Micronesica 32(1):3–10, 1999

Status of the Mariana Crow Population on Rota, Mariana Islands

STEVEN G. FANCY[1]

U.S Geological Survey, Biological Resources Division,
Pacific Island Ecosystems Research Center,
P.O. Box 44, Hawaii National Park, HI 96718.
Steven_Fancy@nps.gov

MICHAEL R. LUSK and DANIEL J. GROUT

U.S. Fish and Wildlife Service, Pacific Islands Ecoregion,
P.O. Box 50088, Honolulu, HI 96850

Abstract—We conducted a survey of the endangered Mariana Crow (*Corvus kubaryi*) population on Rota, Commonwealth of the Northern Mariana Islands, in October-November 1995 to provide current information on numbers and distribution of this species. To allow direct comparisons with a previous survey, we resurveyed transects established in 1982 using the same field methods and used identical analysis methods for both surveys. Several areas on Rota that lack suitable habitat and have few if any resident crows were excluded from our 6,315-ha study area.

Our reanalysis of 1982 survey data for our study area gave an estimated population size of 1,348 crows (95% CI = 1,136–1,564), compared to a 1995 estimate of 592 crows (95% CI = 474–720). Mean number of crows detected per sampling station decreased 57% from 1.06 ± 0.09 SE in 1982 to 0.46 ± 0.05 in 1995. The apparent 56% decrease in population size may be a result of habitat loss from development and typhoons, as well as persecution, but other factors contributing to the decline cannot be identified until more is known about the ecology and demography of the Mariana Crow population.

Introduction

The Mariana Crow (*Corvus kubaryi*) is an endangered tropical forest crow endemic to the islands of Guam and Rota in the Mariana Islands. On Guam, the crow population decreased by 1995 to fewer than 40 individuals because of habitat loss and predation by the invasive brown tree snake (*Boiga irregularis*) (Savidge 1987, Fritts 1988). A report by the National Research Council (1996) stated that the Guam population would soon become extinct unless action is taken. One suggestion for enhancing the Mariana Crow on Guam is to translocate

[1]Present address: National Park Service, 1201 Oak Ridge Dr., Suite 350, Fort Collins, CO 80525

crows from the much larger population on Rota. The most recent systematic, island-wide survey was conducted in 1982 and estimated the Rota population at 1,318 ± 111 SE Mariana Crows (Engbring et al. 1986), but surveys of portions of crow habitat in 1993 and 1994 indicated that the Rota population had declined considerably since the 1982 survey (USFWS, unpubl. data).

Engbring et al. (1986) reported that native forests covered approximately 60% of Rota in 1982, although much of this forest had been altered by human development or typhoons. Since 1982, an unknown amount of crow habitat has been lost by residential, agricultural, and resort development, and further loss and fragmentation of forest habitats on Rota is likely to occur with increasing development pressures on the island. Because most land on Rota is privately owned, the USFWS is developing a habitat conservation plan (HCP) for Rota to allow economic development while preserving essential forest habitat for the Mariana Crow and other native plants and wildlife (National Research Council 1996).

In 1995, we conducted a comprehensive survey of the Mariana Crow population on Rota to provide current information for the HCP planning process and recovery efforts for the Mariana Crow. In this paper, we present findings from this 1995 survey, and we compare population estimates between 1982 and 1995 after analyzing both data sets with the same method.

Study Area and Methods

Rota (14º10'N, 145º12'E) lies about 49 km north of Guam and is the southernmost island in the Commonwealth of the Northern Mariana Islands (CNMI; Fig. 1). An uplifted limestone mesa known as the Sabana rises to 491 m on the western half of the 85-km^2 island. Steep cliffs on the north, south, and west slopes of the Sabana drop to narrow coastal shelves, whereas the northeastern side of the Sabana slopes gradually to a large plateau that covers the eastern half of the island at about 150-m elevation. Agricultural development and phosphate mining on the Sabana has removed most of the native forest there, but relatively undisturbed forest occurs around the base of the Sabana's cliffs and on some coastal shelves with precipitous terrain. Many of the areas on the eastern plateau and coastal shelves that were cleared for agriculture before and during World War II have regenerated with second-growth forest, although much of the understory is scrubby or has been removed by grazing (Engbring et al. 1986, Falanruw et al. 1989).

To estimate Mariana Crow population size on Rota and allow comparisons with 1982 survey results, we followed the same survey design as Engbring et al. (1986) using the variable circular-plot (VCP) method with 8-min counting periods. VCP counts are a modification of line transect sampling and are widely used to estimate the size and trend of forest bird populations (Reynolds et al. 1980, Scott et al. 1986, Buckland et al. 1993, Fancy 1997). Sampling stations were placed systematically at 150-m intervals along transacts after randomly selecting the initial station, and the distance to each bird heard or seen during the 8-min sampling period was recorded. Detection distances were used to develop a detec-

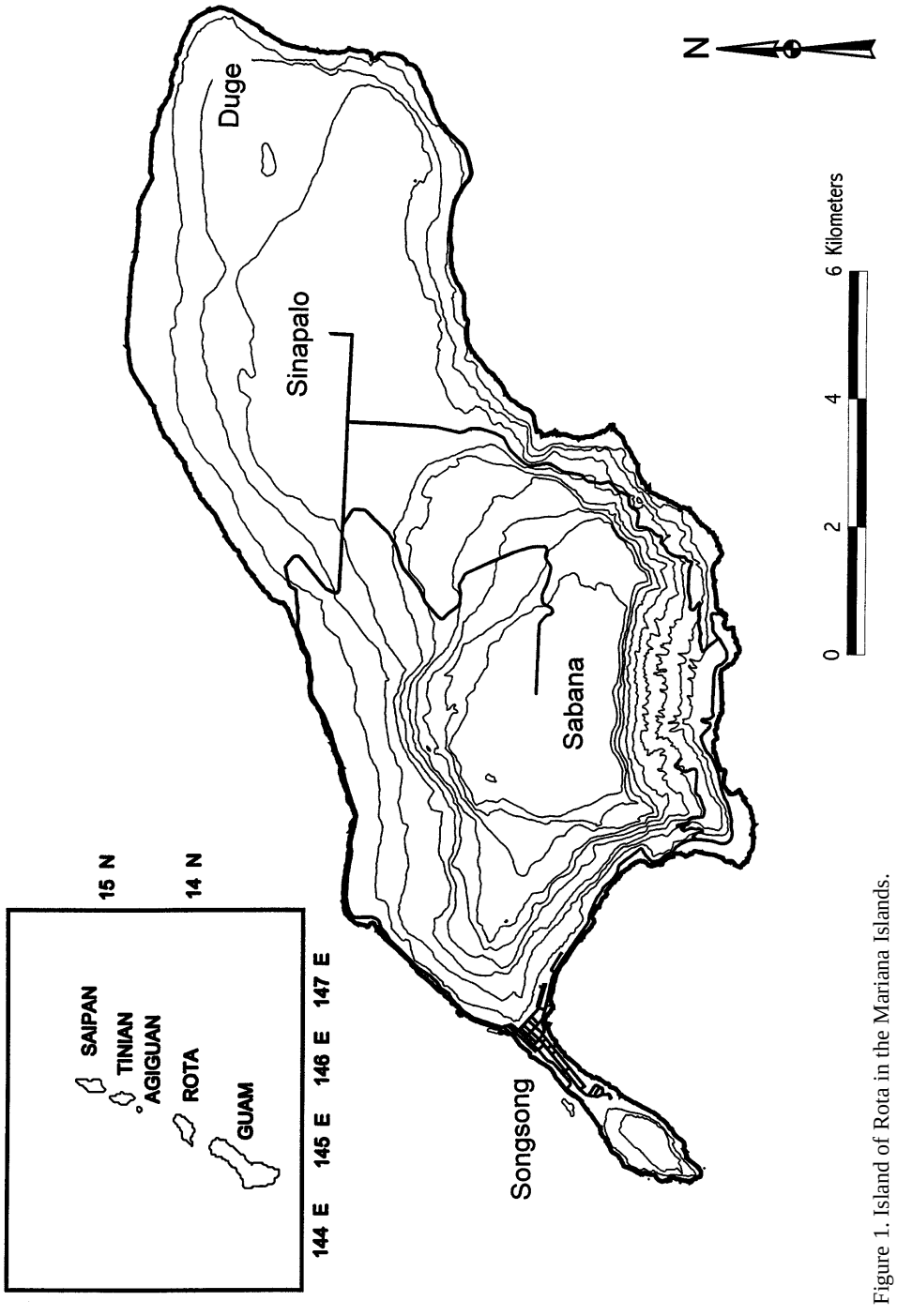

Figure 1. Island of Rota in the Mariana Islands.

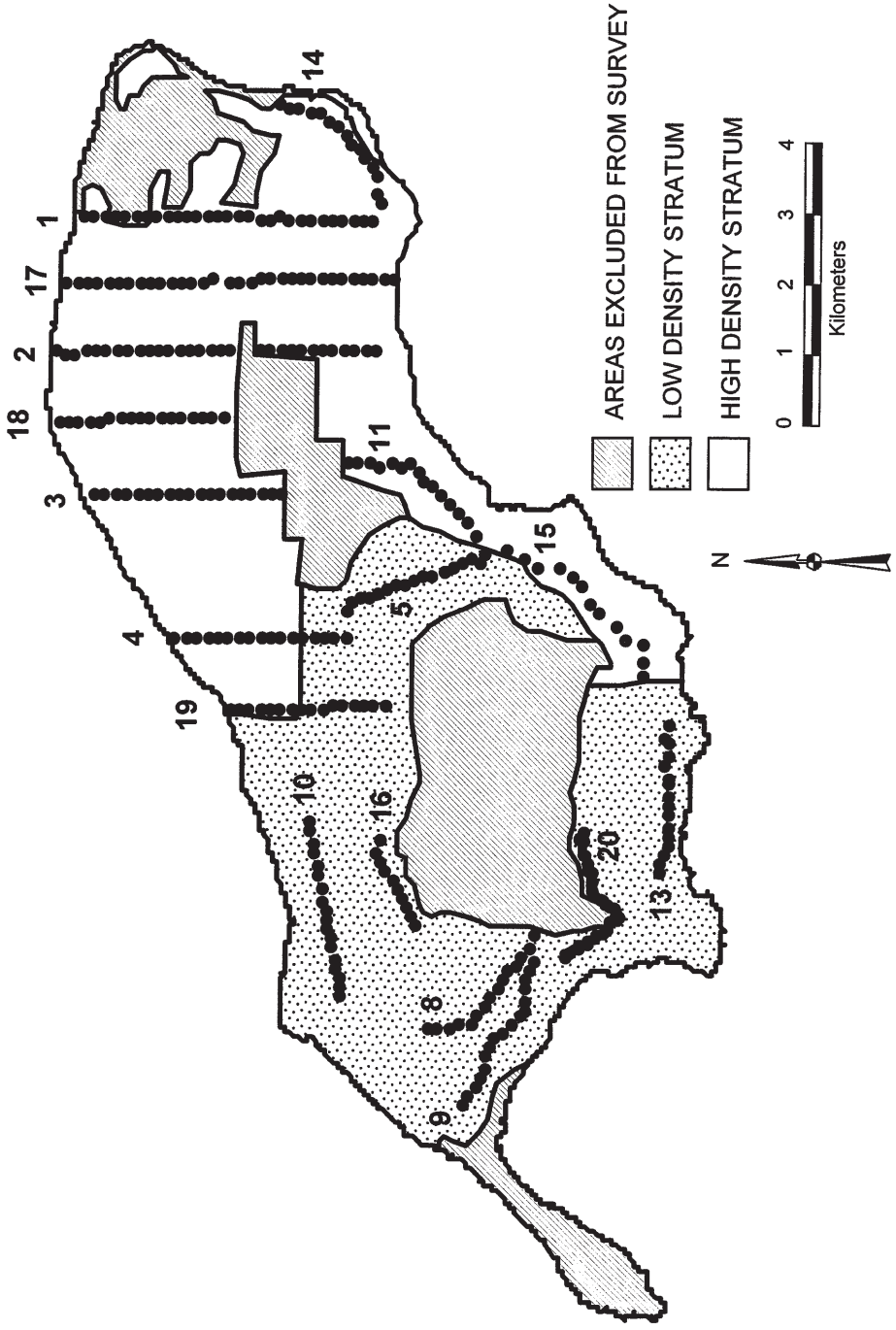

Figure 2. Location of sampling stations and high and low density strata. Numerals are transect numbers.

tion function and the effective area surveyed around each station. Bird density was calculated as the number of birds detected at a station divided by the effective area (Buckland et al. 1993, Fancy 1997).

To allow direct comparisons between the 1982 and 1995 surveys but improve precision of the 1995 estimate, we resurveyed the 1982 transects but added additional transects based on 1982 survey results and recent information on crow distribution and relative numbers. We excluded some areas on Rota from the study area because they lacked suitable habitat and rarely, if ever, supported any crows. Areas considered outside the study area totaled 2,174 ha and included the Songsong Peninsula and Sinapalo areas (Fig. 1), which are mostly deforested and covered by residential or agricultural developments, and the Duge region, which is primarily grassland. We also excluded the Sabana plateau because 1994 surveys for the Rota Bridled White-eye (*Zosterops conspicillata rotensis*) and other surveys of the Sabana indicated that few crows occurred there. The remainder of the island was divided into two density strata (Fig. 2) based on results of the 1982 surveys and recent field work. Stratum 1 (2,919 ha) circled the Sabana region and contained fewer crows and lower quality habitat than areas within Stratum 2 (3,396 ha) at the eastern half of the island. We optimized the survey design by placing additional transacts in areas with higher densities of crows. In 1982, each station was surveyed simultaneously by two observers separated by 20 m. Because of the possibility of statistical dependence between data for the two observers, we excluded data for the less experienced observer at each station in our reanalysis.

All stations were surveyed between 0600 and 1030 h local time during the period of 23 October to 10 November 1995. Prior to the survey, four observers (Dan Grout, Michael Lusk, Annie Marshall, Gary Wiles) conducted three days of distance calibration and practice counts on Rota as described by Kepler and Scott (1981). All four observers had been based in the Mariana Islands and had experience with VCP surveys in the CNMI. We resurveyed 11 of the 14 transacts (211 stations) established in 1982 (Transects 1-5, 8-11, and 13-14; see Fig. 2), but excluded 1982 Transects 6, 7, and 12 in the Sabana region which were sampled in 1994. An additional 100 stations were surveyed along six new transacts (Transects 15-20) to increase sample size and provide better coverage of crow habitat.

We used the program DISTANCE (Laake et al. 1994) to calculate a single effective area of 4.737 ha (122.8 m radius, Fourier detection function, $\chi^2 = 2.4$, 5 df, $\underline{P} = 0.79$) for the combined set of 366 Mariana Crow detection distances recorded in 1982 and 1995. Density at each station was estimated by dividing the number of crows detected at the station by this effective area. To account for sampling error in the effective area, we used its coefficient of variation (4.40%) to sample from a random normal distribution around the mean effective area, and we bootstrapped the analysis 5,000 times using the program VCJADJ as described by Fancy (1997) to obtain confidence intervals. We treated data for the 1982 and 1995 surveys identically to allow direct comparisons.

Results

Our reanalysis of 1982 survey data (using data for only one observer at each station) resulted in 224 crow detections at 211 stations within our study area (Table 1). At least one crow was present at 110 of the 211 (52.1%) stations. Mean crows per station was 1.06 ± 0.09 SE. We estimate that 1,348 ± 109 SE crows (95% CI = 1,136–1,564) occurred within the limits of our study area in 1982.

In 1995, we detected 142 crows at 311 stations, with 87 (28.0%) of stations having at least one crow detection. Mean crows per station in 1995 was 0.46 ± 0.05 SE, a 57% decrease from that in 1982. We estimate population size in 1995 within our study area to be 592 ± 63 crows (95% CI = 474–720). Based on 1994 VCP counts and informal surveys, we estimate that another 20 crows may occur in the Sabana region and other areas outside of our study area, giving a population estimate of approximately 612 crows for the entire island of Rota in 1995.

Table 1. Number of Mariana Crows detected per transect in 1982 and 1995 on Rota.

	1982 Survey				1995 Survey			
Transect	# Stn	#Stn Occupied	# Crows	Crows/ Stn	# Stn	# Stn Occupied	# Crows	Crows/ Stn
1	28	13	28	1.00	29	9	16	0.55
2	30	19	47	1.57	30	7	10	0.33
3	19	11	23	1.21	18	4	4	0.22
4	17	12	22	1.29	17	2	3	0.18
5	17	4	4	0.24	17	1	1	0.06
7	3	0	0	0.00				
8	15	3	7	0.47	15	0	0	0.00
9	17	6	6	0.35	17	6	9	0.53
10	18	10	21	1.17	18	11	15	0.83
11	15	13	31	2.07	15	5	6	0.40
12	6	3	4	0.67				
13	16	10	16	1.00	14	6	11	0.79
14	10	6	15	1.50	15	13	31	2.07
15					13	1	2	0.15
16					10	1	1	0.10
17					32	6	8	0.25
18					17	9	18	1.06
19					16	5	6	0.38
20					18	1	1	0.06
Totals	211	110	224	1.06	311	87	142	0.46

Discussion

Analysis of surveys in 1982 and 1995 using the same methods and study area boundaries indicates that the Mariana Crow population on Rota decreased by 56% since 1982. However, our comparison between 1982 and 1995 survey results may be biased, and the actual decrease in the crow population may have been greater than 56%, for three reasons. First, the 1995 survey was conducted in October-

November, when detectibility of crows is relatively high. The 1982 survey was conducted during April-May when many crows were nesting and were relatively quiet and secretive. We suspect that we would have obtained fewer detections and a lower population estimate if we had conducted the 1995 survey in April-May. Second, 31 of the 142 crows we detected were from Transect 14 (Table 1, Fig. 2), in a narrow band of undisturbed native forest beneath steep cliffs. Detection distances in the narrow forest band on either side of the transect were relatively short, and effective area surveyed was biased low by the many short detection distances. We believe that we reduced the extent of this problem by pooling data for all observers from both surveys. However, crows were uncharacteristically vocal while Transect 14 was being surveyed and many birds were undoubtedly counted from more than one station. Counting the same bird from more than one station is not a problem as long as the bird does not move in response to the observer (Buckland et al. 1993), but the calling frenzy that occurred while this transect was being surveyed, and the short detection distances, were not representative of most of the study area. We suspect that we might have detected fewer crows and thus obtained a lower population estimate if we had surveyed Transect 14 at another time. Finally, surveys of the Sabana region in 1994 focusing on the Bridled White-eye found a 71% decrease in crow density between 1982 and 1994 (USFWS, unpubl. data), probably because of typhoon damage, and the island-wide population probably decreased by >56% because areas outside of our study area showed greater declines.

Mean numbers of crows detected per station decreased by 57% between the 1982 and 1995 surveys, and the proportion of stations where at least one crow was detected decreased by 21%. Decreases occurred throughout the island, with the exception of the area around Transect 14 at the east end of Rota (Table 1). With the exception of Transects 9, 10, and 13, which showed little change, and Transect 14, which showed an increase, measures of crow abundance on all other transects decreased considerably between 1982 and 1995 (Table 1). Comparison of aerial photographs between 1987 and 1994 show that there has been a slow but steady loss and fragmentation of native forest and degradation of crow habitat on Rota. Much of this habitat loss is a result of development in the lowlands and typhoon damage in the Sabana.

Few data exist on the ecology and demography of the Mariana Crow, and factors contributing to the decline of the species on Rota are poorly known (National Research Council 1996). However, during the past four years, bulldozing of occupied crow habitat for golf courses and hotels has occurred, as well as widespread but small-scale clearing of forests for homesteads and grazing lands. Furthermore, the presence of this protected endangered species is seen as a hinderance to development by some, and there has been at least one documented case in recent years of crows being shot on Rota. The objective of the Habitat Conservation Plan now being developed for the island is to allow economic development while protecting native plants and animals. It is believed that the amount of habitat preserved will support a viable population of Mariana Crows, and it is

hoped that the Rota Habitat Conservation Plan will serve as a model for other islands in the Pacific Ocean.

Acknowledgements

We thank Gary Wiles and Annie Marshall for assistance with field work during these surveys. We also thank Stan Taisacan and Frank Toves for assistance with land access and logistics on Rota. Gerald Lindsey and John Simon provided helpful comments on an early draft of the manuscript.

References

Buckland, S.T., D.R. Anderson, K.P. Burnham & J.L. Laake. 1993. Distance sampling: estimating abundance of biological populations. Chapman and Hall, New York.

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

Falanruw, M.C., T.G. Cole & A.H. Ambacker. 1989. Vegetation survey of Rota, Tinian and Saipan, Commonwealth of the Northern Mariana Islands. USDA Forest Service Resource Bulletin PSW-27.

Fancy, S.G. 1997. A new approach for analyzing bird densities from variable circular-plot counts. Pacific Science 51: 107–114.

Fritts, T.H. 1988. The brown tree snake (*Boiga irregularis*) threat to Pacific Islands. U.S. Fish and Wildlife Service, Biological Reports 88(31).

Kepler, C.B. & J.M. Scott. 1981. Reducing count variability by training observers. Studies in Avian Biology 6: 366–371.

Laake, J.L., S.T. Buckland, D.R. Anderson & K.P. Burnham. 1994. DISTANCE user's guide V2.1. Colorado Coop. Fish and Wildlife Res. Unit, Colorado State University, Ft. Collins, CO.

National Research Council. 1996. The scientific bases for preservation of the Mariana Crow. National Academy Press, Washington, D.C.

Reynolds, R.T., J.M. Scott & R.A. Nussbaum. 1980. A variable circular-plot method for estimating bird numbers. Condor 82: 309–313.

Savidge, J.A. 1987. Extinction of an island forest avifauna by an introduced snake. Ecology 68: 660–668.

Scott, J.M., S. Mountainspring, F.L. Ramsey & C.B. Kepler. 1986. Forest bird communities of the Hawaiian islands: their dynamics, ecology and conservation. Studies in Avian Biology 9: 1–431.

Received 7 November 1997, accepted 25 July 1998.