U.S. Fish and Wildlife Service

Recovery Plan

For the Nightingale Reed-Warbler (Acrocephalus luscinia)

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RECOVERY PLAN
FOR THE
NIGHTINGALE REED-WARBLER
(*Acrocephalus luscinia*)

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EXECUTIVE SUMMARY

Current Species Status: The nightingale reed-warbler is federally listed as an endangered species. The species is historically known from six islands in the Marianas archipelago: Guam, Tinian, Aguiguan, Saipan, Alamagan, and Pagan. It has been extinct on Guam since the late 1960's, and was extirpated from Pagan before 1981. Thought to have been extirpated on Aguiguan in the mid 1980's, two males were observed there in 1992, a single bird was sighted in 1993, and a single male was observed in 1995. This population is believed to number only one to six individuals. Sizeable populations persist on Saipan (approximately 4,225) and Alamagan (approximately 2,000).

Habitat Requirements and Limiting Factors: Most birds found on Saipan occur in thicket-meadow mosaics, forest edge, reed marshes, and forest openings, but are largely absent from mature native forest, beach strand, and swordgrass savannah. On Aguiguan, reed-warblers inhabit formerly disturbed areas vegetated by groves of trees and thickets 1 to 2 meters (3 to 7 feet) tall, that may be similar to some habitats utilized on Saipan. On both Guam and Pagan, the species inhabited freshwater wetland and wetland edge vegetation almost exclusively. The population of nightingale reed-warblers on Alamagan inhabits: (1) forests with open overstory and brushy understory; and (2) wooded edges adjacent to open grassland. Past and present threats to populations include habitat destruction, vulcanism, and introduced predators and competitors.

Recovery Objectives: Delisting, with an interim objective of downlisting to threatened status.

Recovery Criteria: Downlisting may occur when populations on Saipan and Alamagan are secure from threats and maintained at their current numbers or increasing for at least 5 consecutive years. For delisting, nightingale reed-warblers in the Mariana Islands must number at least 8,000 individuals distributed in secure populations over at least 5 islands: 4,000 on Saipan, 2,000 on Alamagan, and 2,000 on at least 3 additional islands, to be chosen from a list including Rota, Aguiguan, Tinian, Anatahan, Pagan, and Agrihan. These populations must be stable or increasing for at least 5 consecutive years.

Actions Needed:

1. Protect and manage existing populations.
2. Conduct research on populations dynamics and taxonomy.
3. Establish additional populations.
4. Revise recovery objectives, as necessary.

Total Estimated Cost of Recovery ($1,000's): $ 4,150,000

Year	Need 1	Need 2	Need 3	Need 4	Need 5	Total
1998	130	40	92	0	10	272
1999	232	40	92	0	10	374
2000	247	40	80	0	10	377
2001	284	40	60	0	10	394
2002	219	40	60	0	10	329
2003	219	20	60	2	10	311
2004	256	20	60	0	0	336
2005	215	20	45	0	0	280
2006	215	20	45	0	0	280
2007	245	20	20	0	0	285
2008	180	0	20	0	0	200
2009	163	0	20	0	0	183
2010	203	0	0	0	0	203
2011	163	0	0	0	0	163
2012	163	0	0	0	0	163
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Total	3,134	300	654	2	60	4,150

Date of Recovery: Downlisting to threatened should be initiated in 2006, if the downlisting criteria have been met. Delisting should be initiated in 2012, if all delisting criteria have been met.

INTRODUCTION

1. Brief Overview

The nightingale reed-warbler (*Acrocephalus luscinia*) is federally listed as an endangered species (USFWS 1970). The species is historically known from six islands in the Marianas archipelago: Guam, Tinian, Aguiguan, Saipan, Alamagan, and Pagan (Figure 1). It has been extinct on Guam since the late 1960's (Engbring *et al.* 1986, Reichel *et al.* 1992, USACOE 1979), and was extirpated from Pagan before 1981 (Glass 1987). Thought to have become extirpated on Aguiguan between 1985 and 1987 (Reichel *et al.* 1992), two singing males were observed there in 1992 (Craig and Chandran 1992), one in 1993 (Lusk 1993) and another in 1995 (Annie Marshall, formerly with CNMI-DFW, personal communication 1995). Sizeable populations persist on Saipan and Alamagan (Reichel *et al.* 1992). Factors that contributed to the decline of this species and that continue to limit its recovery include habitat degradation and loss, vulcanism, and introduced predators and competitors.

Because the nightingale reed-warbler is currently represented by more than 6,000 individuals distributed over two islands, one of which is nearly uninhabited, and current population trends tend to be stable or slowly declining, the U.S. Fish and Wildlife Service (Service) has assigned this species a recovery priority number of 8 on a scale of 1 to 18, indicating a species with a moderate degree of threat and a high potential for recovery (USFWS 1983).

2. Taxonomy

Reed-warblers (Sylviinae: *Acrocephalus*) are widespread from Europe through Australasia (Mayr *et al.* 1986). Members of the genus are strong island colonizers, with as many as 10 species presently represented in the tropical Pacific (Pratt *et al.* 1987). The relatively large, long-billed nightingale reed-warbler (*Acrocephalus luscinia*) of the Mariana Islands is among the most distinctive. Baker (1951) believed it to be descended from the Eastern great reed-warbler (*A. orientalis*), a species that has populations in the Bonin Islands, about 750 kilometers (466 miles) north of the Mariana Island chain (Baker 1951). These two species, along with the European-African *A. arundinaceus*, the Australasian

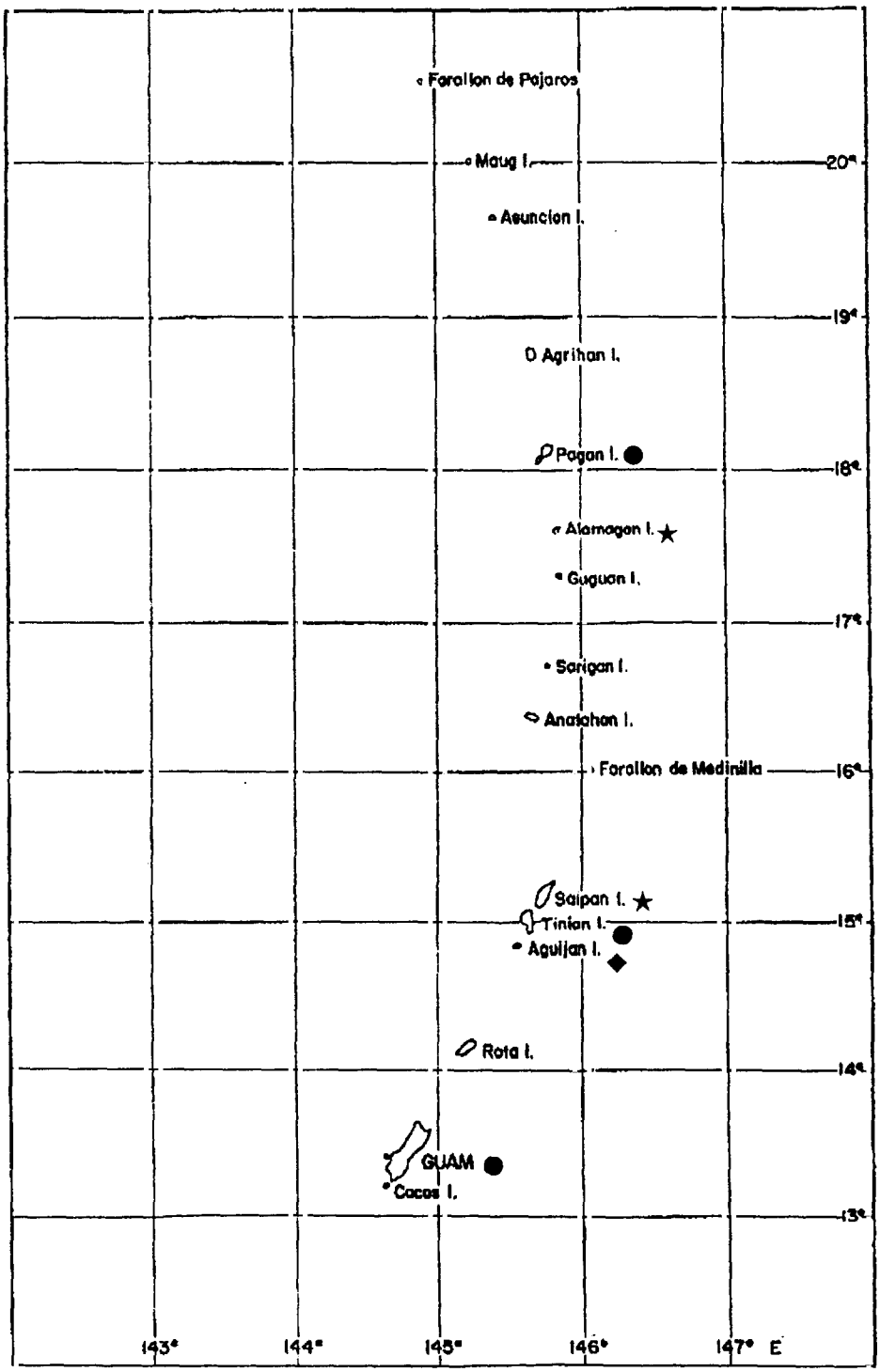

Figure 1. The current and historic distribution of the nightingale reed-warbler in the Mariana Islands; population extant (★), remnant (◆), extirpated (●).

Acrocephalus stentoreus, and all other Pacific Island *Acrocephalus* species, form a superspecies that occurs over much of the Old World (Mayr *et al.* 1986).

Three subspecies of nightingale reed-warbler are currently recognized: *A. l. luscinia* (Guam, Saipan, Alamagan), *A. l. nijoi* (Aguiguan) and *A. l. yamashinae* (Pagan) (Mayr *et al.* 1986). Previously, Yamashina (1942) considered the Guam population to be separate (*A. l. luscinia*) from those of Saipan and Alamagan (*A .l. hawae*), and Baker (1951) considered reed-warblers in the Mariana Islands to be conspecific with those from the Caroline Islands and Nauru. The validity of these subspecies warrants further study, however. For example, Craig and Chandran (1992) did not verify previously reported ecological and behavioral differences between Saipan and Aguiguan birds (Engbring *et al.* 1986, Reichel *et al.* 1992), but instead found them to be similar. The Aguiguan subspecies, based on only five specimens, was distinguished from Saipan birds by its shorter bill and slightly different coloration (Yamashina 1942). However, R. Craig (reported in Craig and Chandran 1992) observed that the bill length of post-fledging nightingale reed-warblers is substantially shorter than that of attending adults. Clearly, further investigation into the validity of at least the subspecies *nijoi* is warranted, considering that the subspecies is based on a small series and that age-related differences in such characteristics as bill length exist.

3. Description

The nightingale reed-warbler, known in Chamorro (the native language of the Mariana Islands) as *ga' ga' karisu* (bird of the reeds) on Saipan and *ga'kaliso* on Guam, is a medium-sized, yellowish passerine. Compared to mainland congeners, it is a large, very long-billed species. Both of these differences are observed frequently among island populations when compared to relatives of the same genus on the mainland (Blondel 1985). Larger bill size is related to a greater range of food size selection (Hespenheide 1973), a potential advantage in an ecosystem with little competition or a food-limited island.

Craig (1992) found that male nightingale reed-warblers were significantly larger than females in mass, wing length, tail length and tarsus length, but did not significantly differ from females in bill length. Because male and female mass, wing, tail and tarsus lengths had non-overlapping ranges (95 percent confidence interval), these characteristics are useful in determining the sex of non-breeding

individuals. Males have a mass greater than 35.0 grams (greater than 1.23 ounces), wing length greater than 86.4 millimeters (greater than 3.4 inches), tail length greater than 81.5 millimeters (greater than 3.21 inches) or tarsus length greater than 34.3 millimeters (greater than 1.35 inches), and females have a mass less than 34.4 grams (less than 1.2 ounces), wing length less than 83.2 millimeters (less than 3.28 inches), tail length less than 79.8 millimeters (less than 3.14 inches) or tarsus length less than 33.7 millimeters (less than 1.33 inches).

4. Historic Range and Population Status

Of the three currently recognized subspecies of nightingale reed-warbler, *Acrocephalus luscinia luscinia*, originally found on Guam, Saipan, and Alamagan, has been extinct on Guam since the late 1960's (Reichel *et al.* 1992). Historically, the Guam population was reported from the Agana Swamp, Atantano River marsh in Santa Rita, near the mouth of the Masso River in Piti, at Agat, and at an uncertain locality named Snajahan (Reichel *et al.* 1992). The species was reported as rare on Guam by several early observers, although Safford (1902) and Baker (1951) found it to occur regularly in the Agana Swamp. In 1960, Hartin (1961) reported reed-warblers to be fairly common at the Agana Swamp, as did J. Jeffrey in 1967 or 1968 (in Reichel *et al.* 1992). However, by 1968 the species was confined to the Agana Swamp and Atantano River, and the last known sighting was made in 1969 (Reichel *et al.* 1992). These observations suggest that it declined rapidly on Guam during the 1960's.

Acrocephalus luscinia nijoi of the presently uninhabited island of Aguiguan was first reported in 1940 by a Japanese collector, and a 1954 visit to the island revealed the population to be rare (Reichel *et al.* 1992). Similarly, Engbring *et al.* (1986) found perhaps 3 separate individuals in 1982, and estimated a total island population of 4 to 15. Commonwealth of the Northern Marianas (CNMI), Division of Fish and Wildlife (DFW) surveys conducted between 1983 and 1985 yielded a maximum count of six individuals (Reichel *et al.* 1992).

Recent investigations on Tinian have revealed prehistoric evidence of the reed-warbler on that island (Steadman 1995). Given the mounting evidence of numerous, human-related prehistoric extinctions of Polynesian (Steadman 1989) and Mariana Island birds (Steadman 1992), it is possible that the reed-warbler

may once have inhabited additional islands in the Marianas archipelago as well.

On Saipan (Figure 2), populations appear to have been localized following World War II, likely a consequence of extensive agricultural use of land during the Japanese administration (Engbring *et al.* 1986). Stott (1947) reported finding only a single pair, and Marshall (1949) found five small populations, including one at Tanapag Harbor. However, he also located a dense population in the Lake Susupe marsh complex. Later, Pratt *et al.* (1979) characterized the species as common, and Ralph and Sakai (1979) estimated a population density at 45 birds per square kilometer (17 birds per square mile). Similarly, Engbring *et al.* (1986) estimated a population density of 46 birds per square kilometer (18 birds per square mile). They estimated the total island population to be 4,867 in 1982 (Engbring *et al.* 1986).

The presence of the nightingale reed-warbler on Alamagan was recorded for the first time in 1931 by the Japanese collector H. Orii. No other historic records of the species on this island exist (Reichel *et al.* 1992).

Acrocephalus luscinia yamashinae of uninhabited Pagan has been little studied, and is known primarily from specimens collected in 1887 and 1931. It is believed to have survived in small numbers until at least the 1960's (Reichel *et al.* 1992). Visits to the island during the 1970's and 1980's produced no sightings, and a 1981 volcanic eruption destroyed the only known habitat of the species when wetlands surrounding the island's lakes were covered with volcanic debris. The population is now thought to be extinct (Reichel *et al.* 1992).

5. Present Range and Population Status

The total number of nightingale reed-warblers is currently approximately 6,225 to 6,230 individuals distributed over 3 islands: Aguiguan (1 to 6), Saipan (4,225), and Alamagan (2,000).

Aguiguan

On Aguiguan, no sightings of the nightingale reed-warbler were made after 1985 until two singing males were located in 1992 (Craig and Chandran 1992). While performing forest bird censuses, R. Chandran encountered two singing males of this species on the southeastern slope of the island (Figure 3). A single nightingale reed-warbler was sighted on Aguiguan in 1993 (Lusk 1993) and

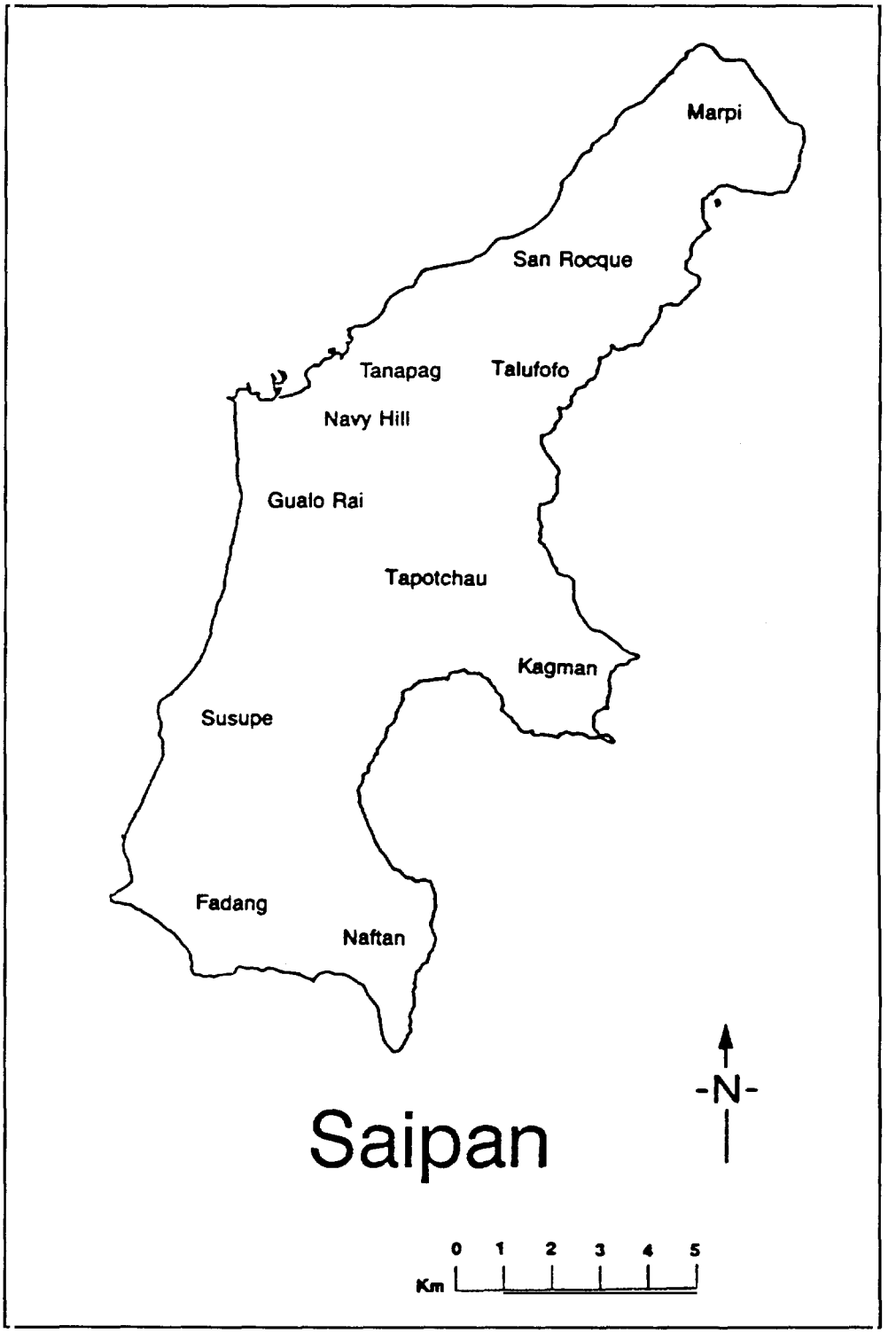

Figure 2. The island of Saipan; area names same as those used in the text.

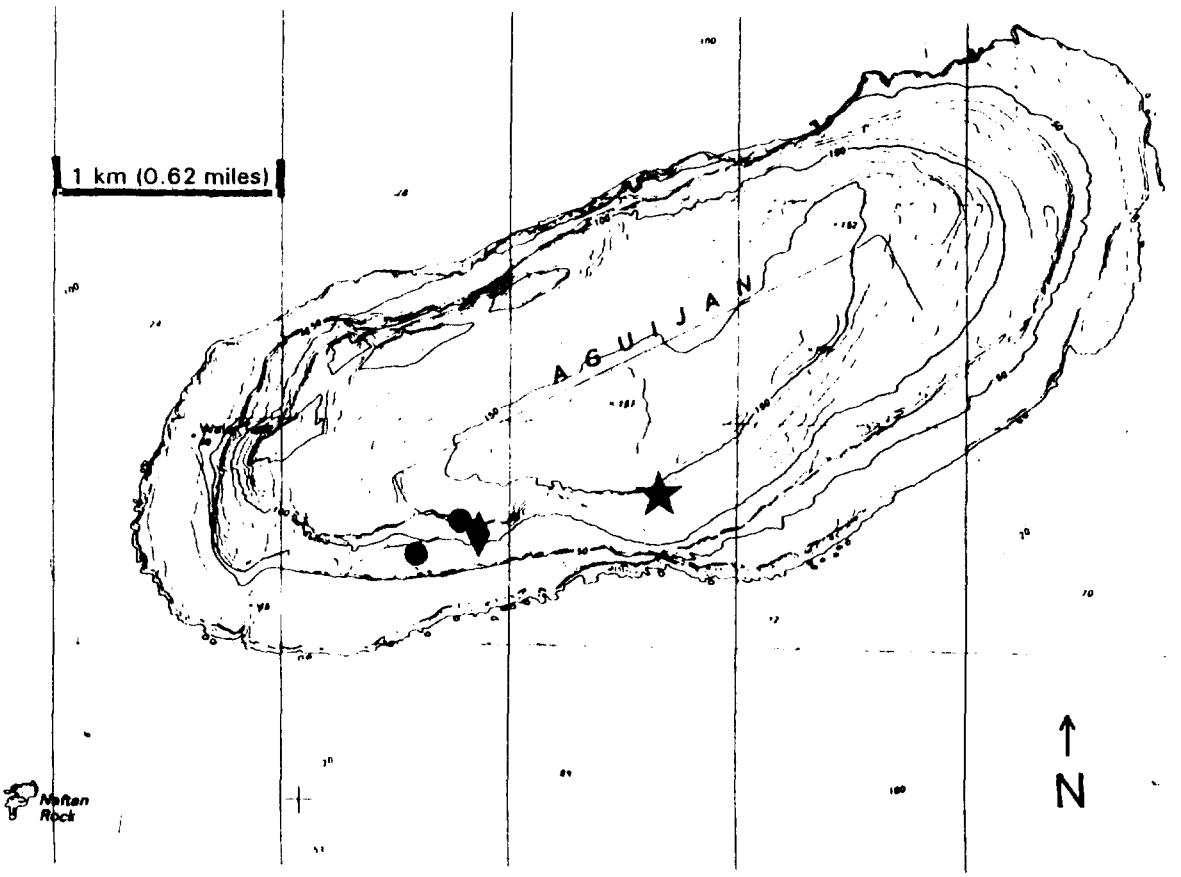

Figure 3. Recent sightings of the nightingale reed-warbler on Aguiguan: 1992 (●), 1993 (★), and 1995 (◆).

a male was observed in 1995 during a forest bird survey (Annie Marshall, personal communication 1995) (Figure 3, Table 1a).

Saipan

On Saipan (Figure 2), the nightingale reed-warbler is distributed island-wide, as demonstrated by Craig (unpublished data), who performed island-wide breeding bird surveys of native limestone forest and disturbed sites from 1990 to 1993. The CNMI-DFW has continued to conduct island-wide counts along the original route established by Craig in 1990, although the original route has been reduced to include only 50 stations (Marshall *et al.* 1996). Reed-warblers have been regularly recorded during these island-wide counts conducted by the CNMI-DFW and these surveys indicate reed-warblers continue to be widely distributed on Saipan (Marshall *et al.* 1996, USFWS unpublished data). During the limestone forest surveys, nearly all birds were detected calling from outside the forest (Craig, unpublished data). Great variation occurred on island-wide counts, which showed no clear seasonal trend (Craig, unpublished data). Previous studies in northern Saipan demonstrated a drop in territorial activity during the wet season (July to December) by up to 24 percent (Craig 1992). The inability to detect a similar island-wide trend of this loudly vocal species may mean that the census data were inherently highly variable or that the local trend found on the northern end of the island may not apply island-wide. These survey results are based on a limited sample size and monthly surveys are underway that will address this question (Mosher 1997a, 1997b, 1997d). At the disturbed census sites (surveyed in March, 1990 to 1993), Craig (unpublished data) found individuals with lower frequency and density (6.1 birds per 10 stations) than did the more comprehensive May surveys done by Engbring *et al.* (1986) (11.8 birds per 10 stations), although the species was generally widespread and common on the island.

In May 1997, the 1982 Engbring *et al.* (1986) forest bird surveys were repeated on Saipan by the Service in cooperation with the U.S. Geological Survey (USGS) Biological Resources Division (BRD) and the CNMI-DFW. Preliminary analyses of the data show that the number of birds detected per station and the number of stations at which nightingale reed-warblers were detected has declined since the 1982 surveys. Based on the preliminary analyses, the current population on Saipan has been estimated at around 4,225 individuals. This estimate may

Table 1a. Nightingale reed-warbler abundance on Aguiguan.

Date	Population estimate	Number observed	Reference
1982	4-15	0 on stations - based on incidental observations	Engbring *et al.* 1986
1984	----	3	Glass 1987
1983-1985	----	6 (based on 4 trips to Aguiguan)	Reichel *et al.* 1992
1987-1990	0	0 (based on 8 trips to Aguiguan)	Reichel *et al.* 1992
1992	----	2	Craig and Chandran 1992
1993	----	1	Lusk 1993
1995	----	1	A. Marshall, personal communication 1995

Table 1b. Assessment of nightingale reed-warbler abundance on Saipan in 1982 and 1997.

Date of survey	Population estimate (± SE)	Mean # birds per station	% of stations occupied
1982	4867 ± 330	1.18*	57.8*
1997	4225 ± 323	.76	48.8

*Based on re-analysis of 1982 (Engbring *et al.* 1986) data using 1 observer/station (S. Fancy, personal communication 1997).

Table 1c. Nightingale reed-warbler abundance on Alamagan.

Date of survey	Population estimate	Reference
1988	350 to 1,000 pairs	Reichel *et al.* 1992
1992	2,000 ± individuals	Stinson 1993

change after further analyses are completed; nonetheless, it may reflect a 13 percent decline of reed-warblers from the number reported by Engbring *et al.* (1986) in 1982 (Table 1b).

Alamagan

Based on 1988 and 1990 surveys, the Alamagan population was estimated at 350 to 1,000 pairs (Reichel *et al.* 1992). At that time Reichel also made predictions as to the likely distribution of reed-warblers on the island (Stinson 1993). In 1992, the north end of Alamagan was surveyed by CNMI-DFW biologists who estimated that the reed-warbler population approached or exceeded Reichel *et al.*'s (1992) estimate of 2,000 individuals (Stinson 1993) (Figure 4, Table 1c).

6. Habitat Requirements

On both Guam and Pagan, the nightingale reed-warbler was reported to inhabit freshwater wetland and wetland-edge vegetation almost exclusively (Reichel *et al.* 1992). These historically rare populations might have been restricted to wetlands, although H.D. Pratt (reported in Craig 1992) suspected this perception to be artifactual in that, before western observations, the populations may not have been restricted to the wetlands. Supporting this notion, Reichel *et al.* (1992) found several references to the species inhabiting scrubby upland habitat on Guam similar to that occupied on Saipan.

On Aguiguan, both male reed-warblers observed by Craig and Chandran (1992) inhabited formerly disturbed areas vegetated by groves of casuarina (*Casuarina equisitifolia*) trees and lantana (*Lantana camara*) thickets 1 to 2 meters (3 to 7 feet) tall. Such habitats may resemble some disturbed habitats utilized on Saipan. These observations contrast with those of Engbring *et al.* (1986), Glass (1987) and Reichel *et al.* (1992), who reported that Aguiguan nightingale reed-warblers were restricted to native forest, unlike birds from Saipan which are virtually absent from this habitat (Craig 1992). In 1993, Lusk (1993) reported a nightingale reed-warbler singing in native forest immediately adjacent to a lantana thicket. The 1995 sighting was also of a male seen over several days singing in a similar forest edge area surrounded by open areas of lantana and other introduced plants (A. Marshall, personal communication 1995).

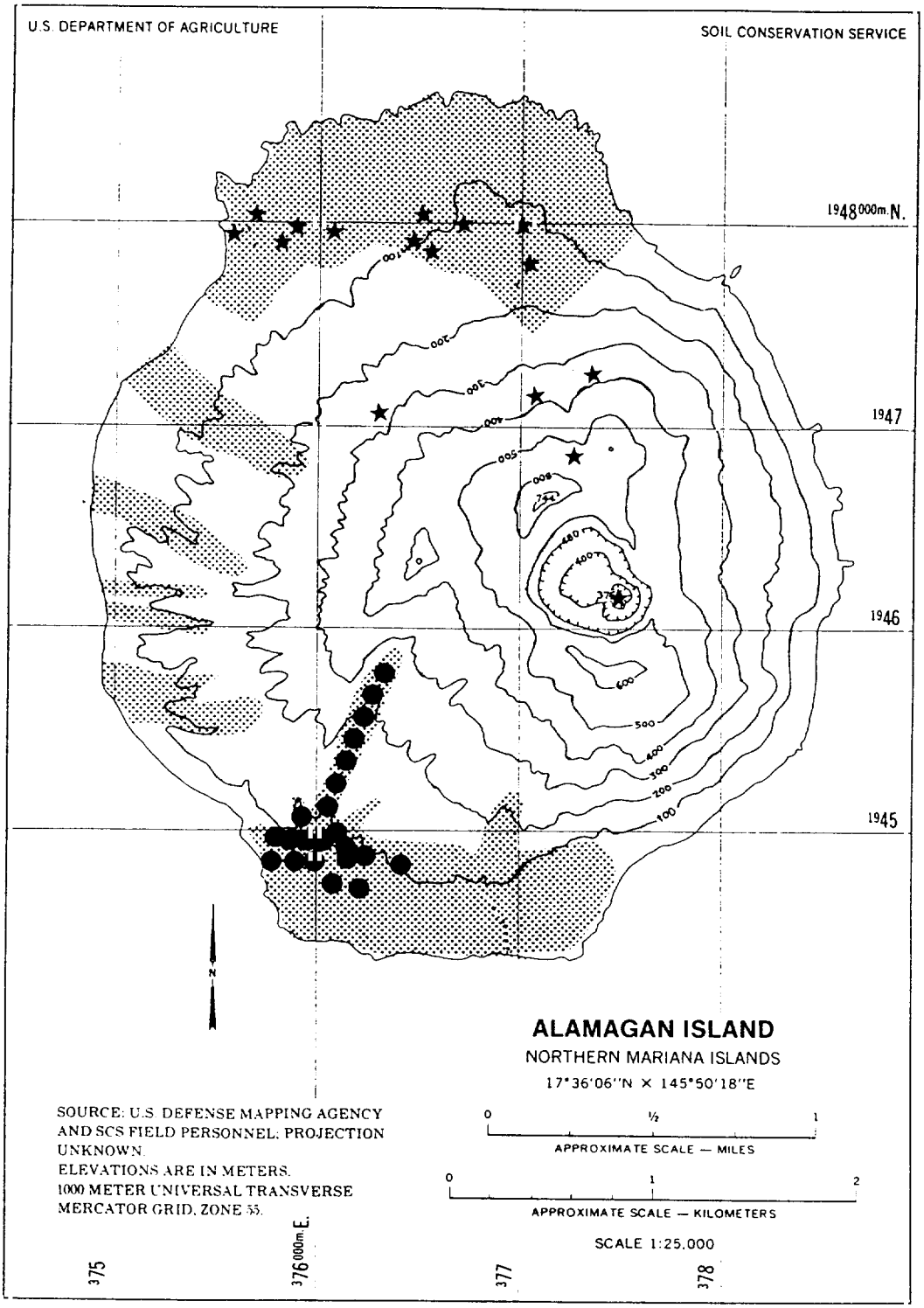

Figure 4. Nightingale reed-warbler sightings (●) and distribution predicted (▒) by Reichel in 1988, and sightings in 1992 (★) by CNMI-DFW biologists on Alamagan.

Most birds found on Saipan by Craig (1992) inhabited areas with a mosaic of two introduced plant species: tangantangan (*Leucaena leucocephala*) and elephant grass (*Pennisetum purpureum*). Birds also inhabited native reed (*Phragmites karka*) marshes near San Roque, Gualo Rai, Chalan Laolao, and Lake Susupe. Contrary to Marshall's (1949) findings, Craig found that the species was not abundant in the Susupe marshes, and most birds were located around the marsh edges. However, the island-wide surveys conducted by Craig (1992) were road surveys conducted along routes that pass near few of the wetland areas of Saipan. Wetland surveys conducted by the Service in cooperation with the CNMI-DFW have shown that nightingale reed-warblers are found in nearly all of the wetlands that occur on Saipan (USFWS and CNMI-DFW 1996). The BRD is currently studying reed-warblers in several wetland sites to determine their use of wetlands on Saipan (Mosher 1997b, c).

In 5 years of conducting observations on Saipan, Craig (unpublished data) located nightingale reed-warblers in interior forest on only three occasions. These birds did not appear to be territory holders, because on subsequent visits to the same sites they were absent. From his general field notes on the distribution of reed-warblers on Saipan, Craig (unpublished data) found that the species occurs in thicket-meadow mosaics, forest edge, reed marshes, and forest openings, but is largely absent from mature forest, beach strand, and swordgrass savannah.

Craig (1992) gathered data on the structure of habitats occupied by nightingale reed-warblers at Marpi, and found that habitat choice was variable, with neither elephant grass meadows nor tangantangan thickets consistently predominating in territories (Table 2). Aside from tangantangan and elephant grass, no plants other than vines had appreciable cover in reed-warbler territories. The predominant vegetation height in territories was greater than 3 to 6 meters (greater than 9.8 to 19.7 feet), although variation among territories was again great. In tangantangan, the predominant height was greater than 3 to 6 meters (greater than 9.8 to 19.7 feet), whereas in elephant grass it was less than 2 meters (less than 6.6 feet).

The nightingale reed-warbler population on Alamagan was found to inhabit areas with (1) open overstory and brushy understory; and, (2) wooded edges and adjacent swordgrass (*Miscanthus floridulus*). Individuals were not found in dense forest (Reichel *et al.* 1992). On northern Alamagan, not visited by Reichel *et al.* (1992), Rice and Stinson (1992a) found nightingale reed-warblers

Table 2. Percent vegetation cover by habitat type, plant species, and vegetation height categories in nightingale reed-warbler territories in Marpi, Saipan (Craig 1992).

	Percent Cover of Habitat Types			Percent Cover of Plant Species				Percent Cover of Vegetation in Height Categories (Height categories in meters)					
	Meadow	Thicket	Mixed	Elephant grass	Tangan tangan	Vines	Other	Elephant grass		Tangan tangan			
								<2	>2-3	<2	>2-3	>3-6	>6
Mean:	26.3	50.1	23.7	49.9	70.8	9.0	15.7	33.6	15.0	11.1	19.6	41.3	3.2
SD[1]:	13.7	20.0	9.3	20.0	13.7	8.0	13.1	15.0	11.8	7.7	6.3	13.5	2.0

[1]SD = Standard Deviation

common in a variety of forest edge situations.

7. Life History

Little information has been available on the life history of the nightingale reed-warbler, but studies on its ecology were begun in January 1997 by the BRD in cooperation with the CNMI-DFW and the Service. The nightingale reed-warbler may be characterized as a secretive species that skulks through dense underbrush. Like many such species, the male is loudly vocal and aggressive toward conspecific (members of the same species) intruders. Its short, round wings and long tail in comparison to its body size are clearly designed for maneuvering in dense habitat. Baker (1951) reported that molting birds were collected in June, July and September, suggesting an extended molt typical of many Pacific Island passerines. Mosher (1997b) also observed molting birds in April, May, and June.

Reproduction

Baker (1951) reported a June nest and June specimens with enlarged gonads. Another nest was found by Engbring *et al.* (1986) in May, with a recent fledgling being fed nearby. Moreover, Craig (unpublished data) found a recently fledged juvenile in February. Thus far, Mosher (1997a, 1997b, *in litt.* 1997) has located 5 active nests in January to March, 3 in April to June, 21 in July to September, and 0 during October to December. Like most species on these islands, the nightingale reed-warbler may breed year-round. However, data collected by Craig (1992) on territory occupancy suggested that there is a breeding peak in the dry season beginning in January to February. Additional data collected during 1998 will help to determine if there is a peak in breeding activity. An empty nest found by Craig (unpublished data) was placed 4 meters (12.2 feet) up in 5 meter (16 feet) tangantangan. It was a typical cup nest constructed of coarse and fine plant fibers and attached on its sides to branchlets and supported from below by a branch. Another nest found by Engbring *et al.* (1986) was described similarly. Mosher (*in litt.* 1997) recorded an average height of 5.5 meters (18 feet) for 49 nests that were predominantly composed of dried vines and tendrils, and occasionally ironwood needles, and had nest cups lined with dried tangantangan petioles or sometimes ironwood needles. Nests often included

another layer of loosely woven vines and in some cases had grass, spider casings, and ironwood needles mixed into this extraneous layer woven around the primary nest construction (Mosher *in litt.* 1997). Some nests have a tightly woven rim that forms an overhanging lip and a few nests were constructed directly on top of older nests (Mosher *in litt.* 1997). Ongoing studies indicate that clutch size is typically two eggs; of eight nests observed, seven nests had two and one had three eggs (Mosher 1997a, b). The incubation period for three pairs studied was 14 to 16 days and nestling period was 17.4 days for seven pairs that successfully fledged juveniles (Mosher *in litt.* 1997). Of 29 active nests observed, only 9 successfully fledged young; 17 failed due to predation of eggs or nestlings and 3 failed due to the weather (Table 3; Mosher 1997a, 1997b, 1997c, 1997d). Of 57 nests found by Mosher (*in litt.* 1997), 43 were in tangantangan, 4 in ironwood, 4 in a lipstick tree (*Ochrosia mariannensis*), 3 in mangrove (*Bruguiera gymnorrhiza*), 2 in sea-hibiscus (*Hibiscus tiliaceus*), and 1 in a kamachile tree (*Pithecellobium dulce*).

Craig (1992) found that unlike *Acrocephalus orientalis*, in which 17 to 43 percent of males are polygynous (having more than one mate) (Urano 1985), and *A. arundinaceus*, in which 12 percent are polygynous (Dyrcz 1977), *A. luscinia* appeared entirely monogamous. Polygyny was not recorded on any of 50 territories studied over three peak breeding seasons (28 individual males). *A. orientalis* (Saitou 1976) and *Acrocephalus arundinaceus* (Dyrcz 1977) principally breed in reed marshes, and marsh passerines are believed to develop polygyny because habitat is limited and territories differ strongly in quality. Females maximize their reproductive output by mating with polygynous males on a superior territory (Verner and Wilson 1966). This situation may not hold in the upland habitats used by *A. luscinia* on Saipan; hence, polygyny does not appear to be favored in this population. However, recent studies indicate that females may increase their home range and associate with more than one male when they are not nesting (Mosher 1997a). Further data on paternity of offspring are needed, however, in order to more reliably estimate the minimum population size necessary for long-term survival.

Food Habits

Because nightingale reed-warblers usually are concealed in thick vegetation, foraging behavior is poorly known despite intensive study by R. Craig (unpublished data). Birds have been observed (Craig, unpublished data) to eat

Table 3. The fate of 29 active nightingale reed-warbler nests observed on Saipan in 1997 (Mosher *in litt.* 1997).

Number of nests	Fate of nest	Comments
9	Fledged young	19 total fledglings
3	Failed	Confirmed predation by rats
1	Failed	Confirmed predation by golden white-eye
4	Failed*	Egg-shell fragments found on ground or in nest
3	Failed*	At least one egg predated and then nest abandoned
4	Failed*	Nestlings gone from nest without evidence of reason
2	Failed*	Eggs gone from nest without evidence of reason
3	Failed	Supertyphoon Winnie (high winds and rain)
Total nests that fledged young = 9 Total nests that failed = 20		

* Predators unknown, but believed to be rats

insects, glean invertebrates from live leaves and a dead leaf, and probe a dead stub. Marshall (1949) reported insects, spiders, snails, and lizards as prey. In unpublished field notes (on file at CNMI-DFW), Marshall also listed the stomach contents of collected specimens as a coccinelid beetle, Hemiptera, and Orthoptera. Seale (1901) reported insects and larvae in stomach contents. Mosher (1997b) has observed nestlings being fed small caterpillars, large spiders, grasshoppers, skinks, geckos, ants, moths, and praying mantids.

Activity Patterns

Craig (1992) found that male nightingale reed-warblers defended territories by singing from exposed treetops, interior thickets, or elephant grass stems. Males responded vigorously to playback of tape-recorded songs, and could be induced to leave their territories in pursuit of taped songs. Females were not observed to sing, but usually accompanied their mates during aggressive encounters. Although the species was intraspecifically aggressive and defended all-purpose territories, no aggressive interactions were observed with other species.

Craig (1992) found evidence of site fidelity among reed-warblers on Saipan. Of males banded in 1988, 9 of 11 (82 percent) were present on the same territory in 1989 (Craig 1992). In 1991, six of the nine banded males (67 percent) were on the territory in which they were originally banded. One male relocated to a new territory after at least 2 years at one territory, and two moved to new territories after 1989. Of eight females banded in 1988, three (38 percent) were observed again in 1989, and two of these were mated to the same male on the same territory. The third female, the mate of the only male to disappear, remained on its 1988 territory with a new mate.

In January to February 1988, the study area of Craig (1992) contained 14 territories, whereas in January to February 1989 there were 19 territories, a 36 percent increase. Territorial activity changed seasonally, such that in November to December 1990 only 13 territories could be located, but by January to February 1991 the number increased to 17. All 17 territories were still active in May 1991, but only 15 territories were active by July, and only 14 territories were found in September, indicating that breeding activity was subsiding. Two territories were vacated after they were partly cleared for grazing after 1989.

Size of the seven territories mapped by Craig (1992) in 1988 averaged

9,338 ± 3,433 square meters (11,168 ± 4,106 square yards). In 1989, five of these territories appeared unaltered, whereas portions of the other two territories were usurped by adjacent territorial birds. One had a slight boundary change in 1989, but the other had substantially altered boundaries. Because less time was spent determining territory boundaries after 1988, Craig (1992) was unable to determine whether the males in these two territories compensated for their loss of some territory by expanding their territory elsewhere. Both of these males used the same preferred song perches as in 1988, however. Mosher (1997a, 1997b) has found that the home range for 13 males varied from 1.37 hectares (16,372 square yards) to 18.11 hectares (216,426 square yards) and from 2.14 hectares (25,574 square yards) to 16.14 hectares (192,883 square yards) for 4 females. The movements of individual reed-warblers appear to be highly variable; some females traveled greater than 800 meters (2,438 feet) away from their territory and returned in a matter of hours and some birds occasionally left their territory to forage (Mosher 1997a, 1997b).

Monthly song surveys were conducted by Mosher (*in litt.* 1997) from February to November 1997 following current CNMI-DFW survey routes. The number of males singing increased from February to July and decreased July to November (Table 4).

Demographic Units

Considering that there are no reports in historic times of the nightingale reed-warbler from Tinian, the population on Saipan may be considered a separate population. Similarly, the population on Alamagan is also probably distinct.

8. Reasons for Decline and Current Threats

The rarity and decline of the nightingale reed-warbler on Guam was initially attributed to wetland fires and wetland destruction (Baker 1951, Jenkins 1983). Indeed, if the population was largely restricted to wetlands, then wetland destruction may have played a role in its decline (Reichel *et al.* 1992). However, on Saipan, Craig (unpublished data) observed that banded territory holders returned to habitats within days after burning. Prior to World War II, agricultural activities resulted in the cutting of reed beds and draining of some wetlands, thereby reducing habitat availability for the reed-warbler. However, some

Table 4. The percent of singing nightingale reed-warbler males recorded on road-side surveys (50 stations) on Saipan in 1997 (Mosher *in litt.* 1997).

Month	% of stations with singing males
February	10
March	34
April	54
May	56
June	40
July	58
August	40
September	30
October	10
November	4

wetlands probably recovered with the widespread decline in agriculture after the war, and sizable areas of wetlands continue to persist on the island to the present (Gary Wiles, *in litt.* 1997).

The final extinction of the Guam population is argued by Reichel *et al.* (1992) to have been due to predation by the brown tree snake (*Boiga irregularis*). The rapid decline of the Agana Swamp population appears coincident with the invasion of that part of the island by the snake. Since the post-World War II introduction of the snake to Guam, it has systematically spread throughout the island, extirpating nearly all of the avifauna and other native vertebrate species of Guam (Savidge 1987, USFWS 1995). Pesticides and major fires in the Agana Swamp during the 1960's were also likely significant problems. It is also probable that, in combination, several of these factors caused the extirpation of reed-warblers from Guam (Gary Wiles, *in litt.* 1997).

On Aguiguan and Saipan, intensive agricultural activity during the Japanese administration (1914 to 1944) is thought to have reduced available habitat and, therefore, reduced reed-warbler numbers (Reichel *et al.* 1992). With the reversion of former agricultural land on Saipan to scrubby habitats after World War II, populations flourished as extensive new habitat became available. More recently, this trend has reversed as land has been developed for agriculture, homesteads, and tourist-related facilities. Hence, the amount of suitable habitat has been declining. On Aguiguan, the historic presence of numerous feral goats (*Capra hircus*) has severely degraded habitats, particularly understory vegetation used by reed-warblers. In 1989, a goat removal program was begun by CNMI-DFW that greatly reduced the Aguiguan goat population (Rice and Stinson 1992b). By 1995, however, goat populations had begun to rebound as hunting pressure was reduced (Gary Wiles, Guam Division of Aquatic and Wildlife Resources (GDAWR), personal communication 1995). Populations of the nightingale reed-warbler on Aguiguan remained low during the post-war period, presumably as a consequence of the goat habitat degradation (Engbring *et al.* 1986).

It is not certain that a brown tree snake population has been established on Saipan, but there have been sightings of snakes in recent years (McCoid and Stinson 1991). In 1986, an unidentified snake that may have been *Boiga irregularis* was seen at the commercial port facility. In 1987, a brown tree snake was seen crawling out of a container at the same port facility. In 1990, a dead

brown tree snake was found inside a container arriving from Guam. In 1994, a live brown tree snake was captured at Saipan International Airport (Eva Beyer, CNMI-DFW, personal communication 1994). There were two more sightings in 1994, and two sightings in 1995 (Fritts *et al.* 1995). In 1996, two snakes were caught when they left cargo ships that had come from Guam, and swam to shore near Charlie Dock, Saipan (Scott Vogt, CNMI-DFW, personal communication 1997). In August 1997, a female snake was captured at the Saipan International Airport (S. Vogt, personal communication 1997). In all, 31 snake sightings have been reported on Saipan since 1986 and sightings have increased in recent years, indicating an incipient population on the island (Vogt 1997). If the brown tree snake were to become established on Saipan, it would probably decimate the nightingale reed-warbler population, and, as it is believed to have done on Guam, could contribute to its extirpation.

On Alamagan, the nightingale reed-warbler is common despite the presence of feral ungulates, perhaps because a small human population present until 1990 kept goat numbers in check, or because the habitat needs of this subspecies differ (Rice and Stinson 1992a). Reichel *et al.* (1992) believe the difference in populations between Alamagan and Aguiguan may be attributed to the denser understory on Alamagan despite the presence of ungulates.

The effects of predation by monitor lizards (*Varanus indicus*), feral cats (*Felis catus*), and rats (*Rattus* spp.) are unknown, but all of these species are known to prey on forest birds and could potentially be threats to the recovery of the species. Recent data suggests nest predation by these introduced predators may be a large factor in the reported high proportion of nest failures (Table 3; Mosher 1997a, 1997b, 1997c).

9. Conservation Efforts

As a federally listed endangered species, the nightingale reed-warbler is protected by the Endangered Species Act of 1973, as amended (ESA). It is also listed as an endangered species by the Commonwealth of the Northern Mariana Islands and the Territory of Guam. Furthermore, wetlands, with which the species is closely associated, are protected by Section 404 of the Clean Water Act, which prohibits unpermitted alteration of wetlands. The U.S. Army Corps of Engineers must take into consideration the effects of a project on endangered species when

issuing a permit for wetland alteration. Similarly, Presidential Executive Order 11990 directs Federal agencies to protect wetlands, and the Emergency Wetland Resource Act assists in wetland acquisition for conservation purposes.

The welfare of the species also has been considered during the permitting phase of major land development projects. Provisions to protect reed-warbler habitat and to mitigate for loss of habitat have generally been included by the CNMI-DFW in permits for such projects. In addition, efforts are currently underway on Saipan to develop Habitat Conservation Plans (HCP) that include the establishment of an upland mitigation bank to maintain and enhance habitat for nightingale reed-warblers and other native endemic species. The CNMI government has also expressed an interest in developing a regional HCP (for Saipan and the northern Mariana Islands).

Although regulations governing the prevention of brown tree snake infestation have been promulgated by the CNMI legislature, current prevention efforts have been restricted to maintaining trap lines at the ports and conducting night searches to detect the presence of snakes and investigating snake reports (A. Marshall, personal communication 1995). A sniffer dog program has recently been established in the CNMI. Two dogs and their handlers have been trained and are now checking cargo at the ports (S. Vogt, personal communication 1997).

The U.S.D.A. Wildlife Services on Guam is also engaged in a large amount of snake interception work in an effort to prevent colonization of the snake in the CNMI. The Guam Department of Agriculture is also setting snake traps around the Guam airport for similar reasons (Gary Wiles, *in litt.* 1997). Several local and Federal agencies have also conducted publicity campaigns in the CNMI to raise the general awareness of island residents, including port workers, about the dangers of brown tree snake colonization (Gary Wiles, *in litt.* 1997).

Aside from these general measures, efforts on behalf of the nightingale reed-warbler have involved only investigations of its distribution and natural history. To date, little to no active management of the species has been undertaken.

10. Overall Recovery Strategy

The primary goal of this recovery plan is to protect the existing populations of the nightingale reed-warbler and the habitat on which they depend.

Most importantly, reed-warblers will need protection from the threat of introduction of the brown tree snake. All islands north of Guam that either currently contain reed-warblers or that could be used in translocation efforts will need to be protected from introductions of the brown tree snake. Habitat protection will involve establishment of sanctuaries and elimination of feral ungulates, where appropriate.

This plan also recommends the continuance of research into the population dynamics and taxonomy of the nightingale reed-warbler. Such basic information is essential to assure that recovery criteria are adequate and that later translocations to other islands, if undertaken, will be successful.

Next, this plan proposes translocating reed-warblers from Saipan and/or Alamagan onto at least three additional islands. Reintroduction projects must be closely monitored and evaluated. The islands proposed as possible sites to establish these populations are Rota, Aguiguan, Tinian, Anatahan, Pagan, or Agrihan. Of these six islands, Guam and Pagan both supported reed-warbler populations in recent times, and Tinian was recently discovered to have prehistoric evidence of reed-warblers (Steadman 1995). Aguiguan supported reed-warblers in the past, and although it seems likely that the few individuals left will be lost, the island may be able to support a population in the future if habitat restoration occurs. Anatahan and Agrihan are not known to have supported reed-warblers in the past, but historic occurrence on scattered islands north to Pagan makes it likely that the nightingale reed-warbler once occurred on more islands in the chain that we currently are aware of (Craig 1992). Current habitat conditions should be given precedence over historical occurrence. Although the habitat is highly disturbed by feral animals, both Anatahan and Agrihan contain upland areas of sword grass (Pratt and Lemke 1984) that may be suitable for reed-warblers .

Finally, the recovery plan should be revised as additional information becomes available.

RECOVERY

Objectives

The objective of this recovery plan is to delist the nightingale reed-warbler. An interim objective for downlisting to threatened status is identified, as well. These objectives are based upon current knowledge of the species and generally follow the Red List Categories established by the International Union for Conservation of Nature and Natural Resources (IUCN).

The nightingale reed-warbler is currently listed as endangered, which is defined in section 3 of the ESA as "any species which is in danger of extinction throughout all or a significant portion of its range." A threatened species is defined as "any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range."

To be considered for downlisting to threatened species, the nightingale reed-warbler populations on Saipan and Alamagan must be protected from threats and be maintained at their current numbers or increasing for at least 5 consecutive years.

For delisting, the total number of nightingale reed-warblers in the Mariana Islands must number at least 8,000 individuals, distributed in secure populations over 5 islands, as follows: at least 4,000 on Saipan, 2,000 on Alamagan, and 2,000 on at least 3 additional islands, to be chosen from the following islands: Rota, Aguiguan, Tinian, Anatahan, Pagan, or Agrihan. These populations must be stable or increasing in number for at least 5 consecutive years.

Once a species is delisted, section 4 of the ESA requires that the Service, in cooperation with the States, effectively monitor the delisted species for at least 5 years to ensure that the protective measures provided by the ESA are no longer necessary.

2. Step-down Outline

1. Protect and manage current populations.

    11. Monitor populations and assess threats.

        111. Saipan.

        112. Alamagan.

        113. Aguiguan.

    12. Control threats.

        121. Develop and implement a brown tree snake interdiction and control plan.

        122. Control feral ungulates.

        123. Control other predators.

        124. Identify and protect essential habitat.

            1241. Delineate essential habitat areas.

            1242. Pursue protective status for wildlife conservation areas.

            1243. Develop resource protection plan for Aguiguan.

2. Conduct basic research to assist in achievement of recovery goals.

3. Develop and implement a plan for establishment of at least three additional populations.

31. Conduct paleontological surveys.

32. Assess current habitat suitability.

33. Determine if reed-warblers are likely to compete with other native wildlife.

34. If nightingale reed-warblers persist on Aguiguan, determine taxonomy of Aguiguan population.

35. Establish additional populations.

4. Revise recovery objectives, as necessary.

5. Conduct public outreach.

3. Step-down Narrative

1. Protect and manage current populations.

The known populations on Saipan, Alamagan, and Aguiguan must be protected from threats and managed to ensure perpetuity.

11. Monitor populations and assess threats.

In order to determine the best management strategies for each of the known populations, it will be necessary to undertake an organized monitoring and threat assessment program. Due to ease of access, such a program on Saipan will be much easier to plan and carry out than that developed for Alamagan and Aguiguan. Each population needs to be monitored on a regular basis to establish information on population trends and possible threats. The USGS-BRD has already begun research efforts on Saipan that includes population monitoring, habitat assessments, and assessment of the effects of predation on reproduction.

111. Saipan.

On Saipan, the greatest threats to the nightingale reed-warbler are the possibility of predation by the brown tree snake and destruction of habitat for agriculture and development projects. The brown tree snake has been seen on numerous occasions and in numerous sites on Saipan. It is important that the CNMI-DFW monitor the reed-warbler population on a regular basis to ensure that any drop in population numbers and/or distribution is quickly noticed and management actions quickly undertaken. Because male reed-warblers are conspicuously vocal and defend exclusive, all-purpose territories, direct counting and mapping of all territories provide a reliable method for determining breeding densities and habitat use. When carried out on a monthly basis, such censuses also provide data on seasonal shifts in breeding intensity. To further characterize density population parameters,

year-round mist-netting and banding must be instituted in which all captured individuals are aged and sexed. An island-wide survey of Saipan should be conducted yearly.

112. Alamagan.

The feral goat population on Alamagan is increasing dramatically as a result of inadequate control. The resulting destruction of the forest with little or no forest regeneration presents an immediate threat to the currently healthy reed-warbler population on this island. This threat, combined with the additional threat of predation by monitor lizards and rats (and possibly feral cats) on Alamagan, needs to be thoroughly assessed and addressed. The short duration of visits and rugged terrain often make quick reconnaissance surveys necessary for northern island trips. A "quick and dirty" index procedure that is standardized would help maintain consistency and reduce observer variation and subjective biases. The CNMI-DFW should undertake an island-wide survey of Alamagan at least every 3 years to determine nightingale reed-warbler population trends as a result of goat and predator control and/or eradication and subsequent habitat restoration. Once the threats have been eliminated and habitat has been restored, surveys should be initiated for 5 consecutive years to monitor the population.

113. Aguiguan

The Aguiguan population is extremely small (one to six individuals). Nothing is known about the sex ratios that currently exist on this island and whether reproduction is occurring. An island-wide survey needs to be immediately undertaken by CNMI-DFW to determine the size, distribution, and make-up of the Aguiguan population and to assess the threats currently acting upon it. These surveys should be repeated on a yearly basis. As is the case on Alamagan, habitat destruction from introduced goats and

predation by monitor lizards and rats are believed to be the limiting factors on this island.

12. Control threats.

Once the threats have been identified through the above-specified monitoring tasks, steps will need to be taken to control such threats. The most urgent need for all of the Mariana Islands is to ensure that the brown tree snake is prevented from establishment and that other potential alien predator introductions are forestalled. In the case of the uninhabited island of Aguiguan and the northern islands, feral ungulates and introduced predators that have already been established on these islands will need to be reduced in number and/or eradicated.

121. Develop and implement a brown tree snake interdiction and control plan.

The introduction of the brown tree snake to any of the Mariana Islands north of Guam will lead to large-scale extinctions of native wildlife. Procedures to prevent the spread of this introduced predator from Guam are among the highest priorities for conservation of Mariana Island wildlife. Ultimate success may require the reduction of the snake population on Guam, along with effective elimination of stowaway snakes from private, commercial, military, and cargo airliners and ships traveling from Guam to other areas of the Pacific. The Brown Tree Snake Control Plan is the first step in developing a cohesive plan for the steps that must be taken by all Pacific Island governments in coordination with one another (BTSCP 1996). Funding implementation of the plan should be a high priority.

As specified in the text of this recovery plan, there have been numerous sightings of brown tree snakes on Saipan over the past few years and there is reasonable evidence to support the hypothesis of an incipient snake population on the island (E. Campbell III, Wildlife Services *in litt.* 1998). Saipan is particularly

susceptible to the introduction of brown tree snakes from Guam, due to increasing tourism and development with concurrent increasing air and boat traffic from Guam. It is imperative that high priority be given to the building of snake exclosures, the use of fumigants, trapping, etc., in the airports and harbors of Saipan. In addition, CNMI-DFW should undertake regularly scheduled night searches and a massive public education campaign to ensure that snake sightings are promptly reported.

Given the present inability to control or eradicate snakes in the Mariana Islands, there is a need to monitor the abundance and distribution of brown tree snakes on Saipan. By taking action at an early stage of the snake infestation, managers may be able to predict when nightingale reed-warbler populations on Saipan are at direct risk from brown tree snake predation (E. Campbell III, Wildlife Services *in litt.* 1998). Another important component of nightingale reed-warbler preservation on Saipan is the planning and development of appropriate management techniques that would reduce the risk of brown tree snake predation on reed-warblers (E. Campbell III, Wildlife Services *in litt.* 1998).

Of the other Mariana Islands, Tinian and Rota, both of which are inhabited and subject to military and/or commercial flights and cargo arriving from Guam, are believed to be the most susceptible to brown tree snake introduction following Saipan. The same precautions outlined for Saipan should be used on these two islands for prevention of brown tree snake introduction. The uninhabited islands from Aguiguan north are less likely to be invaded by the brown tree snake, provided Guam and the CNMI-DFW take every precaution to have ships, airplanes, helicopters, etc., thoroughly inspected prior to their visits to these remote islands. Regulations that require precautionary inspections and issuance of permits for all visits to these islands should be considered by CNMI-DFW to assist in this effort.

122. Control feral ungulates.

Feral ungulates, particularly goats, are extremely destructive elements in native forests. The destruction of forests, with accompanying decline in native wildlife that is dependent on such forests, is a particular problem on Aguiguan and the uninhabited islands north in the chain. Steps must be undertaken by CNMI-DFW to hold regular hunts on these islands (e.g., once a year) or, preferably, to undertake a complete eradication program on Aguiguan, Alamagan, and the other northern islands that are known to harbor feral ungulate populations. Work is currently in progress to eliminate goats and pigs from Sarigan through a cooperative agreement between the CNMI -DFW and the Service as a preliminary eradication project.

123. Control other predators.

Predators other than the brown tree snake that are known or believed to be threats to the nightingale reed-warbler, as well as other native birds, are rats, cats, and monitor lizards. Once the level of threat from these predators has been ascertained during and following completion of Tasks 11 and 2, steps should be taken to control these threats. For instance, if it is determined that the Aguiguan population is unable to increase due to nest predation by rats and monitor lizards, management strategies for protecting individual nest trees may be considered. The plan to control predators may also involve larger scale programs, such as the use of toxicants that have been tested and approved for the local environment.

Recent research indicates that rodents pose a significant threat to nightingale reed-warbler nesting efforts (Mosher 1997a, 1997b, 1997c). Efforts should, therefore, be initiated to assess the practicality of rodent control as a management technique to increase nesting success. The data should be collected in a manner that would aid in getting appropriate regulatory approval to use

cost-effective rodent control techniques such as toxicants (E. Campbell III, *in litt.* 1998).

124. Identify and protect essential habitat.

Information gathered during and following completion of Tasks 11 and 2 will enable agencies to determine essential habitat areas for survival and ultimate recovery of the reed-warbler. Destruction of nightingale reed-warbler habitat, particularly on Saipan, needs to be thoroughly reviewed and evaluated with respect to the impacts of such development on the current population and future recovery needs. Proposals to degrade or destroy nightingale reed-warbler habitat are generally reviewed by the Departments of Coastal Resource Management and Lands and Natural Resources, CNMI, and, in some cases, by the U.S. Fish and Wildlife Service. These agency reviews should continue to be aimed at minimizing habitat alteration and ensuring that all proposed habitat alteration activities will be carried out in a manner that does not negatively effect the reed-warbler's current survival and future recovery potential. The development of an island-wide Habitat Conservation Plan (HCP) would also aid in the preservation of this species.

1241. Delineate essential habitat areas.

Information gathered during the completion of Tasks 11 and 2 will be used to delineate essential habitat areas for survival and ultimate recovery of the reed-warbler.

1242. Pursue protective status for wildlife conservation areas.

Several wildlife conservation areas have been established on Saipan where nightingale reed-warblers occur, but additional sanctuaries are required to protect adequate numbers of this relatively wide-ranging bird. Of particular

concern is the north Marpi forest area. It has been proposed as a wildlife conservation area, but has not yet received formal protection. The CNMI-DFW should actively pursue protective status for this important forest area and other areas deemed essential to the survival and ultimate recovery of the reed-warbler, as determined under Tasks 11, 2, and 1241.

1243. Develop resource protection plan for Aguiguan.

Aguiguan is the only island in the southern portion of the Mariana Island chain that is not seriously at risk from the threat of brown tree snake introduction, due to its inaccessibility. As such, it is frequently discussed as a viable site for translocation not only of the nightingale reed-warbler, but also other native birds from elsewhere in the Marianas, including the Mariana fruit-dove (*Ptilinopus roseicapilla*), Mariana crow (*Corvus kubaryi*), golden white-eye (*Cleptornis marchei*), Tinian monarch (*Monarcha takatsukasae*) and rufous fantail (*Rhipidura rufifrons*). This gives extraordinary priority to the development of a resource protection plan for Aguiguan. The CNMI should ensure protected status of the limestone forest and control island access.

2. Conduct basic research to assist in achievement of recovery goals.

Understanding population phenomena is crucial to determining the degree of recovery and security of an endangered species. Key elements to study include: a) habitat use in upland and wetland sites; b) parameters of habitat preferences; c) population density; d) degree of seasonal and annual population fluctuation; e) recruitment rate (reproduction and immigration); f) rate of loss (mortality and emigration); g) longevity; and h) mating system. These data are gathered through a multi-year censusing and mark and recapture program, preferably combined with the monitoring and management of populations. To determine degree of polygyny or promiscuity within the mating system, DNA studies on nest mates should be undertaken. With such data, the level of reproduction necessary to

maintain population equilibrium, and the level necessary to achieve recovery after periodic population decimation (e.g., typhoon) can be determined. Furthermore, the minimum population size likely to persist indefinitely (i.e., viable population) can be computed.

Because initial data on the above-listed population parameters already exist for the Marpi area of Saipan, this region is a logical choice for initiating further studies of population dynamics. Two years of data are presently available, and year-round monitoring for approximately 5 years are likely to provide sufficient information to develop key population predictions. These population studies should be undertaken in conjunction with the monitoring tasks identified in Task 111 (above).

3. Develop and implement a plan for establishment of three additional populations.

To achieve the delisting objectives, at least three additional populations of nightingale reed-warbler will need to be established in the Mariana Islands. The two islands that supported reed-warbler populations in recent times are Guam and Pagan. Of these two islands, the first logical choice for population reestablishment is on the island of Pagan, where, although habitat may be limited, there is little likelihood of brown tree snake introduction. The opportunity to reintroduce nightingale reed-warblers to Guam will be dependent upon future control of the brown tree snake population on that island. Possible introduction sites should not be limited to these two islands, however, given the fact that the reed-warbler is now known to have occurred prehistorically on Tinian and is likely to have occurred, although as yet undocumented, on other islands in the Mariana Island chain. Although small, Aguiguan harbors a few individual reed-warblers and is a likely translocation site for additional birds.

A plan dealing specifically with the establishment of three additional populations of the nightingale reed-warbler in the Mariana Islands will need to be developed and implemented by all cooperating organizations and landowners. To adequately plan for future population establishments, managers will need to assess, among other things: a) prehistoric occurrence of the reed-warbler throughout the Mariana Islands; b) taxonomic distinctiveness between the different island populations; c) current habitat availability and suitability; d) future

security of new habitat sites; and, e) potential effects of a reed-warbler introduction on other native wildlife already present on site.

31. Conduct paleontological surveys.

Based on its historic occurrence on scattered islands north to Pagan, it seems likely that the nightingale reed-warbler once occurred on most or all islands in the chain. Proving this will help provide a biological basis for translocation and reestablishment on other islands. However, current habitat conditions should be given precedence over historical occurrence.

32. Assess current habitat suitability.

All of the Mariana Islands need to be evaluated to ascertain the suitability of habitat for sustaining reed-warbler populations. Most of this reconnaissance may be done via aerial photos; however, some ground-truthing may also be required. Based upon the habitats being utilized on Saipan and Alamagan, and those formerly occupied on Guam, suitable habitat will most likely consist of scrubby habitat, native forest with a dense understory, and/or wetlands. Sites should also be assessed based upon the chance of future alteration (i.e., development potential).

33. Determine if reed-warblers are likely to compete with other native wildlife.

As part of the planning process for establishment of reed-warbler populations on three additional islands, a risk analysis must be undertaken to weigh the consequences of such introductions on other species of native wildlife already present at the proposed sites.

34. If nightingale reed-warblers persist on Aguiguan, determine taxonomy of the Aguiguan population.

As this population is monitored (Task 113 above), individuals should be captured and blood samples and measurements taken to assist in

resolution of the taxonomic question surrounding this population. Management strategies for increasing this population will be somewhat dependent upon whether or not it is confirmed to be a different subspecies than that which occurs on Saipan and Alamagan.

35. Establish additional populations.

Once a determination has been made as to the most suitable sites for population establishment, steps should be taken to prepare the habitat, control the threats, and introduce birds via translocation from Saipan or Alamagan and/or captive propagation and release. Specific plans for translocation must be carefully prepared and must include criteria for assessing success and for long-term monitoring of the resulting populations.

4. Revise recovery objectives, as necessary.

The recovery objectives identified in this plan should be viewed as preliminary targets, subject to revision pending the accomplishment of the research, management, and planning tasks identified above.

5. Conduct public outreach.

Coordination should be done in order to promote public participation and awareness in this species, as well as natural area conservation and enhancement. Programs should be prepared and presented to area schools and other local venues. In addition, an informational poster should be developed for this species.

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IMPLEMENTATION SCHEDULE

The Implementation Schedule that follows outlines actions and estimated costs for the nightingale reed-warbler recovery program, as set forth in this recovery plan. It is a guide for meeting the objectives discussed in the Recovery section of this plan. This schedule indicates task priority, task numbers, task descriptions, duration of tasks, the organizations responsible for committing funds, and lastly, estimated costs. The organizations responsible for committing funds are not, necessarily, the entities that will actually carry out the tasks. When more than one organization is listed as the responsible party, an asterisk is used to identify the lead entity.

The actions identified in the Implementation Schedule, when accomplished, should protect habitat for the species, stabilize the existing populations and increase the population sizes and numbers. Monetary needs for all parties involved are identified to reach this point, whenever feasible.

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.

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 provide for full recovery of the species.

Key to acronyms and symbols used in Implementation Schedule:

CNMI-DFW	-	Commonwealth of the Northern Mariana Islands, Division of Fish and Wildlife
GDAWR	-	Guam Division of Aquatic and Wildlife Resources, Department of Agriculture
FWS-PIE	-	U.S. Fish & Wildlife Service, Pacific Islands Ecoregion, Honolulu, Hawaii
DOD	-	Department of Defense
WS	-	U.S. Department of Agriculture, Wildlife Services
USGS BRD	-	U.S. Geological Survey - Biological Resources Division
O	-	Ongoing Task
C	-	Continuous Task
*	-	Indicates lead agency

RECOVERY PLAN IMPLEMENTATION SCHEDULE FOR THE NIGHTINGALE REED-WARBLER

Priority #	Task #	Task Description	Task Duration (Yrs)	Responsible Party	Total Cost	Cost Estimates ($1,000's)					Comments
						FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	
1	111	Monitor Saipan population and assess threats.	C	CNMI-DFW	120.0	8	8	8	8	8	
				USGS BRD	30	2	2	2	2	2	
1	112	Monitor Alamagan population and assess threats.	C	CNMI-DFW	150	30			30		
				USGS BRD	50	10			10		
1	113	Monitor Aguiguan population and assess threats.	C	CNMI-DFW	173	15	15	15	15	15	
				USGS BRD	59	5	5	5	5	5	
1	121	Develop and implement a brown tree snake interdiction and control plan.	O	CNMI-DFW*	570	10	40	40	40	40	
				GDAWR	570	10	40	40	40	40	
				DOD	570	10	40	40	40	40	
				FWS-PIE	85	10	10	5	5	5	
				WS	125	10	10	10	10	10	
				USGS BRD	60	10	10	5	5	5	
1	122	Control feral ungulates.	C	CNMI-DFW*	225		30	30	30	15	
				WS	70		15	15	15	5	
1	123	Control other predators.	C	CNMI-DFW*	210			20	20	20	
				WS	40			5	5	5	
2	1241	Delineate essential habitat areas.	2	CNMI-DFW	4		2	2			
				USGS BRD	2		1	1			

RECOVERY PLAN IMPLEMENTATION SCHEDULE FOR THE NIGHTINGALE REED-WARBLER

Priority #	Task #	Task Description	Task Duration (Yrs)	Responsible Party	Total Cost	Cost Estimates ($1,000's)					
						FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	Comments
2	1242	Pursue protective status for wildlife conservation areas.	5	CNMI-DFW	5			1	1	1	
2	1243	Develop resource protection plan for Aguiguan.	5	CNMI-DFW*	10		2	2	2	2	
				FWS-PIE	6		2	1	1	1	
NEED 1 (Protect and manage existing populations)					3,134	130	232	247	284	219	
2	2	Conduct basic research to assist in achievement of recovery goals.	10	CNMI-DFW*	185	25	25	25	25	25	
				FWS-PIE	75	10	10	10	10	10	
				USGS BRD	40	5	5	5	5	5	
NEED 2 (Conduct research)					300	40	40	40	40	40	
3	31	Conduct paleontological surveys.	2	CNMI-DFW*	60	30	30				
				FWS-PIE	60	30	30				
3	32	Assess habitat suitability.	3	CNMI-DFW*	30	10	10	10			
				FWS-PIE	21	7	7	7			
				USGS BRD	9	3	3	3			
3	33	Determine if reed-warblers are likely to compete with other native wildlife.	2	CNMI-DFW*	8	4	4				
				FWS-PIE	4	2	2				
				USGS BRD	2	1	1				

RECOVERY PLAN IMPLEMENTATION SCHEDULE FOR THE NIGHTINGALE REED-WARBLER

Priority #	Task #	Task Description	Task Duration (Yrs)	Responsible Party	Total Cost	Cost Estimates ($1,000's)					
						FY 1998	FY 1999	FY 2000	FY 2001	FY 2002	Comments
3	34	Determine taxonomy of Aguiguan population.	2	CNMI-DFW	6	3	3				
				USGS BRD	4	2	2				
3	35	Establish additional populations.	10	CNMI-DFW*	275			40	40	40	
				FWS-PIE	175			20	20	20	
NEED 3 (Establish additional populations)					654	92	92	80	60	60	
3	4	Revise recovery objectives, as necessary.	1	FWS-PIE*							
				CNMI-DFW							
NEED 4 (Revise recovery objectives)					2.0	0	0	0	0	0	
3	5	Conduct Public Outreach	6	FWS-PIE	24.0	4	4	4	4	4	
				CNMI-DFW*	36.0	6	6	6	6	6	
NEED 5 (Conduct Public Outreach)					60.0	10	10	10	10	10	
TOTAL COST					4,150.0	272	374	377	394	329	

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(*) - Persons or Agencies who provided information necessary to the development of the Plan.

(**) - Personal communication received.

APPENDIX B

SUMMARY OF COMMENTS

The U.S. Fish and Wildlife Service received comments on the Draft Recovery Plan for the nightingale reed-warbler from the Guam Division of Wildlife and Aquatic Resources, Department of Agriculture; the U.S. Department of Agriculture, Wildlife Services, Hawaii Field Station; and the U.S. Geological Survey, Biological Resources Division, Pacific Island Ecosystems Research Center. These comments provided additional information and updates on the population and life history of the nightingale reed-warbler, as well as editorial changes, and have been incorporated into the final plan.

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