caves and is sought by local farmers as a source of finely textured and nitrogen-rich fertilizer. Local informants relate that Vampire Bat Cave on Rota was exploited commercially after World War II. Caves now mined on a small scale are Celis, Navy Hill, and Tin Can Caves on Saipan and Guano Cave on Aguijan. Dangerous access protects the large colonies at Hour Glass and Takpochao Caves on Saipan. The effects of guano mining on swiftlets are unknown but may include: 1) frequent disturbance of nesting birds by mining activities, resulting in nesting abandonment or failure; 2) bad air created by quantitative or qualitative changes of decomposition rates of guano turned over by

miners, resulting in health problems for the birds; and 3) cooking fires or smoke from lanterns in the cave or at its entrance, resulting in temporary or permanent abandonment of caves by swiftlets. Because of a complete lack of data, the effects of such factors on swiftlets are unknown.

Vandalism does occur rarely and is potentially devastating. One man reported that as an adolescent on Guam, he and his friends would stand at the entrance of a cave with sticks and swat down swiftlets entering or leaving the cave; in a short time the boys killed large numbers. Vandals could potentially eliminate an entire colony on repeated visits. All caves, except Cliff Cave on Aguijan, have entrances accessible to people and are therefore vulnerable to vandalism.

Snakes.--Predation by brown tree snakes (Boiga irregularis) is now believed to be the main factor causing most bird species to decline on Guam (Conry, in prep., Savidge 1986), although it is not known whether the snake has significantly affected swiftlets. Individual snakes have been found at both entrances to Mahlac Cave (C. Aguon, personal communications 1987). Brown tree snakes often climb rock faces and trees. By ascending to an advantageous perch at the mouth of a cave, a snake may be able to capture passing swiftlets, particularly at dusk when the birds fly slowly and begin their sonar clicking. Other species of snakes are known to use this approach to capture small cave-dwelling bats (Hill and Smith 1984). Brown tree snakes may also enter caves to prey on roosting or nesting swiftlets, on nestlings, or on eggs. For reasons yet unknown, swiftlets have survived at Mahlac Cave despite the probable existence of brown tree snakes in the area for two decades.

Although snake predation may be a factor in the decline of the swiftlet on Guam, the snake does not occur on the other islands in the Marianas and, therefore, cannot have influenced swiftlet

populations outside of Guam. Nonetheless, the snake presents a potential threat. Most former swiftlet sites on Guam are near cliff areas which appear to have been focal areas for snake distribution, possibly years before snakes were discovered in areas away from cliffs (T. Fritts, personal communications 1987).

Pesticides.--Heavy use of pesticides on Guam was blamed for the decline of swiftlets and other native birds on that island. Jenkins (1983, pg. 52) summarizes the problem:

> The United States military units sprayed, dusted, and fogged DDT on Guam weekly during and after World War II, concentrating their applications on Guam's southern rivers and streams (Baker 1946). Also, former DAWR staff have reported that southern farmers carelessly applied large quantities of DDT throughout the 1960's, about the time many of the southern bird populations apparently began their declines. Body tissues of the Gray [Vanikoro] Swiftlet analyzed in 1975 contained DDE residues averaging 0.27 ppm (range = 0.17-0.39; n=8). Guano samples of the swiftlet from central and northern Guam, similarly analyzed, showed DDE residue levels from 0 to 0.10 ppm, with the top layer of guano deposits more contaminated than the lower layers (Drahos 1977).

Whether or not this level of contamination exceeds the tolerance of swiftlets is not known, but it would be considered "safe" for other birds. After reexamining these early data and conducting new studies, Grue (1985) unequivocably rejects the hypothesis that pesticides are responsible for the continuing decline of birds on Guam. Though application of pesticides may have been a problem in the past, apparently it is unimportant today.

Disease.--Research by Guam biologists and the National Wildlife Health Laboratory found little evidence for a major epidemic of avian disease on Guam, although swiftlets were not specifically studied (Savidge 1986). There is a possibility that a disease favoring the unique environment of swiftlet caves might be connected with the decline of Vanikoro swiftlets in the Marianas. Newly introduced insect vectors, such as mosquitoes, may be aiding in the spread of disease.

Other hypothetical factors.--Typhoons cause severe damage to forests and other habitats in the Marianas. Their temporary effects on native bird populations have not been well documented. Despite the dramatic impact of typhoons, countless generations of swiftlets have survived these devastating storms and presumably have evolved behaviors to help them do so. Swiftlets have not declined recently because of typhoons.

Another hypothesis is that alteration of native habitats could have led to a corresponding decline of forest birds on Guam. The Marianas support a variety of habitats used by swiftlets for foraging. The distribution of these habitats has not changed substantially during the period of decline of the swiftlet. Although habitat alteration should not be totally discounted, it seems unlikely to be the cause for the recent decrease in swiftlet numbers.

Conservation Efforts

Legal status.--In 1960, the enactment of Guam Public Law 6-87 prohibited the taking, buying, or selling of wild birds, including the Vanikoro swiftlet, or their eggs on Guam. On September 24, 1981, the Guam population of the Marianas subspecies of Vanikoro swiftlet became protected by the Endangered Species Act of Guam (Pub. L. 15-36). This subspecies was listed as endangered throughout its native range by the U.S. Fish and Wildlife Service in 1984 (Federal Register 49:33881-33885, August 27, 1984). No

critical habitat has been designated. In the Commonwealth of the Northern Marianas, the swiftlet is protected by local laws. Also, a section of the 1985 Regulations of the Division of Fish and Wildlife provides for the local listing of endangered species within the Commonwealth, and the swiftlet may some day be placed on that list.

Management practices and current land ownership.--There is now minimal management for Vanikoro swiftlets in both the Territory of Guam and the Commonwealth of the Northern Marianas. Although the birds are legally protected, there is no organized enforcement of regulations pertaining to swiftlets. As yet, there are few plans to secure and manage swiftlet caves. Apart from initial surveys, few studies have been conducted that would provide the much-needed evidence for factors causing the decline of swiftlets. Ownership of lands having nesting caves of swiftlets is listed in Table 1.

II. RECOVERY

A. Objectives

Based on historical distribution and population size, interim recovery objectives are established for downlisting to threatened status. Minimum subpopulations that should be established before downlisting is considered are 2,000 birds on Guam; 2,000 birds on Rota; 1,000 birds on Aguijan; and 2,000 birds on Saipan. To protect against disasters at one or more caves, each of these populations must be distributed among at least five caves on each island except Rota. On Guam, at least two of the five occupied caves should be in northern Guam and two in southern Guam. No minimum population size has been designated for Tinian, since it is not known whether this island historically supported swiftlet colonies.

Lack of data on limiting factors, breeding biology, and interisland movements prevents the development of clear, quantitative recovery objectives for delisting. Detailed criteria for delisting are to be developed as part of Task 5.

B. Narrative

1. Preserve and Manage Known Swiftlet Caves.

A crucial element of conserving swiftlet populations involves protection and management of swiftlet caves. Caves are the essential feature of swiftlet habitat, providing shelter and roosting and nesting habitat. Efforts must be made to secure all occupied caves and manage the immediate habitat to provide optimum habitat for the swiftlet.

Twelve caves have been identified as high priority for recovery. These 12 caves include the 11 known active colonies and one formerly occupied cave on Rota, Vampire Bat Cave. Because there are now no active colonies on Rota, it is essential that at least one potential site be managed for future reintroduction of the swiftlet there.

11. Provide long-term security for the cave site and buffer zone.

"Securing" a cave (i.e., providing permanent legal protective status for the land) could be accomplished by several means, including a cooperative agreement, a lease, or a purchase. In addition to securing caves, a buffer of at least a 50-m radius of natural habitat around all entrances of the caves should be secured and maintained (a minimum of 1 ha). The need for more buffer should be reviewed for each cave, depending on local topography and vegetation as an adequate barrier to potential disturbances.

111. Mahlac Cave on Guam.

Mahlac Cave is owned by the U.S. Navy. They should be encouraged to enter into a cooperative agreement with the Guam Division of Aquatic and Wildlife Resources and the U.S. Fish and Wildlife Service (Service) to secure the site for management of the swiftlet.

112. Caves on Aguijan and Saipan owned by CNMI.

Guano Cave, Pillar Cave, Cliff Cave, Landing Cave and Black Noddy Cave on Aguijan and Navy Hill Cave on Saipan are owned by the Commonwealth of the Northern Mariana Islands (CNMI). It should be possible to manage these caves without any additional acquisitions but a Memorandum of Understanding (MOU) between CNMI Division of Fish & Wildlife, Mariana's Public Lands Corporation, and the Service should be developed to ensure these areas are managed for the recovery of the swiftlet.

113. Vampire Bat Cave on Rota.

Vampire Bat Cave is most likely already owned by CNMI. If so, then this cave should be included within the MOU that is developed in task #112. However, if it is determined that this site is not under the CNMI ownership, then steps will need to be taken to secure the cave site, either by cooperative agreement, lease or purchase.

114. Takpochao Cave.

Takpochao Cave on Saipan is believed to be owned by an individual, Vicente S. Guerrero. The CNMI should take all steps necessary to secure this site, either by cooperative agreement, lease or purchase.

115. Hour Glass Cave.

Hour Glass Cave on Saipan is most likely already owned by the CNMI. If so, then this cave should be included within the MOU that is developed in task #112.

116. Tin Can Cave.

Tin Can Cave is believed to be owned by an individual, Jose C. Cabera. See narrative for Task #114.

117. Celis Cave.

Celis Cave is owned by an individual, Manuel Celis. See narrative for Task #114.

12. Develop/implement management program to maintain cave and immediately surrounding habitat.

After these key lands are provided permanent protection, management plans should be developed and implemented for each of the caves. Some tasks are presently definable; others should be developed as more information is gathered.

121. Control human and ungulate access.

Intrusion into caves or their surrounding areas can cause direct or indirect disturbance to swiftlets. Efforts are needed to prevent or minimize this disturbance where it is a problem.

Feral goats, domestic cattle, and other species may enter caves in some areas, possibly disrupting nesting and roosting birds. This entry should be controlled by fencing or other means.

1211. Regulate entry to caves.

One management option that may be needed to protect caves is some kind of fence at the mouth of or around the cave. Posting a site for no entry may be needed in some cases. If human disturbance becomes a significant problem, active patrols may be necessary to discourage intentional or unintentional human disturbance. In some cases, removal of war paraphernalia from caves would remove the incentive for collectors to enter. Such removal should be done by qualified archaeologists or war historians. Some caves and surrounding areas may be subject to various existing uses that may be tolerated under controlled circumstances (e.g., guano miners). These uses should be reviewed on a case-by-case basis and regulated by the local wildlife management authority.

The majority of problems potentially caused by humans could be avoided through educating the public. People need to be informed of the endangered status of this bird, the sensitive nature of its cave habitat, and the legal protection afforded this endangered species.

12111. Mahlac Cave on Guam.

Mahlac Cave is located in southern Guam on the Naval Magazine near the base's eastern boundary. The cave is located in forested terrain and is not readily accessible. Except for the occasional illegal trespasser, the cave is rarely seen by people. Entry is not considered a major problem.

12112. Vampire Bat Cave on Rota.

Vampire Bat Cave is a huge, abandoned nesting cave located at the foot of a cliff in limestone forest. Guano has been mined extensively in this cave, and the lower levels appear to be trampled by cattle and possibly deer. Fencing to control entry of ungulates will need to be employed here. Human disturbance resulting from the mining of guano is probably also a problem, so fencing or other means of access restriction should be employed.

12113. Guano Cave.

Guano Cave is the largest cave on Aguijan. Goats can easily enter both passages and may sometimes disrupt the swiftlet colony. Fencing to control entry of ungulates will need to be employed here. Human disturbance is probably also a problem, so fencing or other means of access restriction should be employed.

12114. Pillar Cave.

Pillar Cave on Aguijan is located in the face of a cliff and features a stalactite pillar dividing a large entrance. Human disturbance and feral goats are probably problems in this cave, so fencing or other means of access restriction should be employed.

12115. Cliff Cave.

Cliff Cave on Aguijan is inaccessible to humans, high on the same cliff as Pillar Cave. Human disturbance is probably not a problem in this cave, although feral goats may occasionally reach the site.

12116. Landing Cave.

Landing Cave is near the shoreline of Aguijan and has a large entrance, about 12 x 12 m. Humans and/or feral goats may occasionally be a problem here.

12117. Black Noddy Cave.

Black Noddy Cave is near Pillar and Cliff caves on the northwest shore of Aguijan Island. It is very steep and difficult to enter. Human disturbance is not considered to be a serious problem.

12118. Takpochao Cave.

Takpochao Cave is a sinkhole in the hills behind the town of Gualo Rai, Saipan. It is 7 - 10 m deep and completely covered by tangantangan trees. Although this cave may have served as a Japanese shrine in the past, it is not currently impacted by human or ungulate disturbance.

12119. Hour Glass Cave.

Hour Glass Cave is located souteast of Takpochao Cave in central Saipan. This cave is accessible only by ropes. It is, therefore, not believed to be currently impacted by human or ungulate disturbance.

12120. Tin Can Cave.

Tin Can Cave is in the mountains of east central Saipan. This cave, although accessible by humans and ungulates, contains air that is stagnant and barely breathable. It is doubtful, therefore, that human and ungulate disturbance are problems here.

12121. Navy Hill Cave.

This cave, about 1 km southeast of Garapan Village, Saipan, is highly accessible and is littered with debris from the Japanese occupation. It may be disturbed by both guano and war paraphernalia hunters, so fencing or other means of access restriction should be employed.

12122. Celis Cave.

This cave, privately owned, is located 350 m north of Papago Stream, Saipan and may be accessible to both humans and ungulates, so fencing or other means of access restriction may need to be employed.

122. Manage Habitat in and Around Cave to Inhibit Access by the Brown Tree Snake.

1221. Mahlac Cave on Guam.

On Guam, the brown tree snake has been identified as a major cause in the decline of many of the native birds. This introduced predator may eat swiftlets and eggs if it is able to find suitable perches at the entrance to caves or is able to enter caves and reach the walls where roosting and nesting birds are located. Management of vegetation in and around cave entrances can reduce these risks. Building barriers, setting traps, or smoothing walls might also be effective control measures for the snake at cave entrances. Research is needed to determine if such measures are necessary or will be effective (see task #321).

2. Survey for, Secure, and Manage Additional Colonies of Swiftlets and Potentially Usable Caves.

Recent surveys have identified a number of formerly occupied caves and it is probable that other caves, some possibly active, have yet to be discovered. Surveys are needed to identify all such sites. Once a relatively complete list of caves is available, these sites should be protected and managed.

21. Conduct Surveys for Additional Colonies and Other Potentially Usable Caves.

Caves known to be occupied by swiftlets are limited to those mentioned under task #1. Other caves may have potential as habitat for swiftlets especially those that were historically

occupied. These caves should be identified, surveyed, and incorporated into the overall recovery strategy.

22. Secure Newly Identified Swiftlet Colonies and Other Potentially Usable Caves.

Newly identified sites should be secured, much as it is planned to secure presently occupied caves.

23. Develop and Implement Management Programs for Newly Identified Colonies and Other Potentially Usable Caves.

Previously occupied caves or caves with potential to support swiftlets should be protected as presently occupied caves are protected. Management programs should be instituted for these caves.

3. Determine Reasons for Decline

Relatively little information exists regarding the causes of the swiftlet decline. Exact causes need to be determined to provide adequate information for guiding the recovery program.

31. Investigate Population Biology of the Swiftlet.

A thorough understanding of the population biology of this species is needed. This is an important element in understanding healthy versus stressed populations.

311. Breeding Biology.

Study breeding biology of the swiftlet. Determine parameters of a population with a healthy rate of reproduction.

3111. Determine Reproductive Rate.

Study nest sites to determine eggs per clutch and clutches per year. Develop average reproductive rate data for population as a whole. Also determine what proportion of the population breeds each year.

3112. Determine Recruitment Rate.

Study nest sites to determine rates of successful fledglings per nest and per year or season. Develop average recruitment rate data for population as a whole.

312. Movements Among Caves and Islands.

The typical flight range or "territory" of birds and the frequency of movements among caves and islands needs to be determined. Fidelity to home caves and pioneering abilities should also be studied. These factors may indicate how far swiftlets are able to locate and colonize unoccupied caves or mix with other colonies.

313. Habitat Requirements.

Physical and ecological parameters of caves should be studied to determine optimal conditions. This study could expand to include habitat requirements outside of the cave.

314. Foraging Requirements.

Foraging requirements need to be investigated to determine the adequacy of food availability and foraging habitat. One possible approach would be to examine and compare guano deposits before and after dramatic population declines. Direct observation of birds might also provide important information. The suitability of available food resources needs to be determined.

32. Investigate Suspected Limiting Factors.

Certain factors have been implicated in the decline of the swiftlet. These factors need to be further investigated to determine how they affect the swiftlet.

321. Predation by Brown Tree Snake.

Investigations are needed to determine to what degree, if any, the brown tree snake is responsible for the decline of the swiftlet, and how to prevent such predation. This research can be coordinated with other research on the brown tree snake, oriented towards recovery of the other endangered Guam birds.

322. Effects of Pesticides.

Research conducted on Guam in 1981 indicates that pesticides have not affected the vertebrate fauna of Guam. However, significant declines in the flying insect fauna (swiftlet prey) due to large-scale aerial applications of malathion may have had an impact on the swiftlet population in the past. The impact of prior and present pesticide use on insect prey of the swiftlet needs to be assessed.

323. Susceptibility to Avian Diseases.

Although avian disease studies on Guam have found no serious problem, further investigations oriented specifically at the swiftlet may be warranted, particularly on Rota where no work has been done to date. This need should be examined and specific research conducted if necessary.

324. Effects of Disturbance to Swiftlets at Caves.

Although human disturbance of swiftlet caves is recognized as a problem, the degree of disturbance is unclear. Further research is needed to gain a better understanding of what actions constitute a disturbance and what actions are tolerable.

4. **Promote Population Reexpansion into Suitable Historical Habitat.**

An integral component of recovery for the swiftlet, especially on Guam and Rota, will be reexpansion into suitable, presently unoccupied habitat. Efforts are needed to provide the conditions that will allow populations to reoccupy suitable habitat through natural or, if necessary, human-aided means. Swiftlets may have strong nest fidelity, which could complicate human-aided reintroductions.

41. Determine the Likelihood of Natural Recolonization of Currently Unoccupied Caves.

Natural reexpansion of swiftlets is the preferred method of range expansion. Investigations are needed to determine whether or not this can occur under the current status of population and cave conditions, distribution, and abundance. These investigations should include determining what can be done to enhance natural population expansion. Coordinate this task with task #312. As techniques to promote recolonization into unoccupied caves are developed, implement these techniques.

42. Increase Reproductive Success.

If it is found that reproductive success is low, a population increase may be possible with an increase in reproductive success. With what is learned from tasks #31 and #32, feasible management actions to increase reproductive success should be developed and implemented.

43. Develop and Implement Techniques for Reintroduction of Swiftlets into Suitable Habitat, as needed.

As a last resort, if it is determined that direct human assistance is needed to encourage swiftlet population expansion, proper techniques for this work would be needed. Experimentation and pilot projects would be needed to determine if translocation can be successful. Once acceptable techniques have been developed they should be implemented on an "as needed" basis.

431. Develop Reintroduction Program for Reestablishment of Colonies, as Needed.

It is not known whether or not it is feasible to reestablish a swiftlet population in presently unoccupied habitat. However, a population was established in Hawaii simply from a release of about 150 birds in 1962 (Berger 1981). Techniques for a complete program need to be developed. Needs for population expansion are first on Guam and Rota. Sites should be chosen and methods developed to facilitate establishment of populations at these sites. Later, if needed, similar efforts can be applied on other islands.

432. Implement Reintroduction Program if Appropiate.

If natural reexpansion of swiftlests does not occur then reintroduction program should be implemented.

433. Construct Artificial Caves for Swiftlets, if feasible.

In some instances the construction of man-made caves or the modification of natural caves could provide additional habitat for swiftlets. Swiftlets are known to use man-made caves elsewhere in the Pacific.

5. Develop Suitable Criteria for Complete Delisting.

Appropriate criteria for complete delisting are lacking. Further information, much of which will be gathered through implementation of other tasks in this plan, is needed to develop these criteria.

6. Monitor Population.

Routine monitoring of known populations needs to be done to provide indications of population response to recovery actions and other factors affecting them.

61. Conduct Up to 12 Censuses Per Year at Selected Caves.

Frequent censuses at certain caves would provide information on the use of caves by swiftlets throughout the period of a year. Such censuses should be conducted at least once every 2 months, and preferably once a month in at least Navy Hill Cave and Mahlac Cave.

62. Conduct Annual Census of Key Caves.

Certain caves harbor especially important swiftlet colonies. Close monitoring of these areas will be important in protecting the key colonies. Monitoring should occur annually at the following caves: Navy Hill Cave, Mahlac Cave, Guano Cave, Pillar Cave, Cliff Cave, Takpochao Cave, Hour Class Cave, and Tin Can Cave.

63. Conduct Complete Census at Least Every 5 Years.

Response to recovery efforts can and should be monitored through censuses conducted at least every 5 years.

LITERATURE CITED

Baker, R.H. 1946. Some effects of the war on the wildlife of Micronesia. Trans. N. Am. Wildl. Conf. 11:205-213.

Baker, R.H. 1947. Size of bird populations at Guam, Mariana Islands. Condor 49:124-125.

Baker, R.H. 1951. The avifauna of Micronesia, its origin, evolution, and distribution. Univ. Kansas Publ. Mus. Nat. Hist. 3:1-359.

Beck, R.E., G.J. Wiles, and A.B. Amerson. In prep. Avifauna of Tinian. Guam Marine Lab. Tech. Rept.

Berger, A.J. 1981. Hawaiian birdlife, 2nd Edition. The University Press of Hawaii, Honolulu. 270 pp.

Brooke, R.K. 1972. Generic limits in Old World Apodidae and Hirundinidae. Bull. British Orn. Club 92: 52-57.

Bryan, E.H., Jr. 1936. Birds of Guam. Guam Recorder 13(2):14-15, 24-25; 13(3):10; 13(4):14, 30; 13(5):15-16, 30-31; 13(6):14-15, 34; 13(7):18-20, 34-35.

Conry, P.J. In prep. High nest predation by brown tree snake on Guam.

Downs, T. 1946. Birds of Tinian in the Marianas. Trans. Kansas Acad. Sci. 49:87-106.

Drahos, N. 1977. The status of the Edible Nest Swiftlet on Guam. Div. Aquatic Wildlife Resour., Dep. Agric., Gov. Guam. Report.

Engbring, J., F.L. Ramsey, and V.J. Wildman. 1986. Micronesian forest bird survey, 1982 - Saipan, Tinian, Aguijan, and Rota. U.S. Fish and Wildlife Service, Honolulu. Report.

Gleize, D.A. 1945. Birds of Tinian. Bull. Mass. Audubon Soc. 29:220.

Grue, C.E. 1985. Pesticides and the decline of Guam's native birds. Nature 316:301.

Guam Aquatic and Wildlife Resource Division. 1984-5 Annual Report.

Harrisson, T. 1972. The food of Collocalia swiftlets (Aves, Apodidae) at Niah Great Cave in Borneo. J. Bombay Nat. Hist. Soc. 71:376-393.

Hartin, M.H. 1961. Birds of Guam, observations July to Nov. 1960. 'Elepaio 22:34-38.

Hill, J.E. and J.D. Smith. 1984. Bats: a natural history. Univ. Texas Press, Austin. 243 pp.

Jenkins, J.M. 1983. The native forest birds of Guam. Ornithological Monographs 31:1-61.

Jenkins, J.M., and C.F. Aguon. 1981. Status of candidate endangered bird species on Saipan, Tinian, and Rota of the Mariana Islands. Micronesia 17:184-186.

Kittlitz, F.H. von, 1836. Observations zoologiques faites pendant l'expedition de la corvette Le Seniavine, par F. H. de Kittlitz. In Lutke, Voyage "Le Seniavine," 3:237-330.

Marshall, J.T., Jr. 1949. The endemic avifauna of Saipan, Tinian, Guam and Palau. Condor 51:200-221.

Mearns, E.A. 1909. A list of birds collected by Dr. Paul Bartsch in the Philippine Islands, Borneo, Guam, and Midway Island, with descriptions of three new forms. Proc. U. S. Nat. Mus. 36:463-478.

Medway, L. 1966. Field characters as a guide to the specific relation of swiftlets. Proc. Linn. Soc. Lond. 177:151-172.

Oberholser, H.C. 1906. A monograph of the genus Collocalia. Proc. Acad. Nat. Sci. Philad. 58:177-212.

Pratt, H.D. 1986. A review of the English and scientific nomenclature of cave swiftlets (Aerodramus). 'Elepaio 46(11):119-125.

Pratt, H.D., P.L. Bruner, and D.G. Berrett. 1979. America's unknown avifauna: the birds of the Mariana Islands. Am. Birds 33:227-235.

Pratt, T.K. 1984. Land and freshwater bird investigations. Pittman-Robertson Job Progress Reports FY 1984, CNMI Div. of Fish and Wildlife. Pp. 87-100. Unpublished.

Ralph, C.J., and H.F. Sakai. 1979. Forest and fruit bat populations and their conservation in Micronesia: notes on a survey. 'Elepaio 40:20-26.

Safford, W.E. 1901. A notebook of a naturalist on the Island of Guam. I-XXV. Micronesia Area Research Center, Univ. Guam. Unpubl.

Savidge, J.A. 1986. The role of disease and predation in the decline of Guam's avifauna. Ph.D. thesis, Univ. of Illinois, Urbana - Champaign.

Seale, A. 1901. Report of a mission to Guam. Occas. Pap. Bernice P. Bishop Mus. 1:17-128.

Tubb, J.A. 1966. Notes on birds of Guam. Nat. Hist. Bull. Siam Soc. 21:135-138.

PERSONAL COMMUNICATIONS

Aguon, C. 1987. Zoology Department of the University of Hawaii, Honolulu, HI 96822.

Bruner, P. 1986. Department of Biology, Brigham Young University of Hawaii, Laie, HI 96762.

Fritts, T. 1987. Project Leader, Herpetological Studies, University of New Mexico, Albuquerque, NM 87131.

Glass, P. 1987. Division of Fish and Wildlife; Commonwealth of the Northern Mariana Islands, Saipan, Mariana Islands 96950 (unplublished data).

Wiles, G. 1987. Division of Aquatic and Wildlife Resources, Department of Agriculture, P.O. Box 2950, Agana, Guam 96910.

III. IMPLEMENTATION SCHEDULE

The Implementation Schedule that follows outlines actions and estimated cost for the Vanikoro swiftlet recovery program. It is a guide for meeting the objectives of the Recovery Plan for the Mariana Islands population of the Vanikoro swiftlet as elaborated upon in Part II, Action Narrative Section. This schedule indicates task priority, task numbers, task descriptions, duration of tasks, the responsible agencies, and estimated costs. These actions, when accomplished, should bring about the recovery of the species and protect its habitat. Initiation of these actions is subject to the availability of funds.

Priorities in Column 1 of the following implementation schedule are assigned as follows:

Priority 1 - An action that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future.

Priority 2 - An action that must be taken to prevent a significant decline in species population/habitat quality, or some other significant negative impact short of extinction.

Priority 3 - All other actions necessary to meet the recovery objective.

IMPLEMENTATION SCHEDULE FOR THE VANIKORO SWIFTLET RECOVERY PLAN

PRIORITY #	TASK #	TASK DESCRIPTION	TASK DURATION (YRS)	RESPONSIBLE PARTY	TOTAL COST	FY 1992	FY 1993	FY 1994	FY 1995	FY 1996	COMMENTS
Need 1 - Secure / Manage Known Caves											
Secure known swiftlet caves:											
1	111	Mahlac Cave	1	GDAWR*	0	X					
				USN	0	X					
				FWE	0	X					
1	112	CNMI Caves on Aguijan and Saipan	1	CNMI*	0	X					
				FWE	0	X					
1	113	Vampire Bat Cave	1	CNMI*	0	X					
				FWE	0	X					
1	114	Takpochao Cave	1	CNMI*	0	X					
				FWE	0	X					
1	115	Hour Glass Cave	1	CNMI*	0	X					
				FWE	0	X					
1	116	Tin Can Cave	1	CNMI*	0	X					
				FWE	0	X					
1	117	Celis Cave	1	CNMI*	0	X					
				FWE	0	X					
Regulate entry to caves:											
1	12111	Mahlac Cave	C	GDAWR*	26		2	2	2	2	
				USN	26		2	2	2	2	
1	12112	Vampire Bat Cave	C	CNMI	39				5	5	
1	12113	Guano Cave	C	CNMI	13		1	1	1	1	

IMPLEMENTATION SCHEDULE FOR THE VANIKORO SWIFTLET RECOVERY PLAN

PRIORITY #	TASK #	TASK DESCRIPTION	TASK DURATION (YRS)	RESPONSIBLE PARTY	TOTAL COST	FY 1992	FY 1993	FY 1994	FY 1995	FY 1996	COMMENTS
1	12114	Pillar Cave	C	CNMI	13		1	1	1	1	
1	12115	Cliff Cave	C	CNMI	13		1	1	1	1	
1	12116	Landing Cave	C	CNMI	13		1	1	1	1	
1	12117	Black Noddy Cave	C	CNMI	13		1	1	1	1	
1	12118	Takpochao Cave	C	CNMI	15		3	1	1	1	
1	12119	Hour Glass Cave	C	CNMI	13		1	1	1	1	
1	12120	Tin Can Cave	C	CNMI	15		3	1	1	1	
1	12121	Navy Hill Cave	C	CNMI	13		1	1	1	1	
1	12122	Celis Cave	C	CNMI	15		3	1	1	1	
Inhibit access of brown tree snake:											
1	1221	Mahlac Cave	C	CNMI*	26		2	2	2	2	
				USN	26		2	2	2	2	
				FWE	26		2	2	2	2	
		Subtotal Need 1			305	0	26	20	25	25	
Need 2 - Secure / Manage Add'l. Caves											
1	21	Conduct surveys for additional colonies & caves.	2	FWE*	20	10	10				
				GDAWR	10	5	5				
				CNMI	10	5	5				
1	22	Secure newly identified colonies & caves.	2	FWE	0		X	X			
				GDAWR*	0		X	X			
				CNMI*	0		X	X			

IMPLEMENTATION SCHEDULE FOR THE VANIKORO SWIFTLET RECOVERY PLAN

PRIORITY #	TASK #	TASK DESCRIPTION	TASK DURATION (YRS)	RESPONSIBLE PARTY	TOTAL COST	FY 1992	FY 1993	FY 1994	FY 1995	FY 1996	COMMENTS
1	23	Manage new caves and colonies.	C	GDAWR* CNMI*	22 33				2 3	2 3	
		Subtotal Need 2			95	20	20	0	5	5	
Need 3 - Conduct Research on Population Biology and Threats											
2	3111	Determine reproductive rate.	10	FWE GDAWR* CNMI*	13 26 26	2 4 4	2 4 4	2 4 4	1 2 2	1 2 2	
2	3112	Determine recruitment rate.	10	FWE GDAWR* CNMI*	13 26 26	2 4 4	2 4 4	2 4 4	1 2 2	1 2 2	
Investigate suspected limiting factors:											
2	321	Predation by brown tree snake.	3	FWS-RES GDAWR*	6 9	2 3	2 3	2 3			
2	322	Effects of pesticides.	2	FWS-RES* GDAWR CNMI	12 4 4		6 2 2	6 2 2			
2	323	Susceptibility to avian diseases.	4	FWS-RES* GDAWR CNMI	60 20 20		15 5 5	15 5 5	15 5 5	15 5 5	
2	324	Effects of disturbance to swiftlets at caves.	3	FWE GDAWR* CNMI*	3 3 3			1 1 1	1 1 1	1 1 1	
2	312	Study movements among caves & islands.	5	FWE GDAWR* CNMI*	5 10 10			1 2 2	1 2 2	1 2 2	

IMPLEMENTATION SCHEDULE FOR THE VANIKORO SWIFTLET RECOVERY PLAN

PRIORITY #	TASK #	TASK DESCRIPTION	TASK DURATION (YRS)	RESPONSIBLE PARTY	TOTAL COST	FY 1992	FY 1993	FY 1994	FY 1995	FY 1996	COMMENTS
2	313	Study habitat requirements.	5	FWE	5			1	1	1	
				GDAWR*	10			2	2	2	
				CNMI*	10			2	2	2	
2	314	Study foraging requirements.	5	FWE	5			1	1	1	
				GDAWR*	10			2	2	2	
				CNMI*	10			2	2	2	
		Subtotal Need 3			349	25	60	78	53	53	
Needs 4 - Promote Population Expansion											
2	41	Determine likelihood of natural recolonization.	5	FWE	5		1	1	1	1	
				GDAWR*	10		2	2	2	2	
				CNMI*	10		2	2	2	2	
2	42	Increase reproductive success.	0	FWE	13		1	1	1	1	
				GDAWR*	26		2	2	2	2	
				CNMI*	26		2	2	2	2	
		Subtotal Need 4			90	0	10	10	10	10	
Need 5 - Reintroduce Swiftlets											
3	431	Determine feasibility of reintroduction.	3	FWE	6		2	2	2		
				GDAWR*	12		4	4	4		
				CNMI*	12		4	4	4		
3	432	Develop reintroduction program.	5	FWE	10				2	2	
				GDAWR*	20				4	4	
				CNMI*	20				4	4	

IMPLEMENTATION SCHEDULE FOR THE VANIKORO SWIFTLET RECOVERY PLAN

PRIORITY #	TASK #	TASK DESCRIPTION	TASK DURATION (YRS)	RESPONSIBLE PARTY	TOTAL COST	FY 1992	FY 1993	FY 1994	FY 1995	FY 1996	COMMENTS
3	433	Construct artificial caves.	3	FWE	6						
				GDAWR*	27						
				CNMI*	27						
		Subtotal Need 5			140	0	10	10	20	10	
Need 6 - Monitor Population											
3	61	Conduct up to 12 censuses per year at selected caves.	0	FWE	14	1	1	1	1	1	
				GDAWR*	14	1	1	1	1	1	
				CNMI*	28	2	2	2	2	2	
3	62	Conduct annual census of key caves.	0	GDAWR*	14	1	1	1	1	1	
				CNMI*	28	2	2	2	2	2	
3	63	Conduct complete census at least every 5 years.	0	GDAWR*	6	2					
				CNMI*	6	2					
		Subtotal Need 6			110	11	7	7	7	7	
		TOTAL COST			1089	56	133	125	120	110	

Key to Acronyms used in Implementation Schedule

FWE	-	U.S. Fish & Wildlife Service, Fish and Wildlife Enhancement
FWS-RES	-	U.S. Fish & Wildlife Service, Research
USN	-	U.S. Navy
GDAWR	-	Guam Division of Aquatic & Wildlife Resources
CNMI	-	Commonwealth of the Northern Mariana Islands, Division of Fish and Wildlife
X	-	Cost to be determined
*	-	Lead agency
Continuing	-	Continuing once initiated
Ongoing	-	Action now being implemented and continuing
TOTAL COST	-	Projected cost of task from start of task to completion or for ongoing / continuous tasks until 2005

APPENDIX A

Individuals Contacted During Review

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* Comments were received.