(ISBN: 0-943610-38-9)

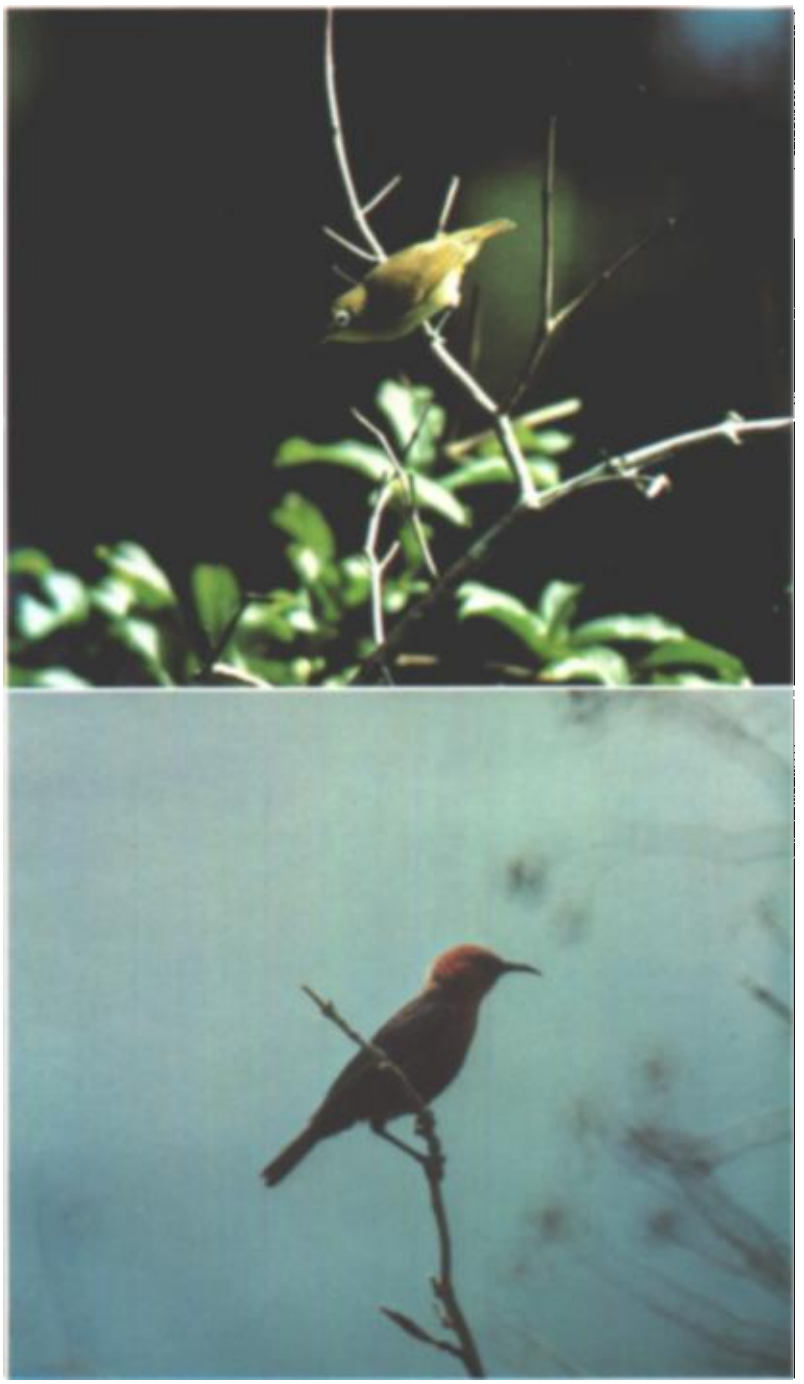
THE NATIVE FOREST BIRDS OF GUAM

BY

J. MARK JENKINS
Division of Aquatic and Wildlife Resources
Department of Agriculture
Government of Guam

ORNITHOLOGICAL MONOGRAPHS NO. 31

PUBLISHED BY
THE AMERICAN ORNITHOLOGISTS' UNION
WASHINGTON, D.C.
1983



FRONTISPIECE. *Above:* Bridled White-eye (*Zosterops conspicillata*) from Truk, Caroline Islands, illustrating a typical white-eye posture. Photo by D. Roberson. *Below:* Male Cardinal Honeyeater (*Myzomela cardinalis saffordi*) illustrating the tendency to perch on exposed branches. Photo by H. D. Pratt.

THE NATIVE FOREST BIRDS OF GUAM

ORNITHOLOGICAL MONOGRAPHS

This series, published by the American Ornithologists' Union, was established for major papers too long for inclusion in the Union's journal, *The Auk.* Publication has been made possible through the generosity of the late Mrs. Carll Tucker and the Marcia Brady Tucker Foundation, Inc.

Correspondence concerning manuscripts for publication in the series should be addressed to the Editor, Dr. Mercedes S. Foster, USFWS, NHB-378, National Museum of Natural History, Washington, D.C. 20560.

Copies of *Ornithological Monographs* may be ordered from the Assistant to the Treasurer of the AOU, Frank R. Moore, Department of Biology, University of Southern Mississippi, Southern Station Box 5018, Hattiesburg, Mississippi 39406. (See price list on back and inside back covers.)

Ornithological Monographs No. 31, x + 61 pp.

Editor of AOU Monographs, Mercedes S. Foster

Special Reviewers for this issue, Murray D. Bruce, Turramurra, New South Wales; H. Douglas Pratt, Museum of Zoology, Louisiana State University, Baton Rouge

Author, J. Mark Jenkins; *present address*: Ecological Sciences Section, Department of Engineering Research, Pacific Gas and Electric Co., 3400 Crow Canyon Rd., San Ramon, California 94583

First received, 22 January 1982; revision completed, 30 March 1983; accepted 16 April 1983.

Issued 9 December 1983.

Price $9.00 prepaid ($7.00 to AOU members)

Library of Congress Catalogue Card Number 83-72897

Printed by the Allen Press, Inc., Lawrence, Kansas 66044

Copyright © by the American Ornithologists' Union, 1983
ISBN: 0-943610-38-9

THE NATIVE FOREST BIRDS OF GUAM

BY

J. MARK JENKINS
Division of Aquatic and Wildlife Resources
Department of Agriculture
Government of Guam

ORNITHOLOGICAL MONOGRAPHS NO. 31

PUBLISHED BY
THE AMERICAN ORNITHOLOGISTS' UNION
WASHINGTON, D.C.
1983

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

INTRODUCTION

The resident avifauna of Guam currently consists of 12 native land birds, four breeding seabird species, one native wetland bird, one reef heron, and seven non-native species (Appendix I). Populations of most of the native land species on Guam have declined rapidly during the past 20 years, and these species now occupy small fractions of their island-wide historical ranges. Many of them are in danger of extinction within the foreseeable future. Ten bird species were proposed recently by the Government of Guam for inclusion on the United States Endangered Species List (Division of Aquatic and Wildlife Resources 1979). To effectively manage these species and increase the probability of their survival, we must know something of their biology. Yet, the life history, ecology, and behavior of Micronesian birds remain almost unknown.

In fact, less is known about the birds of Guam and the northern Mariana Islands than about any other avifauna on United States territory. Early naturalists (e.g., Hartert 1898; Safford 1901, 1902; Seale 1901; Mearns 1909) working in these South Pacific areas emphasized collecting and systematics. Accounts and collections made by American servicemen during World War II supplemented their findings (Gleize 1945; Downs 1946; Moran 1946; Stophlet 1946; Watson 1946; Baker 1947, 1951; Borror 1947; Stott 1947; Marshall 1949; Kibler 1950), and, in 1951 Baker published a comprehensive work on the birds of Micronesia. He emphasized systematics and distribution, however, and included little ecological and behavioral information.

Postwar accounts of birds on Guam and other Mariana Islands have consisted largely of checklists, brief distributional surveys, and notes on behavior (Hartin 1961; King 1962; Tubb 1966; Beaty 1967; Owen 1977; Pratt et al. 1979; Ralph and Sakai 1979). No Micronesian bird has ever been the subject of an intensive study. In an attempt to fill this gap, I report here on 11 of the 12 native land birds of Guam including information on habitats, behavior, food habits, nesting, distribution, and status of each species. The endemic Guam Rail (*Rallus owstoni*) is considered elsewhere (Jenkins 1979). The Micronesian Megapode (*Megapodius laperouse*), long extirpated from Guam, was not included in this study. In discussing each species, I attempt to draw together pertinent, but widely separated, observations of other authors who have published brief accounts of birds on Guam or other Mariana Islands. These accounts outline the former distribution and abundance on Guam of the species examined, and provide the historical base to which I compare my 1978 and 1979 findings for these birds. I concentrated on the native forest birds because of the critical status of most of these species. However, I also discuss briefly other native birds, migrants, and non-native species. These species accounts are intended to add to our knowledge of the ecology and behavior of Guam birds, encourage more comprehensive studies in the future, and stimulate concern for a unique and disappearing avifauna.

STUDY AREA

Guam is the largest and southernmost island of the Mariana Archipelago (Fig. 1). Lying at approximately 13°13′N and 145°E, Guam is 45 km long and 6 to 13 km wide. The island has a uniformly warm and humid climate throughout the year. High temperatures are typically about 30°C and lows about 21°C. Relative

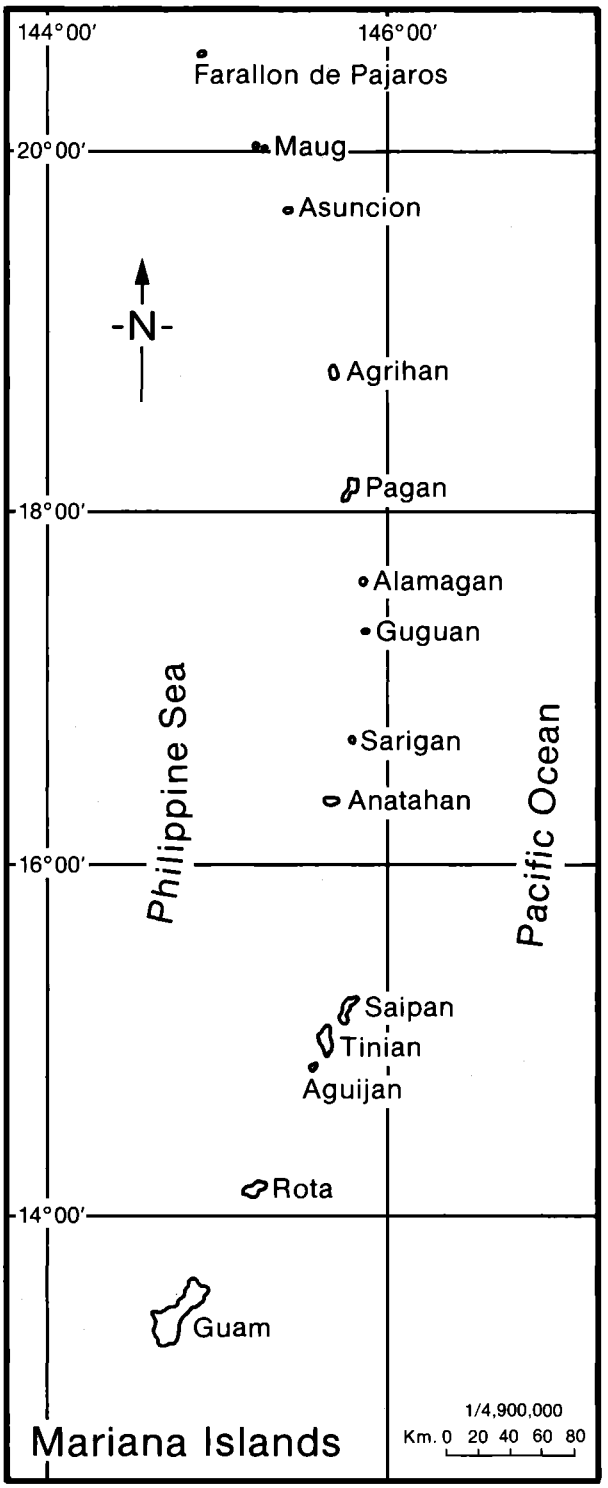


FIG. 1. Map of the Mariana Islands.

humidity varies with season but usually ranges from 65 to 75% during the day and from 85 to 100% at night (Stone 1970). Rainfall is greatest from July through October, with 62% of the average annual precipitation of 2200 mm falling within these four months. January through April is relatively dry, and precipitation in other months varies from year to year (Stone 1970). The seasons are defined primarily by rainfall, though changes in photoperiod are noticeable.

The northern half of Guam is a limestone plateau or mesa with coralline limestone soils predominating. The southern half is primarily volcanic in origin, with lateritic soils and mountainous topography. Stone (1970) described the predominant vegetation of the northern plateau as "Typhoon Forest." Dominant vegetation on the southern volcanic soils includes ravine forest and savanna. Many other habitat types also occur on the island, and most of the native forest birds of Guam occur in various of these as well. The general habitats of Guam (Stone 1970) referred to throughout the text are:

Mature limestone forest.—Found around the northern cliffline; dominated by *Pisonia* and *Pandanus* (Plate I).

Mature ravine forest.—Found on southern mountain slopes and in ravines. Plant species are similar to those in the mature limestone forests although soil types differ from those of the limestone forest areas (Stone 1970).

Mixed woodlands.—Found primarily on the northern plateau. Similar to the mature limestone forest, but canopy much lower and vegetation more open. *Artocarpus, Pandanus, Neisosperma,* and *Cocos* predominate.

Second growth.—Areas cleared of mature forest and presumably returning to climax vegetation. Primarily the Northwest Field area of Andersen Air Force Base. Habitats with little or no closed canopy and many *Casuarina, Pandanus, Neisosperma, Scaevola, Morinda,* and *Hibiscus.*

Scrub vegetation.—Similar to mixed woodlands and second growth habitats, except vegetation lower growing and with fewer *Neisosperma* and *Artocarpus.* Many *Pandanus, Scaevola, Hibiscus, Bikkia,* and *Cynometra.* Found on the northern plateau.

Coastal strand vegetation.—Open sandy beaches dominated by *Cocos, Casuarina, Ipomoea, Canavalia, Scaevola, Triumfetta,* and other species. Found all around the perimeter of the island.

Savannas.—Primarily grassland communities found on southern volcanic soils. Common species include *Miscanthus, Dimeria,* and *Phragmites.*

Marshes.—Found mainly in southern and central Guam. Vegetation consists primarily of *Phragmites, Scirpus,* and *Cyperus.*

Mangrove swamps.—Chiefly found in Apra Harbor; primary plant species are *Rhizophora, Bruguiera, Lumnitzera,* and *Avicennia.*

Leucaena forest.—An introduced community composed of nearly pure stands of *Leucaena leucocephala.* Used for reforestation following World War II, this habitat occurs over much of the island (Plate I).

METHODS

Birds were observed in the field for 10 to 15 hours each week from January, 1978 through December, 1979. The majority of the fieldwork was done in Northwest Field and near Ritidian Point (Fig. 2), although I visited all parts of the island to determine the distribution and abundance of the native birds. Additional

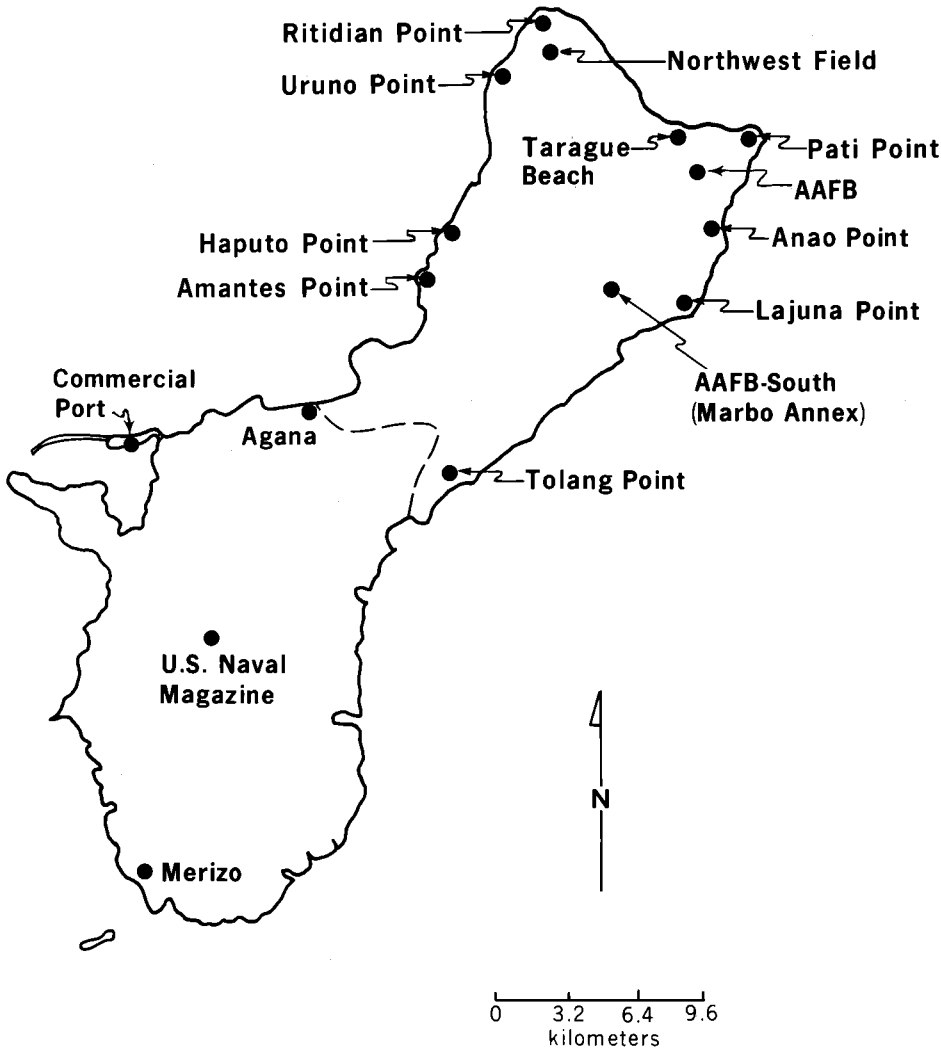


FIG. 2. Locations of the 11 forest bird census stations and other localities mentioned in the text. Dashed line indicates the approximate area of transition from the northern plateau to the southern mountainous areas.

data were obtained from road-kill specimens, from field notes taken by biologists of the Division of Aquatic and Wildlife Resources (DAWR) of the Guam Department of Agriculture, and from roadside and station counts. Field notes and unpublished reports of the DAWR are on file at the Department of Agriculture, Government of Guam.

Observations provided data on foraging, general activities, and courtship and mating behavior for each species. When nests were located, they were observed to obtain information on clutch and brood sizes, incubation dates, nestling periods, parental care, and fledging. Egg length and greatest width or diameter were measured with vernier calipers. Weights and measurements of birds were determined by DAWR staff from specimens collected during the 1960's and 1970's, and from

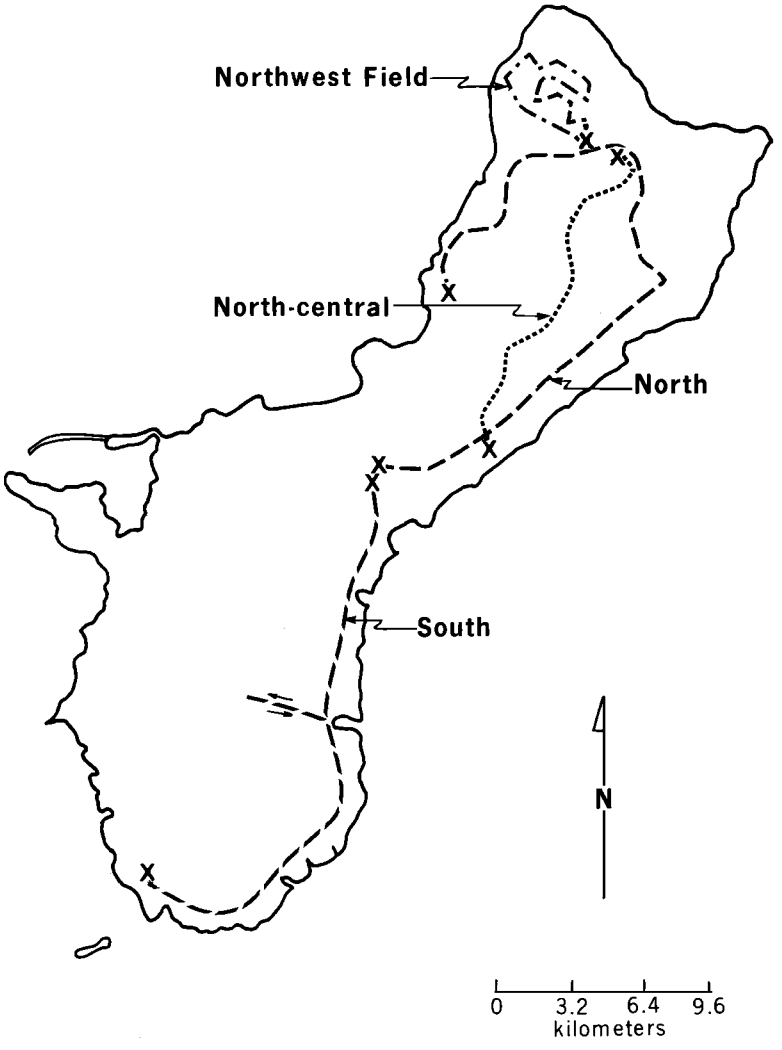


FIG. 3. North, South, North-central, and Northwest Field roadside bird census routes. Ends of routes, censused in either direction, are indicated by X's.

a few road-kill birds in good condition. Measurements were made with a millimeter ruler according to standard methods (Baldwin et al. 1931). Food habits were determined by combining a limited number of stomach content analyses with observations of feeding.

ROADSIDE COUNTS

Counts were made along 40.8 and 39.0 km of roads in northern and southern Guam, respectively (Fig. 3). DAWR biologists began roadside counts in 1961 in an attempt to determine populations of three game species, the Guam Rail, Philippine Turtle Dove (*Streptopelia bitorquata*), and White-throated Ground Dove (*Gallicolumba xanthonura*). In 1974, the DAWR established a 14.6 km Northwest

Field Route and began to record all bird species there and also along the Northern Route (Fig. 3). The Southern Route was discontinued in 1975 due to a lack of birds, and the following year, a new 22.4 km North-central Route, where all birds were recorded, was established (Fig. 3).

Roadside counts, which began at dawn, were made weekly at first, and later, bimonthly, from vehicles moving 20 to 30 kph. After 1974, all birds seen were recorded. Total numbers of birds observed monthly and yearly were converted to birds per 160 km (100 mi) travelled.

Station Counts

I established 11 count stations in 1978, primarily around the northern cliffline of Guam (Fig. 2). Count stations were located in areas known to support remnant native bird populations. No stations were established in southern Guam because few native birds could be found there. All birds seen or heard were recorded at each count station each week during a 15-min period in the early morning. The distance from which the birds were observed also was recorded. These data were used to generate three indices of species abundance at each station (Appendix II): (1) Species Frequency is the proportion of count periods during which a species was recorded (i.e., number of count periods during which a species was recorded, divided by the total number of count periods); (2) Species Incidence is the total number of individuals of a species recorded, divided by the number of count periods during which the species was recorded; and (3) Relative Abundance is the number of individuals of a species recorded during a count period, divided by the number of individuals of the most abundant species recorded during the same period.

Distribution and Abundance

I mapped the distribution and abundance of each species throughout the island using roadside and station counts and estimates of the frequency with which species were observed in the field. I designated each species at each site as: (1) Abundant, seen or heard on 90 to 100% of the visits to an area; (2) Common, seen or heard on 50 to 90% of the visits; (3) Uncommon, seen or heard on 10 to 50% of the visits; (4) Rare, seen or heard on less than 10% of the visits; or (5) Extirpated, neither observed nor reliably reported during 1978 or 1979 from an area where they formerly were known to occur. I did not make observations systematically in all parts of the island and generally spent less time in southern Guam because most native birds were not found there.

SPECIES ACCOUNTS

Yellow Bittern (*Ixobrychus sinensis*)

Description.—*Ixobrychus sinensis* is a relatively small, slightly dimorphic heron (Table 1). The adult male has a black head, rufous neck, brown back, and a black tail. Primaries and secondaries are black, but the inner half of the wing is buff colored. The bill and feet are yellow-green (Mayr 1945; Baker 1951).

The adult female resembles the male but has the upper parts mottled brown and golden chestnut. In both sexes, the body is streaked with pale brown below.

TABLE 1

WEIGHTS AND MEASUREMENTS OF FOUR SPECIES OF BIRDS NATIVE TO GUAM[a]

Species	Sex/age[b]	n	Weight (g)	Wing chord (mm)	Tail length (mm)	Tarsus length (mm)	Culmen length (mm)
Ixobrychus sinensis	M/A	1	104	122	45	53	50
	F/A	1	92	131	52	48	50
Gallicolumba xanthonura	M/A	1	128.7[c]	149	100	34	17
	F/A	1	95.6[d]	131	86	30	15
Aerodramus vanikorensis bartschi	?/A	10	7.4 (6.5–8.0)[e]	92.4 (90–101)[e]	50.0 (48–54)[e]	10.4 (9.0–11.0)[e]	4.0 (3.5–4.0)[e]
Aplonis opaca guami	M/A	7	83.9 (75.0–92.8)[e]				
	F/A	4	82.4 (71.5–93.0)[e]				
	M/I	4	89.6 (88.0–95.0)[e]				
	F/I	1	77.0				

[a] Values for samples with n > 1 are means.
[b] A = adult, I = immature.
[c] $\bar{X}$ of 2 specimens, range = 117.0–140.5.
[d] $\bar{X}$ of 4 specimens, range = 58.5–119.0.
[e] Range.

The immature plumage resembles that of the adult female, though streaking on the upper parts may be heavier.

Males and females often can be distinguished in the field, particularly when seen together. Immature birds are easily confused with adult females.

Distribution.—*Ixobrychus sinensis* is distributed throughout Asia and Micronesia but shows little geographic variation. Its range includes northeastern China, Japan, Malaysia, Burma, India, Indonesia, and Ceylon. In Micronesia, the species occurs in the Palau Islands, Caroline Islands, and the Mariana Islands of Guam, Saipan, Tinian, and Rota (Baker 1951). *Ixobrychus sinensis* is resident in most areas but may be only a winter visitor to the Papuan region (Mayr 1945).

Habitat.—*Ixobrychus sinensis* is found in all habitats on Guam, most commonly in the southern savannas and the few remaining freshwater wetlands. Bitterns are seen less often in scrub and mixed woodland of the northern plateau and infrequently in mature mixed forest along forest openings or roadsides. I never observed bitterns along sandy shorelines or on coralline reefs.

Behavior.—Solitary *I. sinensis* are commonly seen flying across great distances. Birds appear to labor in flight, and at takeoff, the legs dangle behind the body. The bird often utters harsh notes that give rise to its local name of "kak-kag." Males and females may fly together at any time of year. Twice in June and again in November I observed pairs of *I. sinensis* flying in circles as they moved vertically and horizontally, appearing to intereact, possibly in courtship. Rarely, flocks of from three to more than 30 individuals were observed in flight, mostly leaving or returning to nesting colonies.

Food habits.—Foods previously reported for this species include black crickets (Seale 1901), grasshoppers, small fish (Marshall 1949), insects, and snails (Beaty 1967). Six stomachs examined by DAWR staff in 1968 and 1969, however, contained only small reptiles, including skinks, geckos, and anoles. The species apparently feeds entirely on animal foods.

Ixobrychus sinensis occasionally alights on *Cocos nucifera* or *Pandanus* spp. trees where it may feed in the foliage. More characteristically, however, it perches close to or on the ground, compacting its long body until a prey item is observed. The head and neck are then quickly extended in an attempt to capture the prey. This foraging technique is used in all habitats, including freshwater ponds where birds perch low in the reeds, extending the head and neck into the water to secure small fishes (Marshall 1949). Unlike Baker (1951), I never observed this species feeding in purely salt water habitats, although the birds occasionally foraged in brackish waters and estuaries.

Nesting.—The colonial *I. sinensis* prefers vegetation in marshes or freshwater ponds for nesting. Occasionally, solitary nests are built in trees, usually adjacent to fresh water. Nests are normally located in or near permanent or intermittent ponds, swamps, marshes, or streamsides, primarily in southern Guam. Less frequently, nests are built in dry fields or grassy thickets, well removed from water. The nests in freshwater habitats are constructed of grasses, whereas those built in trees or shrubs may include twigs or *Casuarina* needles. Nests are cupped platforms; one measured 17.5 cm in outer diameter and 10.2 cm in height. Nests usually are within 40 to 50 cm of the ground, but one was located 3 m up in a *Pithecellobium dulce* tree. Nests also have been recorded in *Casuarina equisetifolia,* swales of *Cyperus* sp., and in shrubs of *Cestrum diurnum.* The largest colony reported in DAWR staff notes consisted of 13 nests in varying stages of development, concentrated in an area of about 200 m^2.

At three colonies investigated by DAWR staff during the early 1970's, individuals laid eggs asynchronously at about 24-hour intervals, with a determinate clutch size of 3 or 4. Egg-laying within a colony was also asynchronous, with some nests containing young and others under construction. Eggs are ivory white; nine averaged 32.4 mm (range = 31.0–33.2) long and 24.2 mm (range = 23.0–24.6) wide. Incubation began after the laying of the first egg, with hatching occurring asynchronously at about 24-hour intervals. Two of three marked eggs hatched 18 days after laying, and one, 17 days after. The young lost the egg tooth when approximately 3 days old and if disturbed, left the nest after 5 to 7 days to stand on the ground below. One nestling fledged at 18 days. Both adults fed the young; food items included insects, skinks, and geckos.

Staff notes of DAWR record nesting in all months of the year except May, July, August, and September. The gap in nesting records from July through September coincides with the onset and heaviest part of the rainy season, which often causes flooding in wetland areas. The majority of nesting attempts (34 of 37) recorded in the DAWR staff notes were concentrated in the dry season from January to June, which suggests that nesting peaks then.

Status on Guam.—*Ixobrychus sinensis* is one of two indigenous birds that continue to exhibit an island-wide distribution despite the loss of much of Guam's wetland habitats (Fig. 4). It is the only native species that is commonly sighted throughout southern Guam. Other native wetland birds, including the Mariana Mallard (*Anas oustaleti*), the White-browed Rail (*Porzana cinereus micronesiae*), and the Nightingale Reed-warbler (*Acrocephalus luscinia luscinia*), have been extirpated from Guam. Some decline in numbers, however, has undoubtedly occurred since Marshall's (1949) description of the species as abundant and conspicuous on the island. Baker (1951) also commented on the species' abundance.

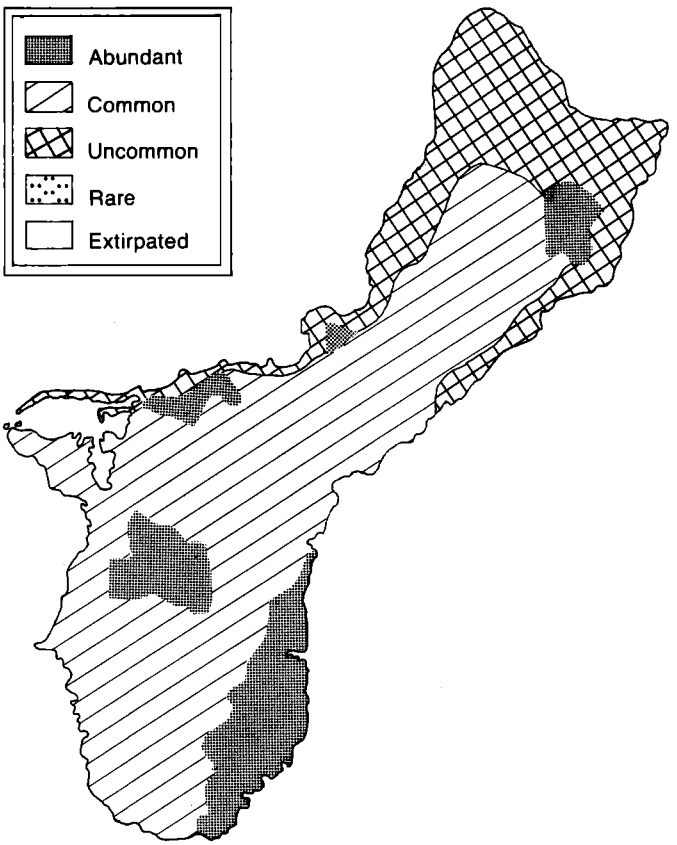


FIG. 4. Distribution and abundance of the Yellow Bittern (*Ixobrychus sinensis*) on Guam, 1978–1979.

Current attempts to halt development of the remaining wetland areas on Guam, combined with the ability of *I. sinensis* to use xeric as well as forested habitats, may allow this species to maintain stable populations at a time when most other native birds are suffering severe population declines.

WHITE-THROATED GROUND DOVE (*GALLICOLUMBA XANTHONURA*)

Description.—*Gallicolumba xanthonura* is a highly sexually dimorphic dove (Table 1). The adult male has a white head, neck, and breast that contrast with the dark bronze feathers of the lower body (Fig. 5). Mantle feathers and upper wing coverts are edged in metallic purple-violet. The wings, tail, and rest of the lower body are dark brown. The bill and feet are dark brown (Baker 1951; Goodwin 1970).

The adult female is smaller and cinnamon brown, the head and neck with a greenish-brown gloss. The tail is rufous-brown with a broad black subterminal band. Baker (1951) described a male-like female plumage that may include white markings on the head and neck.

The immature male resembles the adult male, but the white head and neck are heavily washed with brown. These birds are easily identified in the field. Im-

FIG. 5. Male White-throated Ground Dove (*Gallicolumba xanthonura*) showing the contrast of the white head and neck with the dark brown body. Photo from DAWR files.

mature females resemble adult females but lack the greenish gloss of the adult. I was unable to reliably identify immature females in the field.

Distribution.—*Gallicolumba xanthonura* is known from the Mariana Islands of Asuncion, Pagan, Alamagan, Saipan, Tinian, Rota, and Guam, and from Yap in the Caroline Islands.

In 1979, I made counts of this species on Saipan, Tinian, and Rota (Jenkins and Aguon 1981). The species was rare on Saipan and Tinian, but less so on Rota. Population levels on Asuncion, Pagan, Alamagan, and Yap are unknown.

Habitat.—*Gallicolumba xanthonura* formerly occurred in all forested habitats on Guam. At present, the species is about equally abundant in the second growth, mixed woodland, and mature forest communities of the northernmost, less disturbed portions of the island. Stophlet (1946) observed the species throughout the open habitats of south-central Guam, and Marshall (1949) occasionally observed ground doves perched, but not feeding, in wetland habitats. Field notes of DAWR from the early 1960's indicate that this species was commonly sighted in the southern ravine forests also, although it now is extirpated from this habitat (Drahos 1977a, 1977b). I did not see the species in savanna or wetland, nor did I find it in the coastal strand habitats that often border the forested communities where ground doves occur.

Behavior.—These doves frequently make long, solitary flights above the forest canopy. They appear to labor with deep constant wingbeats as they slowly cover great distances. Kibler (1950) suggested that these long flights may indicate widely separated feeding grounds.

Males are more commonly sighted than females. Baker (1951) reported that 80 percent of the birds he observed were males; I observed 33 males and 17 females during my study. These data probably indicate behavioral differences between males and females rather than a skewed sex ratio. Presumably, the females are

more secretive than the males. On Yap, Pratt et al. (1977) observed more females than males of the species.

Despite its common name, I seldom observed this species on the ground, but usually saw it in trees or shrubs. Marshall (1949) reported that *G. canifrons* from the Palau Islands is mainly terrestrial, and Mayr (1945) stated that terrestrial habits are common for *Gallicolumba* species. Holyoak (1979) noted that in Fiji *G. stairii* often ran rather than flew when disturbed.

During courtship and mating (two observations), the male dove follows the female in short flights between different perches; mating occurs high in the larger trees. The female alights in a tree, sometimes moving away as the male approaches, but other times remaining stationary while he paces around her, preening her head and neck. The male mounts three or four times, presumably achieving cloacal contact and mating. Mountings last 20 to 30 sec, and, as copulation occurs, the male grabs nearby small twigs and branches in a ritualized fashion. While the male is mounted, the female utters a short, raspy, soft call, quite unlike the usual moaning call of the species. The pair then separates and repeats the entire sequence, either in another area of the same tree, or in a nearby tree. The whole procedure lasts 4 to 5 min, after which the birds perch quietly in different parts of the same tree.

Territorial interactions between adult males are common throughout the year. These interactions typically involve repeated feet-first attacks directed by the aggressor at the head and neck of his rival. Birds often become entangled and tumble down through the dense vegetation before separating and alighting on exposed perches. Both males then begin a prancing display, slowly flapping their wings and exposing the pure white of the neck and breast in the direction of the

TABLE 2

FOOD OF THE WHITE-THROATED GROUND DOVE (*GALLICOLUMBA XANTHONURA*)[a]

Plant species	Leaves	Seeds	Flowers	Fruits
Aglaia mariannensis				x
Atrocarpus sp.				x
Bidens pilosa				x
Callicarpa sp.				x
Carica papaya				x
Cestrum diurnam	x			x
Ficus sp.				x
Flagellaria indica				x
Glochidion marianum		x		x
Guettarda speciosa				x
Hibiscus tiliaceus		x		x
Melanoplepis multiglandulosa		x	x	x
Messerchmidia argentea		x	x	x
Momordica charantia		x		
Muntingia calabura		x		x
Pandanus sp.	x			
Passiflora foetida		x		
Pithecellobium dulce				x
Premna obtusifolia			x	x
Scaevola taccada		x		x
Triphasia trifolia				x
Triumfetta procumbens				x

[a] Data based on single observations.

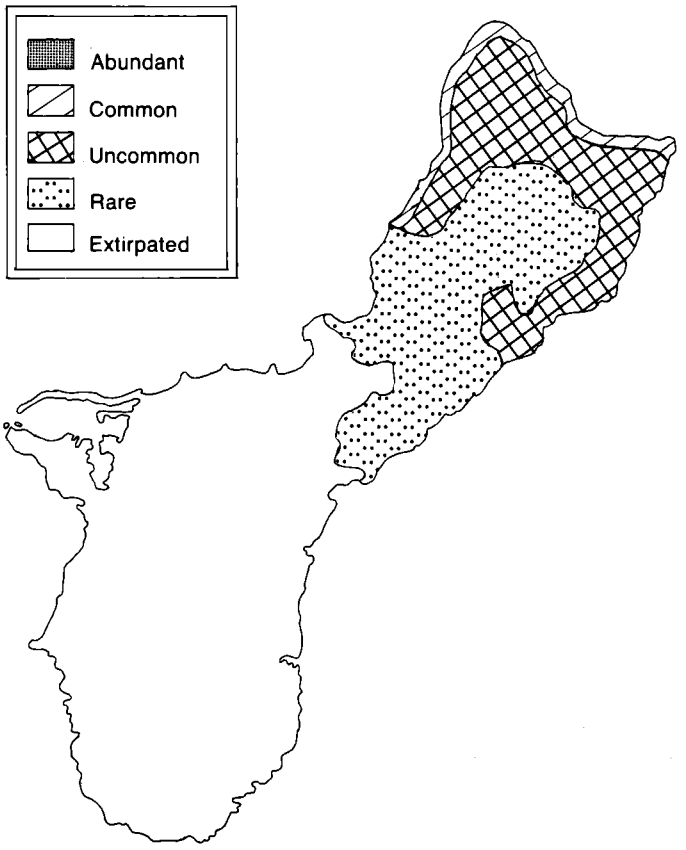


FIG. 6. Distribution and abundance of the White-throated Ground Dove (*Gallicolumba xanthonura*) on Guam, 1978–1979.

other male. Another attack is then initiated. A female may perch quietly in the general vicinity during these interactions.

Food habits.—White-throated Ground Doves most frequently eat small fruits and berries but will also take seeds and flowers when available (Table 2). They feed primarily in trees or shrubs. Stophlet (1946) believed he may have observed *G. xanthonura* gleaning insects from the foliage of *Artocarpus* sp., but I never observed them feeding on animal matter.

Nesting.—Little is known of the nesting habits of *G. xanthonura.* No nests were located during 1978–1979, which reflects the rarity of this species on Guam. Older DAWR field notes and Baker's (1951) observations indicate that nests may be built in *Ficus prolixa, Artocarpus* sp., *Pandanus dubius, Bambusa* sp., *Leucaena leucocephala,* and *Hibiscus tiliaceus.* Baker (1951) reported nests built high in large trees. Of two nests recorded in DAWR field notes, one was built 4 m up in a *L. leucocephala,* and one 1.5 m up in a *H. tiliaceus* (DAWR 1964). G. S. A. Perez (pers. comm.) reported a clutch of two eggs in a nest attended only by the female, although the male remained nearby. Baker (1951) reported that both sexes participate in nest construction and incubation.

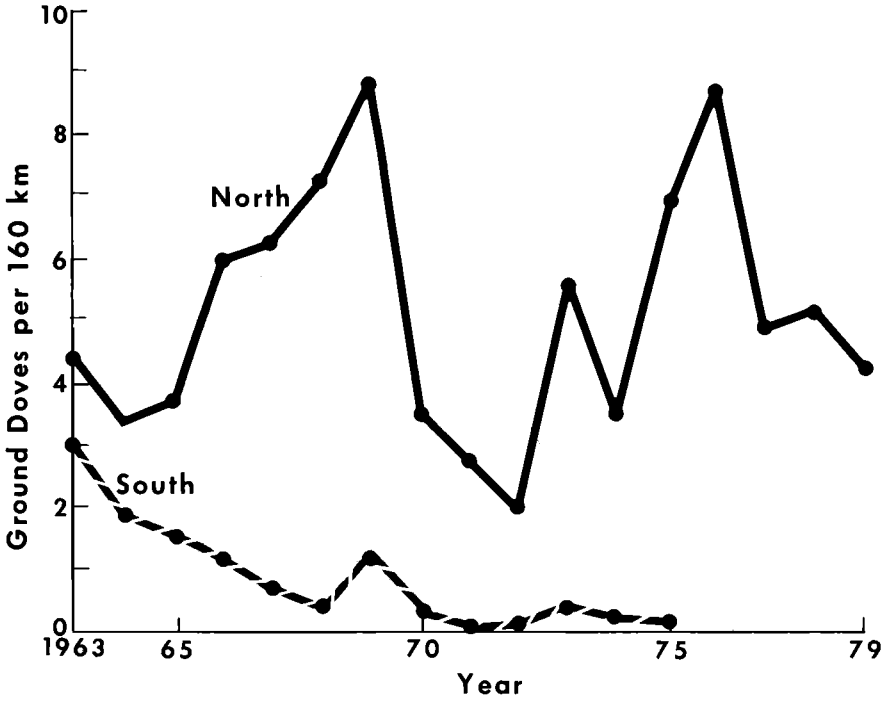


FIG. 7. Mean number of White-throated Ground Doves (*Gallicolumba xanthonura*) observed per 160 km of travel during roadside counts on the North (1963–1979) and South (1963–1975) Routes.

Previously, ground dove nests have been reported only from the first half of the year (Baker 1951). Marshall (1949) hypothesized on the basis of scattered physiological data, however, that *G. xanthonura* breeds year-round. My field data support Marshall's (1949) assumption. I observed, (1) an adult carrying nesting material in late May, (2) courtship and mating in September and mid-November, (3) recently fledged males in immature plumage in September and November, (4) territorial interactions between adult males year-round, and (5) paired birds in all months of the year. A DAWR staff biologist recorded an active nest in August, 1964.

Status on Guam.—Ground doves were formerly distributed throughout the island (Stophlet 1946). *Gallicolumba xanthonura* apparently has now disappeared from the southern half of Guam where it was still found in the early 1960's (DAWR 1964). This species probably was never abundant. Bryan (1936) referred to it as less common than the other native dove, *Ptilinopus roseicapilla*; Stophlet (1946) referred to it as uncommon. Some years earlier, however, Seale (1901) described the species as common throughout the island.

Currently, *G. xanthonura* is confined primarily to the northern cliffline of Guam from Amantes Point through Pati Point (including the Northwest Field area of Andersen Air Force Base), and along the northeastern cliffline, from Pati Point to Mangilao (Fig. 6). Occasionally, solitary birds are seen in flight over the central area of the northern plateau. Sightings along the North census route have remained fairly constant during the past two decades (Figs. 7, 8). Many of these birds probably nest in the northern cliffline habitats and range onto the plateau. *Gal-*

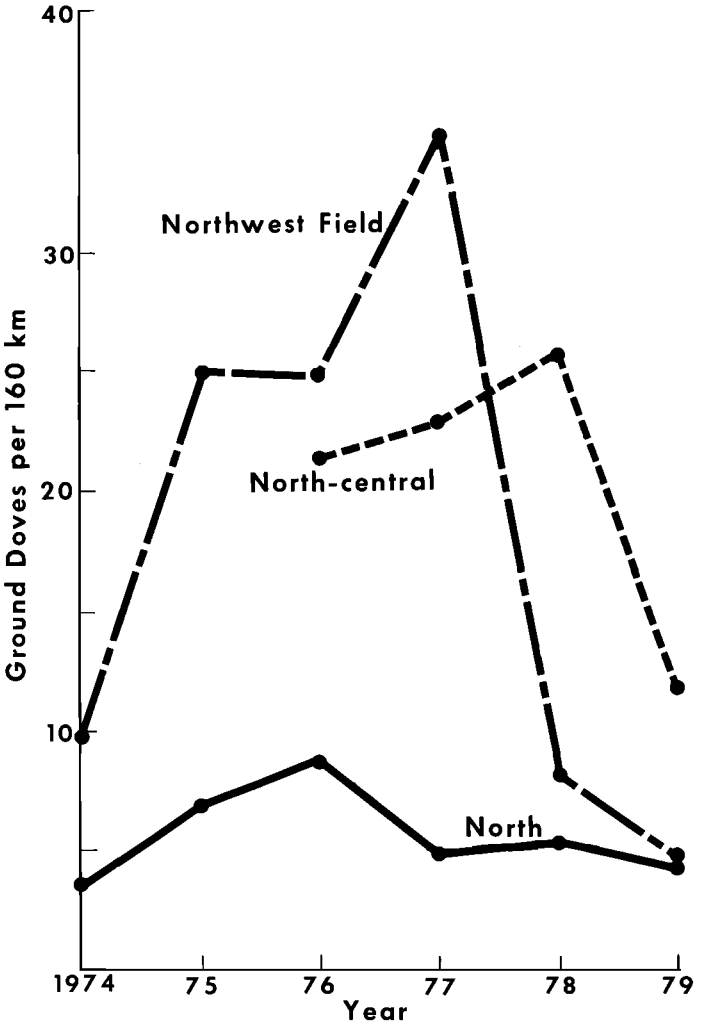


FIG. 8. Mean number of White-throated Ground Doves (*Gallicolumba xanthonura*) observed per 160 km of travel during roadside counts on North and Northwest Field Routes (1974–1979) and on the North-central Route (1974–1979).

licolumba xanthonura is one of the few remaining native birds that can still be found over the central portions of the northern plateau.

MARIANA FRUIT DOVE (*PTILINOPUS ROSEICAPILLA*)

Description.—Ptilinopus roseicapilla is a small bright green dove with a purple crown and forehead (Plate II). The chin and throat are pale yellow to white. The breast is green, with a dark purple patch posteriorly. The abdomen is orange to yellow-green. The undersides of the wing and tail are gray, along with a terminal band on the upper tail; the rest of the upper tail is green. The bill is green, and the legs and feet are dark maroon (Baker 1951; Goodwin 1970).

Adult females resemble males but are slightly smaller with a greener neck. I

TABLE 3

FOOD OF THE MARIANA FRUIT DOVE (*PTILINOPUS ROSEICAPILLA*)[a]

Plant species	Leaves	Seeds	Flowers	Fruits
Cestrum diurnam	x			x
Ficus sp.				x
Glochidion marianum		x		x
Guettarda speciosa				x
Hibiscus tiliaceus				x
Melanolepis multiglandulosa				x
Momordica charantia		x		x
Muntingia calabura		x		x
Passiflora faetida		x	x	x
Pithecellobium dulce				x
Premna obtusifolia		x		x
Scaevola taccada		x		x
Triphasia trifolia				x

[a] Data based on single observations.

was unable to distinguish the sexes in the field. Immature birds are easily recognized, however, as they lack the conspicuous purple crown-patch.

Distribution.—*Ptilinopus roseicapilla* is endemic to the Mariana Islands of Guam, Saipan, Tinian, Aguijan, and Rota. I conducted counts of *P. roseicapilla* on Saipan, Tinian, and Rota, in 1979 (Jenkins and Aguon 1981). These doves, although surely reduced from historic levels (Marshall 1949), were more common on Saipan and Tinian than on Guam. The species also was more widespread on these islands. On Rota, *P. roseicapilla* appeared common, and populations probably approach historic levels (Marshall 1949).

Habitat.—Currently, *P. roseicapilla* is primarily a bird of mature forest, although it is still found in some moderately disturbed mixed woodland and second growth habitats, particularly in the Northwest Field area of Andersen Air Force Base. Baker (1951) found fruit doves most common in second growth and scrub forest habitats, but also fairly common in undisturbed forest. Before its disappearance from southern Guam in the late 1960's (Drahos 1977a, 1977b), *P. roseicapilla* was recorded in ravine and coastal forest, with nine records of nesting in a mangrove swamp (DAWR 1964–1967). *Ptilinopus roseicapilla* is seldom found in coastal strand dominated by introduced coconut palms, or in savanna.

Behavior.—Mariana Fruit Doves are secretive, usually solitary, and difficult to see because their bright green plumage blends with the dense foliage (Plate II). Often, the only evidence of a dove's presence is its loud, far-carrying, and ventriloquial song (Seale 1901; Bryan 1936; Marshall 1949). Pratt et al. (1980) provided a sonagram for the species. Frequently, songs are "answered" by other fruit doves, the initial song evoking a chorus of vocalizations by many individuals. *Ptilinopus roseicapilla* flies only occasionally, but always in a swift and direct manner, usually covering short distances of 20 to 30 m at treetop level.

Food habits.—Food items previously reported for *P. roseicapilla* include the fruits of *Triphasia trifolia* (Seale 1901), unidentified berries, figs, and flowers (Marshall 1949), and the fruits of *Cestrum diurnam* and *Carica papaya* (Baker 1951). The known foods of *P. roseicapilla* determined by observations during this study and from DAWR records are given in Table 3. I frequently observed fruit

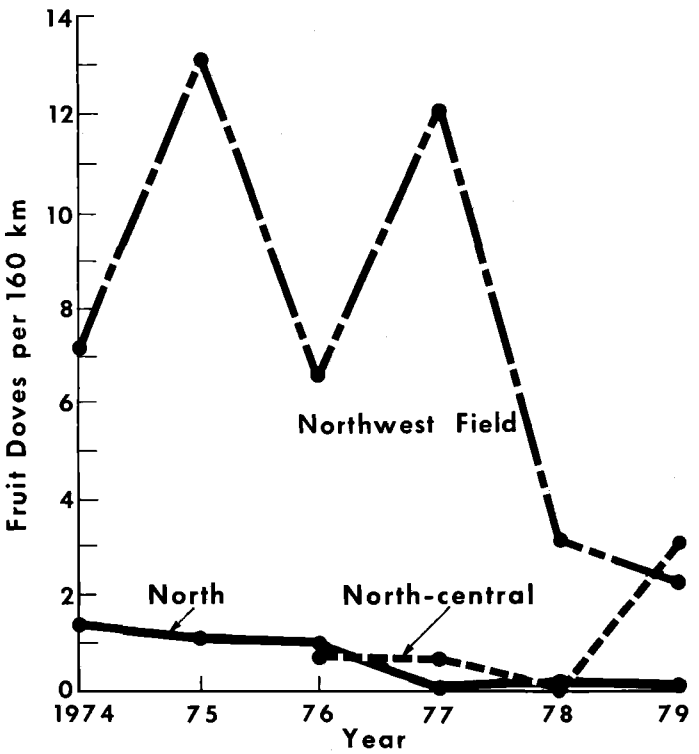


FIG. 9. Mean number of Mariana Fruit Doves (*Ptilinopus roseicapilla*) observed per 160 km of travel during roadside counts on North and Northwest Field Routes (1974–1979) and on the North-central Route (1976–1979).

doves perched in large *Ficus* or *Guettarda* trees near Ritidian Point, and Frith et al. (1976) reported that figs (*Ficus*) were the most important food for several species of *Ptilinopus* in New Guinea. Holyoak and Thibault (1978) stated that many *Ptilinopus* species in eastern Polynesia feed on insects. No data are available to indicate if *P. roseicapilla* feeds on any animal food. *Ptilinopus roseicapilla* often perched, but never foraged, in introduced *Casuarina* trees. In contrast, I observed a White-throated Ground Dove in a *Casuarina* only once.

Nesting.—Unlike *G. xanthonura, P. roseicapilla* builds its nests in the forks of tree branches near the ground. Combining the reports of Seale (1901) and Hartert (1898) with data from DAWR records, 15 *P. roseicapilla* nests averaged 2.8 m (range = 1.0–7.0) above the ground. The nest is a flat, crude structure measuring about 13 cm in outer diameter by 1.5 cm deep; it is made of 40 to 50 small twigs, 1 to 2 mm in diameter. Nests have been recorded in *Pithecellobium dulce* (Hartert 1898), *Triphasia trifolia* (Seale 1901), *Avicennia alba,* and *Casuarina equisetifolia* (DAWR 1964–1967) trees. The clutch of one ivory white egg rests precariously upon this structure. One egg measured 31.0 by 22.4 mm.

The roles of the sexes in nest-related activities are unknown. Once, during a 10-day period, a single bird was seen on an active nest containing one egg, and no other fruit dove was observed in the area. This suggests that only one member of a pair incubates, broods, and cares for the young.

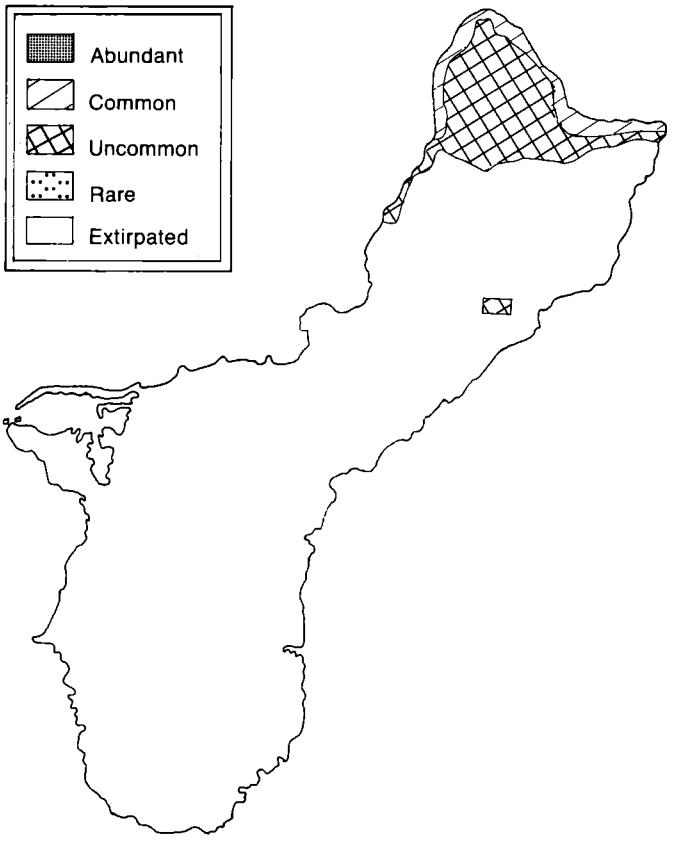


FIG. 10. Distribution and abundance of the Mariana Fruit Dove (*Ptilinopus roseicapilla*) on Guam, 1978–1979.

Ptilinopus roseicapilla previously has been reported to breed only from March through July (Seale 1901; Baker 1951). DAWR field notes and my observations indicate nesting in all months except December and February, and *P. roseicapilla* probably breeds year-round. The lack of nesting records for December and February are likely the result of insufficient fieldwork during these months. *Ptilinopus roseicapilla* is probably a year-round breeder. Other species of this genus breed year-round in New Guinea, with peaks in breeding activities timed to coincide with seasonal rainfall and the resultant seasonal abundance of fruits (Frith et al. 1974). Seasonal peaks are also possible for breeding activities of *P. roseicapilla* on Guam, with its wet and dry seasons, but data necessary to elucidate such a relationship are lacking.

Status on Guam.—Various early workers have referred to the former abundance of fruit doves in the forested areas of Guam (Bryan 1936; Stophlet 1946). Baker (1947) suggested that this species may have been one of those most disturbed by military operations during World War II, yet Beaty (1967) later described the species as secretive rather than rare. Even during the mid-1960's, DAWR staff notes indicate that this species occurred regularly and nested in southern Guam. Apparently, *Ptilinopus roseicapilla* has now disappeared from this area and from

most of the northern plateau (Fig. 9), and is confined to the Northwest Field area and the northern cliffline (Fig. 10). As previously mentioned, *P. roseicapilla* is less widely distributed than *G. xanthonura* (Figs. 6, 10), but it may actually be more common in some areas where both are found (Appendix II). The fact that the species has disappeared from about 90 percent of its former range (Fig. 10), does not augur well for its continued existence on Guam.

Gray Swiftlet (*Aerodramus vanikorensis bartschi*)

Description.—This small (Table 1) swiftlet has sooty black upperparts except for a slightly paler rump. The underparts are dark gray. Some white appears at the base of the feathers in the loreal region. The tarsi are naked, and the irides are dark hazel. When viewed in the field, these birds appear uniformly dark except for an occasional flash of the lighter rump patch.

Distribution.—The subspecies *A. v. bartschi* is endemic to Guam, Tinian, Saipan, and Rota. Similar conspecific and congeneric forms occur throughout Micronesia, Southeast Asia, India, and the South Pacific.

I made counts of this subspecies on several islands in 1979 (Jenkins and Aguon 1981). No swiftlets were found on Tinian or Rota, but small numbers were recorded on Saipan. In light of the rarity of this subspecies on Guam, *A. v. bartschi* must be considered as critically endangered throughout its range.

Habitat.—Several observers have referred to the preference of *A. v. bartschi* for open habitat, particularly grassy hills and valleys (Seale 1901; Bryan 1936; Stophlet 1946). Marshall (1949) recorded large flocks foraging over ridges and steep canyons in areas sparsely covered with vegetation. The birds forage less commonly over mature forest. Historically, caves used for nesting and roosting were located in mature forest, notably along the northern cliffline of Guam and in the hills and mountains of the southwest coast. Openings to the caves were often in the densest portions of the mature limestone and ravine forests, in contrast to the open mixed woodland, scrub, and savanna habitats preferred for foraging. Baker (1951) reported seeing the species in coastal habitats dominated by coconut palms and noted that the largest concentrations were found near cliffs, which undoubtedly contained roosting and nesting caves.

Behavior.—*Aerodramus v. bartschi* is diurnal and crepuscular and is seen away from its caves only when foraging. Occasionally, pairs are observed, but, generally, birds occur in flocks ranging from a few to several hundred individuals. These flocks are most frequently seen in the early morning or late evening, with birds foraging in open areas usually within 1 or 2 km of their roosting caves.

Aerodramus v. bartschi produces several sounds, including a staccato clicking noise audible to the human ear for a distance of 2 to 3 m. These clicks are used for echolocation as the birds enter the usually small openings to their nesting and roosting caves in the evening (Drahos 1977c). A slower clicking call also audible for short distances is sometimes given by foraging or flying birds. Adults produce a harsh alarm or aggressive call in response to human intruders in nesting caves, and nestlings 1 to 2 weeks old make a faint "cheeping" call (Drahos 1977c).

Food habits.—*Aerodramus v. bartschi* presumably feeds entirely on insects captured in flight; however, studies of food habits of this species are lacking. Harrisson (1972) described the difficulty of studying swiftlet food habits but found that flying

ants (Hymenoptera) and termites (Isoptera) were preferred foods for *Aerodramus* spp. in Borneo.

Gray Swiftlets usually fly within a few meters of the vegetation while feeding. Large numbers of swiftlets may be attracted to an area by swarming prey populations. The birds fly erratically in random circular patterns as they forage. Individuals appear to flap their wings vigorously when a prey item is spotted, then use a stiff-winged gliding motion at the last moment before capture, when superior agility is crucial.

Nesting.—*Aerodramus v. bartschi* nests only in caves, eschewing the dead tree hollows or cliffsides used by some congeneric species. The number of nests in a colony varies from 25 to more than 200, although not all nests are active at any one time (Delacour 1947, in Bowles 1962). Nests are usually built in small dark pockets away from the cave opening and as high above the cave floor as possible. Cave ceilings appear to be the preferred sites.

The nest is composed of moss tightly held together and firmly secured to cave walls with copious amounts of hardened, mucus-like saliva. All 350 nests examined by DAWR staff were composed of *Neckeropsis lepiniana* (Drahos 1977c), a moss that is abundant in the forests near the nesting caves. The nests are often cone-shaped, but may vary considerably to conform to the cave walls to which they are attached. Height of the nest appears to vary the most, from less than 50 mm to more than 100 mm. Breadth of the cup is more consistent. Two nest tops varied from 50 to 60 mm in width perpendicular to the cave wall, and 65 to 70 mm in length parallel to the cave wall (Drahos 1977c). Depth of the shallow cup-like nest is about 10 mm.

At three colonies observed by DAWR staff (Drahos 1977c), 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.

Status on Guam.—Many authors have referred to the past abundance of *A. v. bartschi* on Guam (Seale 1901; Safford 1902; 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 1977c).

Today, *A. v. bartschi* is one of the rarest and most critically endangered of the native birds of Guam. The species never has been recorded on roadside or cliffline station counts (Appendix II). It can be found regularly only around the U.S. Naval Magazine along firebreak 4, the Fena Lake spillway, and occasionally along Cross-island Road, Route 17 (Fig. 11). Nowhere is the species common. The largest

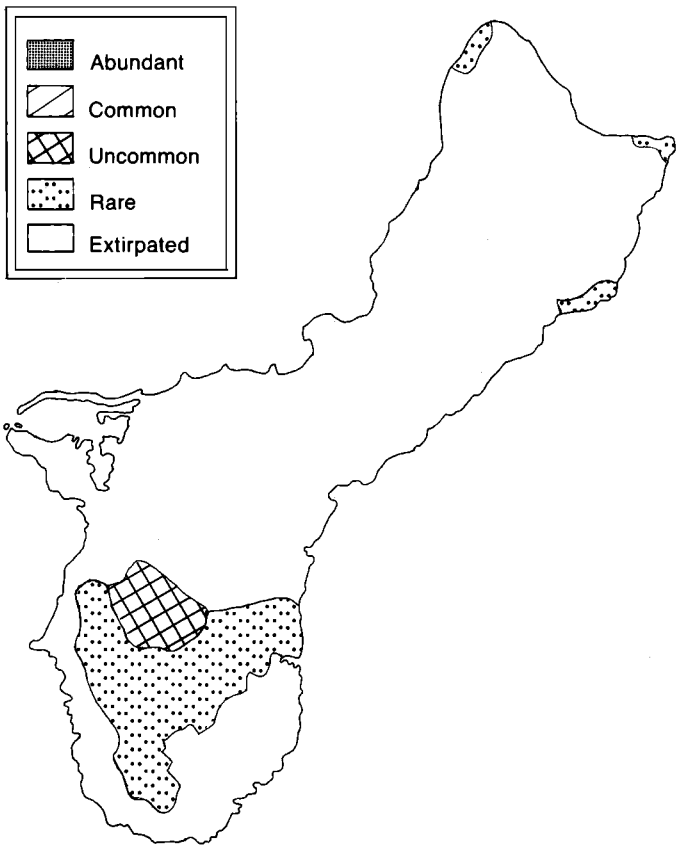


FIG. 11. Distribution and abundance of the Gray Swiftlet (*Aerodramus vanikorensis bartschi*) on Guam, 1978–1979.

group observed during two years of field work was seen near the Fena Lake spillway in June, 1978 and included about 17 individuals. On other visits to this area in May, July, and August, 1978, I observed five, eight, and one bird, respectively. Small groups of *A. v. bartschi* continue to be sighted occasionally along the southwest mountain range and in the interior of southern Guam. The formerly large northern cliffline population is now exceedingly small. The large colony at Amantes Point has disappeared completely, and only one bird was sighted in July, 1978 at Janum Point, where a small nesting colony was present in the early 1970's. In June, 1979 I visited a large nesting cave near Pati Point Beach that contained from 200 to 250 old nests of *A. v. bartschi.* I found neither birds nor active nests. In October, 1979 I observed four or five birds flying near Pati Point and in the same month, after a tropical storm, a group of 14 birds foraging over the mature limestone forest at Ritidian Point. This was the largest group of *A. v. bartschi* sighted in northern Guam in more than 10 years. It suggests that at least one small nesting colony persists somewhere around the northern cliffline, although the possibility that these were storm-displaced birds from more northerly islands cannot be discounted.

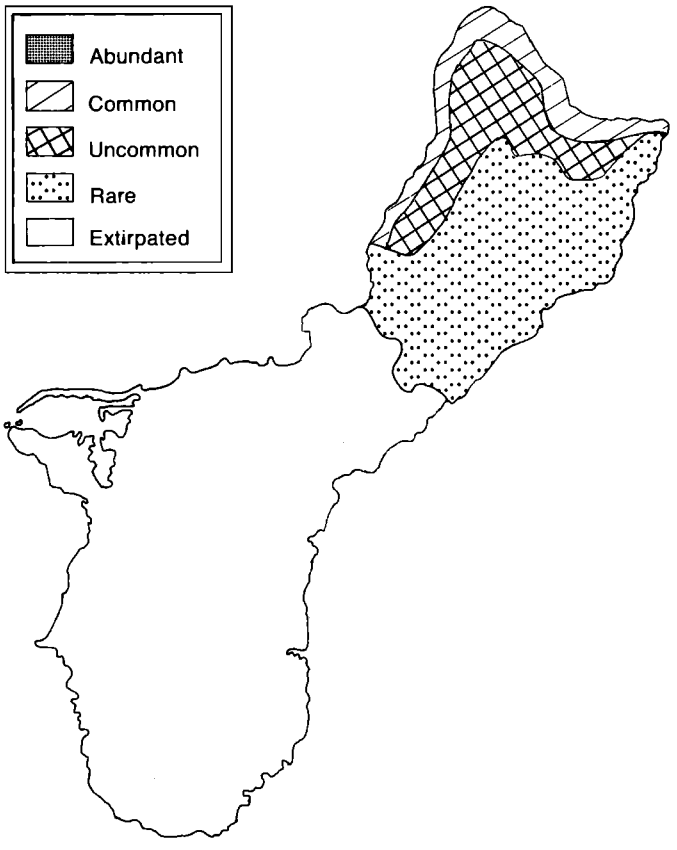


FIG. 12. Distribution and abundance of the Micronesian Kingfisher (*Halcyon cinnamomina cinnamomina*) on Guam, 1978–1979.

MICRONESIAN KINGFISHER (*HALCYON CINNAMOMINA CINNAMOMINA*)

Description.—*Halcyon c. cinnamomina* is sexually dimorphic, the male possessing a cinnamon-brown head, neck, upper back, and underparts (Plate IV). A narrow black line extends around the nape; the orbital ring is black. The lower back, lesser wing coverts, and scapulars are deep greenish-blue. The tail is blue. The feet and irides are dark brown, and the bill is black except for some white at the base of the lower mandible (Baker 1951). The weight of five adult males collected by DAWR staff averaged 58.7 g (range = 50.5–63.8).

The adult female resembles the male except that the upper breast is paler, as are the chin and the throat, with the rest of the underparts and underwing coverts white (Plate IV). Immature birds have the crown washed in greenish-blue, and a whitish chin and throat. Underparts are buffy-white in the immature male, but may be paler in the female.

In adults, the sexes are easily distinguished in the field. It also is possible to identify immature birds in the field, by the greenish-blue sheen of the crown; they cannot be reliably sexed, however.

Distribution.—The subspecies *H. c. cinnamomina* is endemic to Guam. Sup-

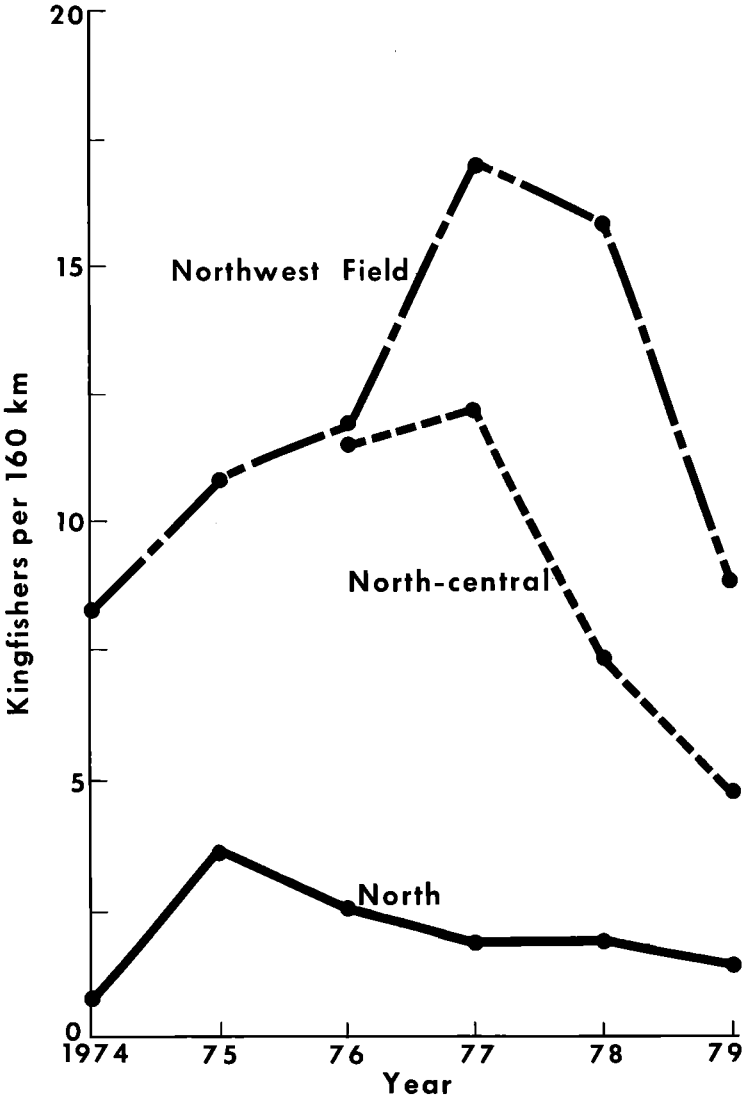


FIG. 13. Mean number of Micronesian Kingfishers (*Halcyon cinnamomina cinnamomina*) observed per 160 km of travel during roadside counts on North and Northwest Field Routes (1974–1979) and on the North-central Route (1976–1979).

posedly conspecific forms occur on Palau and Ponape (Baker 1951). A congener, *H. chloris,* occurs on the Mariana Islands north of Guam.

Habitat.—Halcyon c. cinnamomina nests and feeds primarily in mature limestone forest, mixed woodland, and second growth stands, and, to a lesser extent, in the scrub forests of the northern plateau. It is, perhaps, most common along the edges of the mature limestone forest in the transition to the mixed woodland communities of the plateau. Also, the species is frequently observed in the coastal strand that is dominated by introduced coconut palms. Historically, *H. c. cinnamomina* was common in the ravine and coastal forests of southern Guam, as

well as in riparian communities along southern rivers and streams. It does not occur in wetland or savanna habitats. The kingfisher is one of the few native birds that perches on telephone or power lines adjacent to forested habitats.

Behavior.—*Halcyon c. cinnamomina* is an extremely vocal bird, and its loud resonating calls can be heard for several hundred meters. The longest and most pronounced vocalization is given by birds in flight, beginning as they take wing. A shorter variation of this loud rattle-like call, but one similar in quality, is produced when birds dive from their foraging perches to capture food on or near the ground, when paired birds excavate nests, and when birds aggressively drive other species from their territories. A soft scratchy or raspy call is uttered between paired birds close to one another. On one occasion I heard it given aggressively by two females. Nestlings of this species produce a rattle-like call, similar in quality to an adult call, apparently to beg for food.

Halcyon c. cinnamomina is an aggressive bird. Seale (1901) mentioned its reputation as a chicken thief; Marshall (1949) observed it harassing flocks of Bridled White-eyes (*Zosterops conspicillata conspicillata*), and Kibler (1950) described adults driving bands of Micronesian Starlings (*Aplonis opaca guami*) away from a fledgling. I observed intraspecific aggressive interactions as well. These typically involved males perched within 4 m of one another. One bird always had its head pointed upward, wings held back and away from the body, and tail pointed straight down. I interpreted this as a threat posture. The two males perched motionless for many minutes, with only one bird holding the threat posture continuously. The other male perched in a more typical posture (Plate IV). Finally, one of the males initiated an attack, at which time each bird called and thrust its large bill at its opponent. One time, two males locked their beaks together and flapped their wings as they tumbled to the ground from a height of about 10 m.

Mated pairs of *H. c. cinnamomina* drill nesting cavities in various trees, primarily from January through July. Excavations also are attempted on telephone poles or other wooden structures. Some cavities are never used as nesting sites, suggesting that excavation may also be important in courtship, pair formation, or pair maintenance. In excavating the nesting cavity, the sexes alternate thrusts of the beak at the chosen site in flights initiated from a nearby perch. Not having the foot structure necessary for perching on the vertical trunk, a bird flaps its wings vigorously (and awkwardly) as it attempts to deliver more than one blow per flight. Usually, the bird is restricted to only one or two blows and returns to the perch after each attempt. A call is given upon leaving the perch with each new attempt.

Food habits.—The species feeds entirely on animal food, which it captures primarily on the ground. Marshall (1949) reported insects and a large annelid as food of *H. c. cinnamomina*; Stophlet (1946) recorded grasshoppers as food; Seale (1901) reported lizards and grasshoppers; Baker (1951) found insects, skinks, and geckos in the stomachs of three birds he examined. Food items recorded in DAWR staff notes and during my study include small hermit crabs (*Coenobita* sp.) once, skinks twice, one caterpillar (Lepidoptera), one cricket (Orthoptera), one mantid (Orthoptera: Mantidae), and unidentified insects four times.

When foraging, the birds typically perch motionless on exposed branches, primarily in the larger trees that command good views of the ground below (Plate IV). The birds used various species of plants as well as telephone lines during

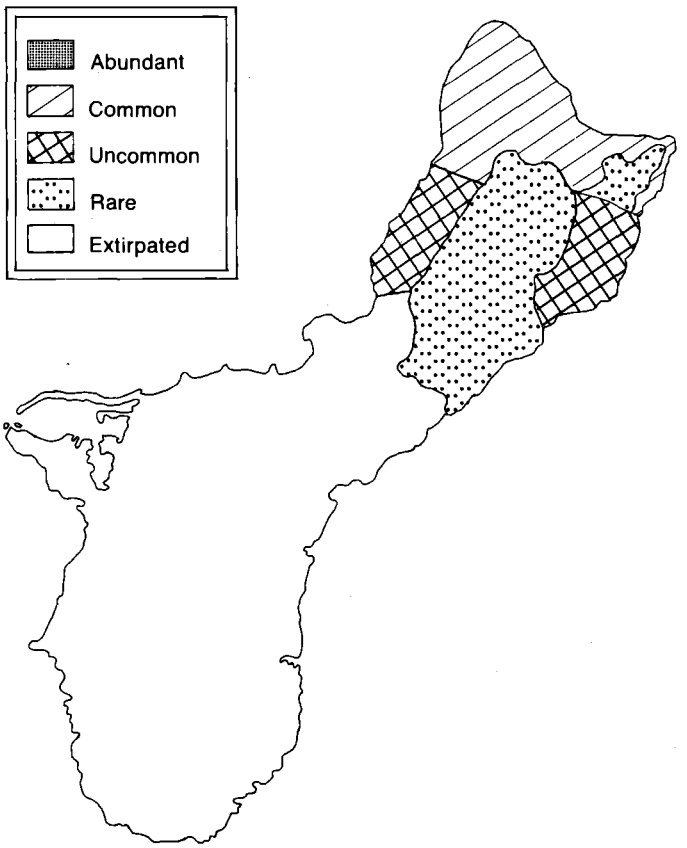


FIG. 14. Distribution and abundance of the Mariana Crow (*Corvus kubaryi*) on Guam, 1978–1979.

1978 and 1979. Foraging perches ranged from 2 to 10 m in height. Upon spotting a prey item, the bird swoops down from its perch to attempt capture, usually, but not necessarily, calling. If successful, the bird returns to the same or another perch where it holds the prey perpendicular to the bill. The bird beats the prey side-to-side on the branch as many as 20 times to stun or kill it before swallowing it whole.

Nesting.—Halcyon c. cinnamomina is a cavity nester. Pairs may excavate their own nests or use other available cavities such as broken, hollow tree limbs. Nests are usually located high in the taller forest trees; Baker (1951) reported one at 8 m in a banyan tree (*Ficus* sp.). DAWR staff found one nest in a hollow coconut palm. I observed an active nest about 17 m up in a broken limb of a dead tree (*Artocarpus* sp.). H. D. Pratt (pers. comm.) observed one 3 m up in the largest tree available in the area. Two clutches reported by Baker (1951), and one reported by DAWR staff contained two eggs, and one brood had two young. Both sexes tend the young. The incubation and nestling periods for this species are unknown.

Nests have been observed in all months except August through November. This noticeable gap in nesting records during the rainy season may indicate that breeding is reduced or nonexistent. My year-round observations of paired birds

and territorial interactions suggest that nesting territories may be held throughout the year.

Status on Guam.—*Halcyon c. cinnamomina* is more widely distributed than many of the other native forest birds. Although it is common along the northwestern and northernmost cliffs, nowhere is it abundant (Fig. 12). The species is uncommon in the plateau habitats of the northwestern portion of the island and becomes rare along the northeastern cliffline (Appendix II) and most of the northern plateau (Figs. 12, 13). The apparently large territories of paired birds preclude great numbers of the species even in the remaining suitable habitat.

Historically, the species was distributed throughout the forested habitats of southern Guam (Stophlet 1946; Kibler 1950; Hartin 1961) although probably never abundant. Baker (1947) recorded the birds on only 11.2% of his roadside counts in 1945. Stophlet (1946) also considered it uncommon. The species was last reported from southern Guam in the mid-1960's (Tubb 1966; DAWR staff notes). It is now extirpated from that area.

MARIANA CROW (*CORVUS KUBARYI*)

Description.—*Corvus kubaryi* is a small black crow with a bluish gloss on the back, wings, and tail (Plate III). Feathers on the neck have white bases and thus a ragged appearance. Bristles extend over the nostrils from the base of the culmen. The irides are dark brown, the bill and feet black. Females are similar to males in plumage but are smaller.

Immature birds lack the glossiness of the adult plumage, but this character is of limited use in the field. I recognized several juvenile crows by their immature squawks and tendency to beg adults for food.

Distribution.—*Corvus kubaryi* is endemic to Guam and Rota of the Mariana Islands, and is the only *Corvus* in Micronesia. *Corvus kubaryi* may be a relict of a species that formerly exhibited a wider distribution in Micronesia (Baker 1951).

I conducted counts on Rota for this species during 1979 (Jenkins and Aguon 1981). It was uncommon there, appearing on only 16% of 19 station counts, despite the birds' high visibility and loud vocalizations. Although observed more often than on Guam, crows on Rota are surely less numerous than formerly and may be declining.

Habitat.—*Corvus kubaryi* was found in most habitats on Guam. Several authors have noted its preference for mature forest (Seale 1901; Stophlet 1946; Marshall 1949), although in this study the bird was observed in about equal numbers in mature forests, second growth, and mixed woodlands of the northwesternmost portion of the island. Crows were also seen frequently in the coastal strand, where they often perched or foraged in coconut palms. Staff notes of DAWR from the early 1960's indicate that this species formerly was common in the ravine and coastal forests, as well as the riparian habitats of southern Guam. Baker (1951) noted the bird in southern coconut plantations. Perhaps the only habitat in which this species was not found historically is the savanna.

Behavior.—Seale (1901) reported that crows damaged newly planted corn crops, but these birds are no longer even a minor agricultural pest. Even historically, their reputation probably was largely undeserved, since they prefer native forests to agricultural areas. *Corvus kubaryi* is one of the least wary of the forest species. It has been known to perch and vocalize within 2 to 3 m of an observer.

TABLE 4

PLANT FOOD OF THE MARIANA CROW (*CORVUS KUBARYI*)[a]

Plant species	Leaves	Seeds	Flowers	Fruits	Bark
Aglea mariannensis					x
Cestrum diurnam				x	
Cocos nucifera	x		x		
Ficus sp.				x	
Hibiscus tiliaceus	x			x	x
Momordica charantia		x			
Neisosperma oppositifolia	x				
Ocrosia sp.	x				x
Pandanus sp.	x				x
Premna obtusifolia				x	

[a] Data based on single observations.

Corvus kubaryi is highly vocal with at least two distinct calls. Its harsh squawks are higher-pitched and more nasal than calls of the American Crow (*Corvus brachyrhynchos*). The loudest squawks are given as the birds hop and make short flights through the forest, and when greeting one another returning from short flights. This loud squawk also is given by birds in flight, when it may serve as a flocking call. A softer, squeakier call is uttered when groups of birds forage on or near the ground.

Corvus kubaryi is gregarious, often forming small groups for foraging. Most frequently, small family groups of two to five individuals are observed; only infrequently are single birds seen. Occasionally, larger flocks are seen in flight; the largest group I observed included 14 birds, the next largest, seven.

These birds frequently allopreen. This behavior is probably most common between mated adults, but once an adult was observed preening its fledgling. Crows perch adjacent to one another, alternately allopreening, primarily on the back of the head and neck. The birds appear to be plucking ectoparasites rather than merely preening the feathers. Staff notes of DAWR from the early 1960's indicate that several specimens of *C. kubaryi* were heavily infested with chicken shaft lice (*Menopon gallinae*) and other unidentified lice, and Wharton (1946 in Baker 1951) obtained a chigger (*Trombicula*) from a crow.

Interspecific interactions of *C. kubaryi* with other forest birds are frequent. The birds have been seen pursuing Mariana Fruit Doves, but Micronesian Starlings and kingfishers are said to harass crows. Crows reportedly steal other birds' eggs (Beaty 1967). The birds also are subjected to repeated attacks in flight by the recently introduced and abundant Black Drongo (*Dicrurus macrocercus*).

Food habits.—*Corvus kubaryi* is omnivorous. Previously reported foods include grasshoppers (Orthoptera) and other insects, lizards, buds, and flowers (Marshall 1949). The stomachs of four birds collected by DAWR staff in the early 1960's contained mole crickets (*Gryllotalpa africana*), praying mantids (Orthoptera), earwigs (Dermaptera), and hermit crabs (*Coenobita* sp.). Three times I observed crows feeding on large caterpillars (Lepidoptera).

Crows also feed frequently on vegetable matter. This consists primarily of fruits, but also includes seeds, flowers, buds, foliage, and bark (Table 4). *Corvus kubaryi* secures fruits and flowers throughout the dense vegetation. The fruits of *Ficus*

PLATE I. Limestone cliff near Ritidian Point, Guam. (A) The mature limestone forest at the base of the cliff is dense and has a low canopy. In the foreground is the introduced weed *Leucaena leucocephala*. (B) View from the edge of the plateau down the cliffline near Uruno Point, Guam. Introduced coconut palms appear at the lower left. Photos by J. M. Jenkins, 1979.

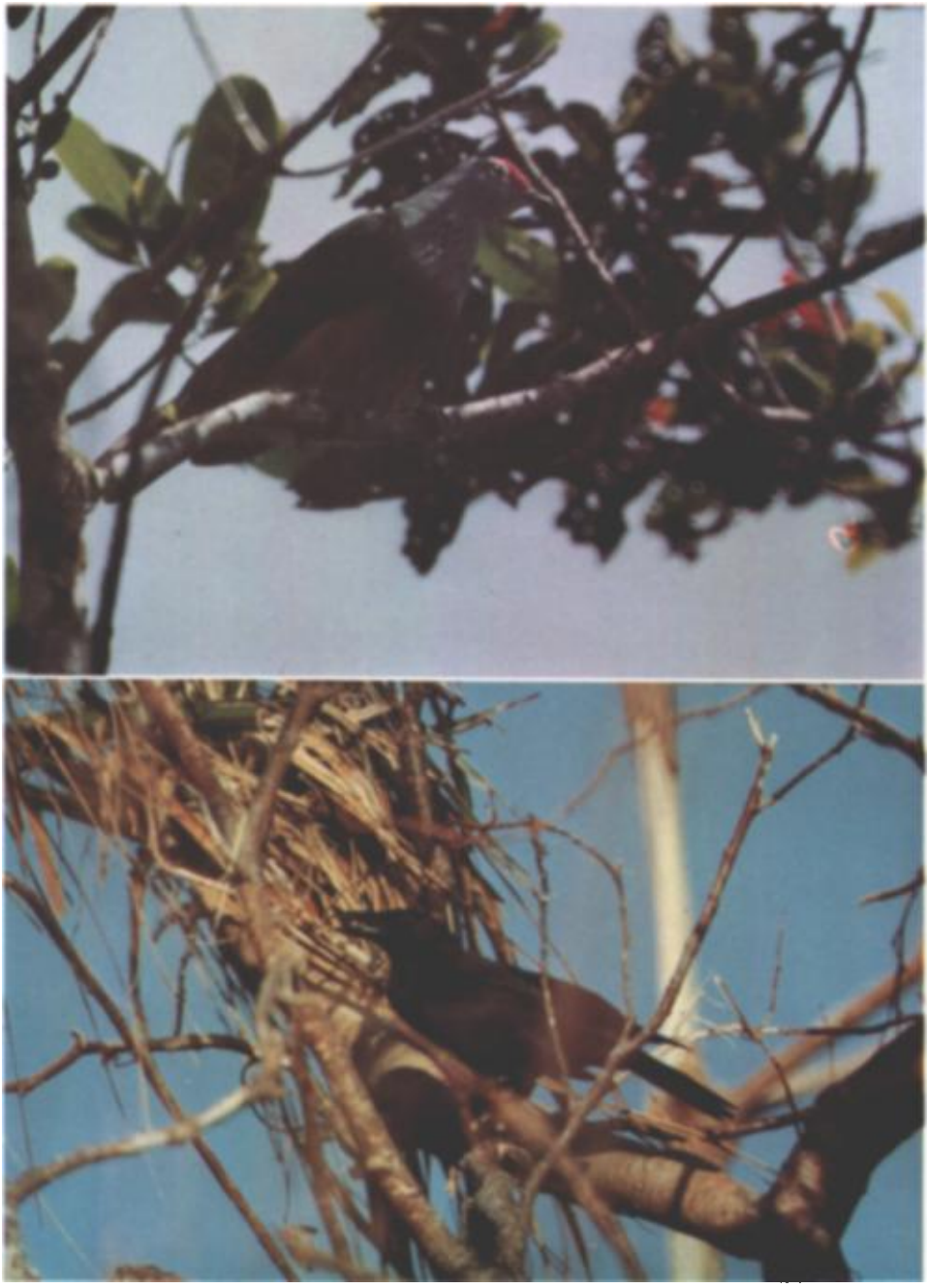


PLATE II. Mariana Fruit Dove (*Ptilinopus roseicapilla*). Photo by H. D. Pratt, 1976, on Rota.

PLATE III. Mariana Crow (*Corvus kubaryi*) perched in a *Pandanus* tree. Photo by H. D. Pratt, 1976, near Andersen South.

PLATE IV. Micronesian Kingfisher (*Halcyon cinnamomina cinnamomina*) showing male (above) and female (below) plumages. Photos by H. D. Pratt, 1976, near Andersen South.

PLATE V. Rufous Fantail (*Rhipidura rufifrons*) from Yap, Caroline Islands. Photo by H. D. Pratt, 1976.

PLATE VI. Nest of the Rufous Fantail (*Rhipidura rufifrons*) from Saipan, Mariana Islands. Photo by H. D. Pratt, 1976.

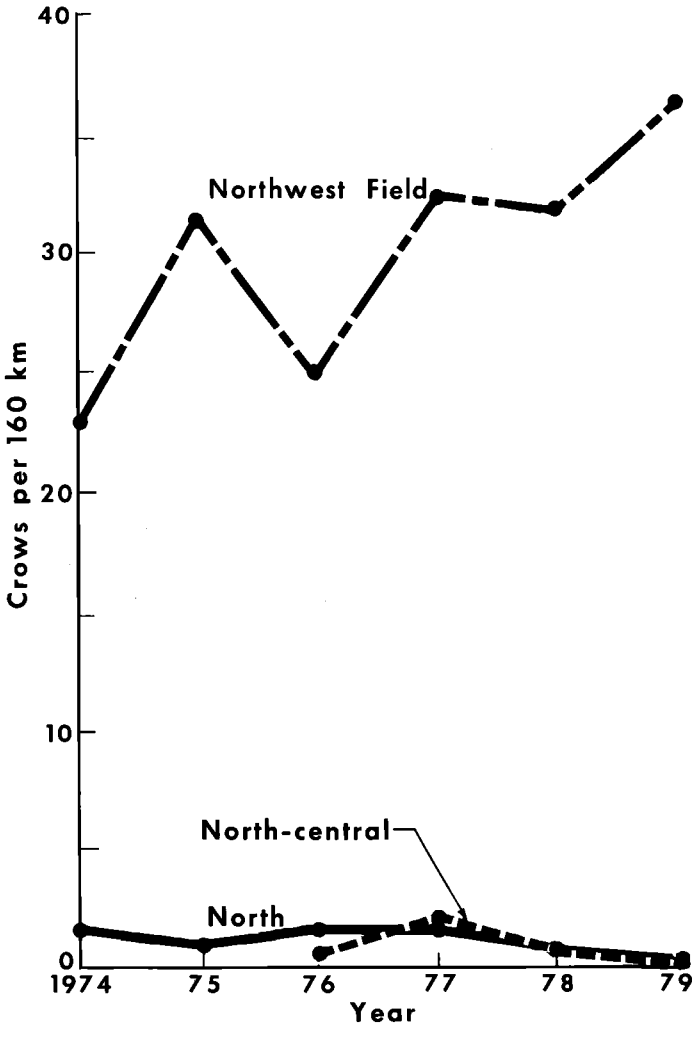


FIG. 15. Mean number of Mariana Crows (*Corvus kubaryi*) observed per 160 km of travel during roadside counts on North and Northwest Field Routes (1974–1979) and on the North-central Route (1976–1979).

sp. are preferred, as are the fruits and flowers of *Hibiscus tiliaceus,* the large fruits of *Neisosperma oppositifolia,* and the small umbeliferous fruits of *Premna obtusifolia.* Foliage is often consumed, with an apparent preference for dead and dying (brown) leaves of *Neisosperma, Pandanus,* and *Hibiscus.* Crows select the leaf and hold it securely with the feet while tearing off and devouring small chunks with the bill. *Corvus kubaryi* is one of the few species of native birds that feed on the abundant *Pandanus.* In addition to eating the fruits and dead leaves of *Pandanus,* the birds often rustle noisily throughout the base of the leaf structure, where they probably secure insects.

Mariana Crows also tear off and eat small chunks of wood and, more frequently, bark from broken branches. Often, a bird delivers woodpecker-like blows to the

branches, apparently to loosen chunks of edible size. Blows are delivered four or five at a time, and the series is repeated three or four times. The bird balances with its feet, pulling back its head and upper body to deliver blows with its large beak. This technique was used by one bird attempting to break through the outer layer of a newly emerging leaf of a coconut palm. The bird pecked persistently for almost 40 minutes.

The crow displays complex foraging behavior. It often feeds on the ground under the thick forest canopy or scrub growth but is not usually seen on the ground in open areas or along roadways. On the ground, the bird rustles vigorously through leaf litter searching for insects.

Apparently, an extensive learning period is necessary for the young. Fledglings closely follow their parents, begging for food with juvenile squawks as they, at times, mimic the foraging patterns of the adults. Adults collect food items which they feed one at a time to their young; adults do not regurgitate from the crop. On one occasion, I saw a caterpillar being fed to a fledgling.

Nesting.—Baker (1951) reported a nest of this species high in a *Ficus* tree in March. DAWR staff recorded an active nest in late November; I observed one inactive nest. Both were built in *Ficus* trees at heights greater than 13 m. The inactive nest was 30 to 35 cm in diameter by 12 to 15 cm deep, and crudely fashioned from large branches 10 to 15 mm in diameter and 20 to 30 cm long, laid in a criss-cross manner. On another occasion, two different adults were seen carrying nesting material, suggesting that both adults share in nest construction. At the active nest, the pair exchanged incubation duties, and two adults accompanied a fledgling. Thus, both adults appear to participate in the incubation of eggs and care of young. Clutch and brood sizes are unknown, but on one occasion, I saw one pair with two fledglings and, on two occasions, I saw a single adult with one fledgling.

Several observations indicate that the Mariana Crow breeds year-round. Baker (1951) recorded nesting in March. DAWR staff members noted fledglings in the company of adults during May, June, September, and October, and took a recently fledged juvenile in September. An adult with enlarged testes was taken by DAWR staff in September, and they found the active nest in November. I observed adults carrying nesting material in November and December. Marshall (1949) suggested that the species does not breed in May, June, or July. My data are insufficient to refute this, but suggest otherwise.

Status on Guam.—Like most of the other native forest birds of Guam, *C. kubaryi* formerly was found throughout the forested habitats of the island (Stophlet 1946; Baker 1951). Baker (1947) recorded the bird on 21.6% of his roadside counts in 1945. Staff notes of DAWR from the early 1960's indicate that *C. kubaryi* was common in southern Guam at that time, but the species is now extirpated from that area (Fig. 14). Its major population center is in the northwest, primarily on Andersen Air Force Base (Fig. 15). Crows are less common along the northeastern coastline (Appendix II), and rare in the central portion of the northern plateau (Figs. 14, 15). The habits of the birds, with their loud squawks and frequent flights, make them somewhat more visible to the casual observer than the other native birds, but the total number of *C. kubaryi* remaining on Guam is probably small. The species is in serious need of protection and management.

GUAM FLYCATCHER (*MYIAGRA FREYCINETI*)

Description.—*Myiagra freycineti* is a small monarchine flycatcher. The head and neck of the adult male are a glossy dark blue; the back and upper wing coverts are a less glossy blue-gray. The chin and throat are white, while the breast is light cinnamon, its intensity varying individually. The abdomen, sides, and undertail coverts are buff. The tail is bluish-gray. *Myiagra freycineti* has black feet and a black bill, and brown irides.

The adult female is more gray than blue and does not show the glossiness of the male. The head and neck are grayer, and the back is browner. The underparts appear paler and lack the cinnamon color of the male plumage. Immature birds resemble adult females.

The sexes of adult *M. freycineti* are easily recognized in the field, although the plumage of both sexes may be quite variable. I was not able to distinguish immature birds from adults in the field.

Distribution.—*Myiagra freycineti* is endemic to Guam. Three congeneric species occur in Micronesia: *M. erythrops* in Palau, *M. oceanica* on Truk, and *M. pluto* on Ponape.

Habitat.—Like the other native monarchine flycatcher of Guam (*Rhipidura rufifrons uraniae*), *M. freycineti* formerly appeared in all habitats with the exception of southern savannas. Safford (1901) recorded it in woodland areas, Baker (1951) in forested areas with brushy undercover, Kibler (1950) in areas dominated by *Leucaena leucocephala,* and Stophlet (1946) in southern riparian habitats. DAWR staff notes recorded this species in coastal strand habitats and in mangrove swamps in addition to forest habitats. Currently, *M. freycineti* is restricted primarily to the mature limestone forest of the relatively undisturbed northern cliffline and becomes rare in the mixed woodland and second growth of the extreme northwestern portion of the plateau. The species' present habitats may not be truly representative of its former habitat preferences.

Behavior.—In contrast to most of the other native forest birds of Guam, *M. freycineti* has swift and direct flight. It uses this, coupled with its aggressiveness, to drive other species and conspecifics from its territory. *Myiagra freycineti* harasses the much larger Yellow Bittern and repeatedly displaces it from low perches. It utters harsh scolding notes and frequently dives at its enemies, its crown feathers erect, when agitated. The flycatcher also drives kingfishers and fantails from their territories. Males engage in these agonistic encounters more frequently than females, but females drive conspecifics, possibly juveniles, from their well-defined territories.

Myiagra freycineti produces at least three distinct vocalizations. The loudest and most frequently heard consists of a series of clear, far-carrying whistles. The series usually includes seven whistles (Marshall 1949), but birds also utter series of three to six notes or, infrequently, use as many as 10 or 11. Often, a singing bird will vary the number of whistles per song within a sequence, alternating a three- to six-note series with 10- or 11-note series. These are often "answered" by another broadbill some distance away.

A harsh scolding note uttered during agonistic encounters was also directed at me when I investigated a nest. Another call, possibly an individual recognition

FIG. 16. Nest and nestling of the Guam Flycatcher (*Myiagra freycineti*) in a *Casuarina* tree in Northwest Field. Photo by J. M. Jenkins, 1979.

device, is produced when members of a pair are close to each other, particularly when they meet after foraging separately. The call is a rapid series of soft scratchy notes.

Food habits.—*Myiagra freycineti* is entirely insectivorous. Baker (1951) listed an unidentified hemipteran and other insects among the food.

Morphologically and behaviorally, *M. freycineti* and *R. rufifrons* appear quite different, which suggests that their foraging niches also differ. The bill of *M. freycineti* is larger than that of *R. r. uraniae*; the exposed culmen of 25 male *M. freycineti* averaged 16.3 mm (range = 15.8–17.0), and 11 male *R. r. uraniae,* 13.6 mm (range = 13.1–14.5; Baker 1951). Guam Flycatchers forage higher in the forest canopy, and fantails hawk insects close to the ground, sometimes alighting on it. Both glean insects from twigs and foliage, *M. freycineti* more frequently than *R. rufifrons.* When hawking insects, *M. freycineti* is rather tyrannid-like, making repeated sallies for prey and returning to the same or sometimes a different perch, where the bird bobs its tail to maintain balance. Rufous Fantails actively and unceasingly move about the forest undergrowth in search of food, and seldom, if ever, return to the same perch.

Nesting.—Nests of *Myiagra freycineti* are firmly constructed, usually in the fork of branches of middle-sized trees or shrubs. The nest is made of thin twigs, roots, pieces of *Hibiscus* leaves, and grasses, woven and held together by spider webs and a mucus-like substance (Fig. 16). One nest measured 53.5 mm in outer diameter, 28.0 mm high, and 14.8 mm deep. Nests are constructed by both sexes and have been found in trees or shrubs of *Bambusa* sp., *Ochrosia oppositifolia, H. tiliaceus, A. alba, L. leucocephala, C. equisetifolia,* and *Oxalis corniculata.* Six nests averaged 2.7 m (range = 1.2–5.2) above the ground. One pair began constructing a new nest in August, 1979, immediately after a storm destroyed its first nest. The birds repeatedly salvaged material from the destroyed nest and used it in the new one located about 10 m from the first. Nest construction required 7 or 8 days. The single egg was laid 2 days after completion of the nest. I observed

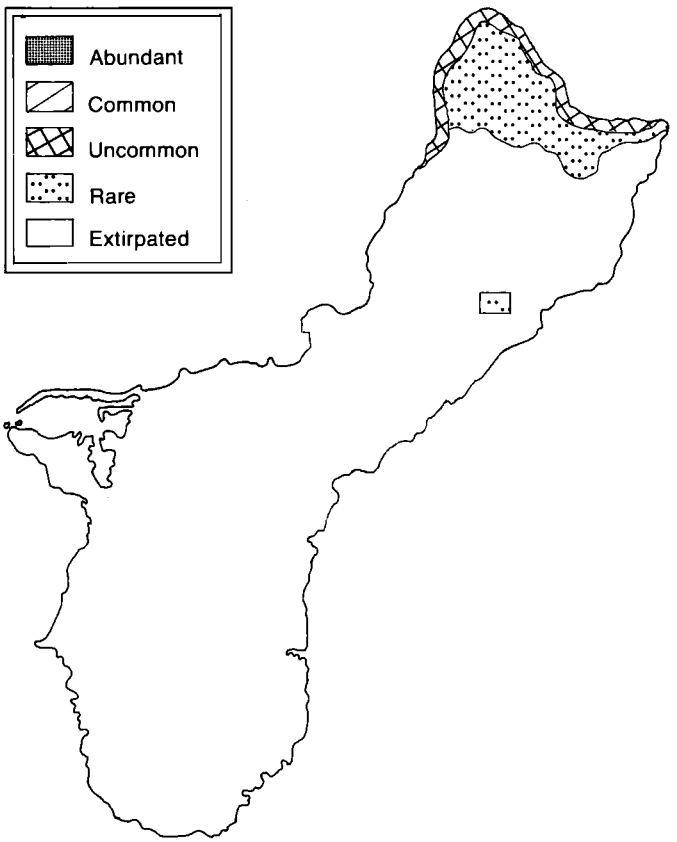


FIG. 17. Distribution and abundance of the Guam Flycatcher (*Myiagra freycineti*) on Guam, 1978–1979.

three clutches, each containing one egg. Hartert (1898) and Baker (1951) found nests with one egg, but Seale (1901) described a nest of *M. freycineti* with two eggs. Two eggs measured during the present study were 19.1 by 15.3 mm and 19.2 by 14.2 mm, and cream-colored with a band of brown splotches around the widest part of the egg. During several hours of observation at one nest, the female performed most of the incubation, but the male also participated. Both sexes brooded and fed the young. The eggshells were consumed by an adult, presumably the female. Two active nests of this species apparently were destroyed by predators, so data on length of incubation or nestling period were not obtained.

Nests of *M. freycineti* have been recorded in all months except November and December. This may result from insufficient fieldwork in these months, and the species may actually breed year-round. Marshall (1949) found some adults not in breeding condition while other individuals were nesting. Data are insufficient to evaluate seasonal peaks or declines in nesting activity.

Status on Guam.—Although formerly distributed throughout the island, *M. freycineti* apparently was never as abundant as *R. rufifrons*. Seale (1901) described *M. freycineti* as common in all parts of Guam, but Baker (1951) found it uncommon and in forested areas only. The birds formerly were found regularly in

southern Guam. Stophlet (1946) observed a pair on the Masso River; Kibler (1950) saw some in the Agat and Apra Harbor areas; and later, Hartin (1961) described them as common in all parts of the island. On 56 monthly counts (1963–1968) at Fena Lake (southern Guam), only two birds were recorded by DAWR staff, indicating that the decline of *M. freycineti* in southern Guam probably had already begun.

Currently, *M. freycineti* has disappeared completely from southern Guam and from most of the northern plateau. It never has been recorded on roadside counts, and its small numbers are becoming increasingly confined to the mature forests of the northern cliffline. It is found only rarely in the most northwestern portion of the plateau (Fig. 17). Rarely, the Guam Flycatcher is still found at Andersen Air Force Base-South (Appendix II). In the northern cliffline habitat, this species is considerably less common than *R. r. uraniae.* Like other native insectivores, *M. freycineti* may have suffered major declines as a result of pesticide overuse. This Guam endemic is in serious danger of extinction.

Rufous Fantail (*Rhipidura rufifrons uraniae*)

Description.—*Rhipidura rufifrons uraniae* is a small, sexually monomorphic, monarchine flycatcher. The forehead and crown are cinnamon and contrast with the black orbital rings and white malar stripes (Plate V). The anterior part of the chin is white, becoming black posteriorly along with the throat and upper breast. The lower breast is spotted brown and white. The abdomen, sides, flanks, and tibia are a darker brown than the head. The rump and base of the tail are rufous. The distal part of the tail is black tipped with white. Underwings are grayish to buff. The bill is black, the feet and irides, dark brown.

Immature birds resemble adults, but head, neck, and scapulars have rufous edges, and the black feathers of the chin and throat are edged white. I was unable to recognize immature birds in the field although this was possible for specimens in hand.

Distribution.—The subspecies *R. r. uraniae* is endemic to Guam. Two other subspecies are found in the Marianas: *R. r. saipanensis* on Saipan and Tinian, and *R. r. mariae* on Rota. Other subspecies of *R. rufifrons* are distributed from the Caroline Islands to Australia (Mayr and Moynihan 1946).

Habitat.—Historically, *R. r. uraniae* was reported in all habitats on Guam except the southern savannas. Baker (1951) mentioned its preference for forest and scrub communities; Marshall (1949) noted its abundance in woodland understories; Stophlet (1946) recorded it in riparian communities; and Kibler (1950) referred to its abundance even in habitats dominated by *Leucaena leucocephala.* Fantails also are found in coastal strand vegetation and in mangrove swamps. In 1978 and 1979, I found *R. r. uraniae* commonly only in the mature limestone forests of the northern cliffline and uncommonly in the second growth and scrub forests of the Northwest Field area. These observations are, I believe, a reflection of restricted range and small population sizes.

Behavior.—Rufous Fantails are extremely active birds that constantly flit about in the understory of the forest in search of food. They are frequently found in pairs or in small groups of three to five individuals that continually spread their large fan-like tails. The birds sometimes accentuate this display by holding the

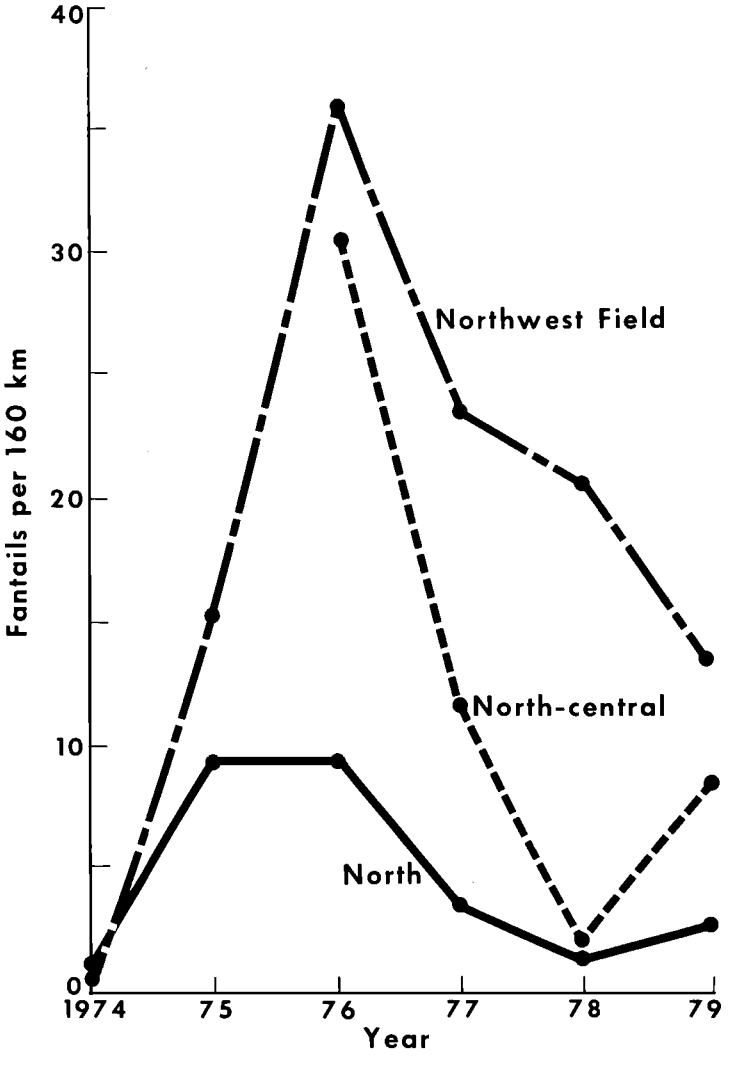


FIG. 18. Mean number of Rufous Fantails (*Rhipidura rufifrons uraniae*) observed per 160 km of travel during roadside counts on North and Northwest Field Routes (1974–1979) and on the North-central Route (1976–1979).

wings back and away from the body at a 45° angle. Although agile in the understory, Rufous Fantails appear to labor in flight when crossing forest openings or roadways, undulating slowly at low altitudes of only 1 to 2 m.

The song is a melodious tinkling of notes which, because of the species' relative abundance in the mature forests of the northern cliffline, continues to be one of the most frequently heard vocalizations in these habitats (Seale 1901; Marshall 1949; Beaty 1967). An aggressive call is given between members of a foraging pair when interacting agonistically. This call, a single note repeated three or more times, is unmusical and quiet.

Food habits.—Contents of two stomachs I examined and field observations

indicate that *Rhipidura r. uraniae* is entirely insectivorous. It captures prey primarily on the wing, foraging low in the forest understory. The birds seldom, if ever, return to the same perch but alight instead in a new area after each sally. Several times I saw foraging birds land on the ground where they probably secured prey. Less frequently, they gleaned food from branches among the foliage. Once, I saw a bird perched in the edge of a forest opening fly vertically upward and attempt to capture prey above the forest canopy. This individual also dived after prey with wings spread and tail held straight. The foraging behavior of this species and that of the Guam Flycatcher are compared in the Food Habits section of the account for the latter species.

Nesting.—*Rhipidura r. uraniae* builds a compact nest around a branch or fork of a tree. The nest is composed of fine grasses, *Casuarina* needles, hair-like matter, and spider webs, all held solidly together by a mucus-like secretion. Nests are about 3.7 cm in outer diameter, 2.2 cm deep, and 4.8 cm high, with fibrous matter extending another 3 to 5 cm below the nest (Plate VI). This extension is characteristic of the genus (Mayr and Moynihan 1946). Two of the four nests reported in DAWR field notes were built in *Hibiscus tiliaceus,* and two in *Leucaena leucocephala.* Three *R. r. uraniae* nests were located an average of 1.7 m above the ground (no data on fourth), in marked contrast to Seale's (1901) report of nests 3.5 to 7 m from the ground, but consistent with Hartert's (1898) report of nests built within 1 to 2 m of the ground. DAWR notes report three clutches with two eggs each. Two eggs (18 mm long by 13 mm in diameter) were dull white, each with a ring of brownish spots diffused around the center or nearer the large end. A brood with two chicks was reported by DAWR staff. Both adults incubate and brood the young. The incubation period is more than 12 days, but the precise length is unknown. One brood fledged in 14 to 15 days. Both adults feed the young, but apparently one (sex undetermined) feeds more than the other.

DAWR reports include records of nests of this species from January through April. Kibler (1950) reported a juvenile being fed in June, and I found a dead bird in juvenal plumage in November. Marshall (1949) listed *R. r. uraniae* as a presumed year-round breeder on the basis of physiological evidence. Field data are insufficient to confirm this, but the lack of nesting records from the latter part of the year probably reflects inconsistent and scanty fieldwork.

Status on Guam.—*Rhipidura r. uraniae* was formerly distributed throughout the island. Seale (1901) commented on its abundance. Kibler (1950) reported that the species may have been more common on the northern plateau than in the forests of southern Guam. During 5 years of monthly roadside counts (1963–1968) at Alamagosa Springs (southern Guam) by DAWR staff, Rufous Fantails were never recorded, so they were apparently extirpated from southern Guam by this time. The birds are now common only in the mature forests along the northeastern cliffs, but are still found uncommonly in the second growth and scrub habitats of northwestern Guam. Fantails are apparently extirpated from much of the northern plateau (Figs. 18, 19). *Rhipidura r. uraniae* was not found along the northeastern cliffline during station counts (Appendix II). Because it is insectivorous, the fantail may have suffered more than some of the other native forest birds from the heavy use of pesticides on Guam. In the northern cliffs where the Guam Flycatcher and Rufous Fantail occur together, the fantail is far more common (Appendix II). The subspecies *R. r. uraniae* is in serious danger of extinction.

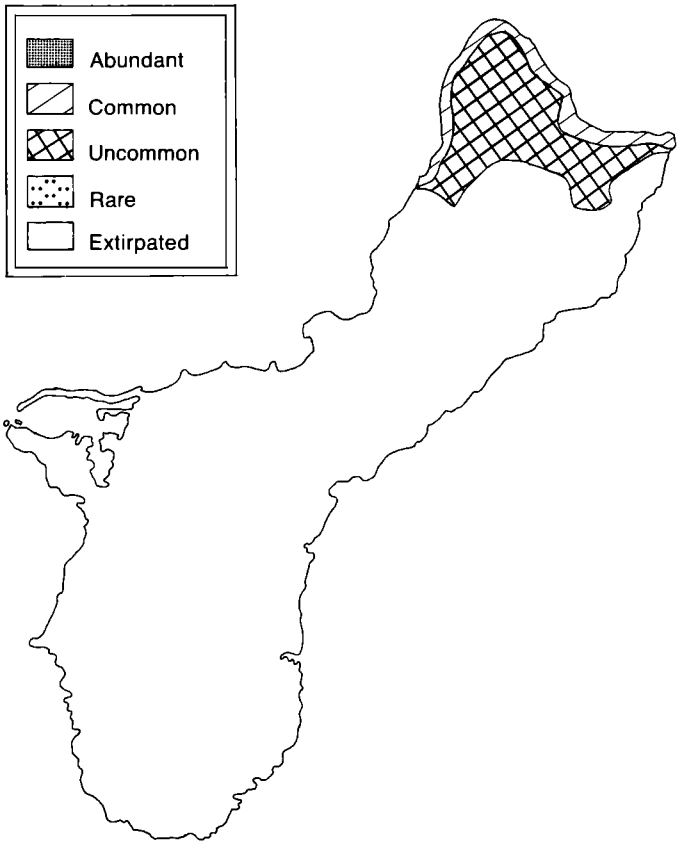


FIG. 19. Distribution and abundance of the Rufous Fantail (*Rhipidura rufifrons uraniae*) on Guam, 1978–1979.

MICRONESIAN STARLING (*APLONIS OPACA GUAMI*)

Description.—*Aplonis opaca guami* is a large starling with a heavy, arched bill. The plumage of both sexes is black with a noticeable greenish-blue gloss. The underparts are duller than the upperparts. The feet and bill are black, and the irides are bright yellow. Females are slightly smaller than males (Table 1; Baker 1951).

Immature birds are easily recognized in the field as the underparts are heavily streaked with white. The upperparts are dark brown rather than black. The base of the bill is horn-colored, and the irides are dull yellow.

Distribution.—*Aplonis opaca* is widely distributed throughout Micronesia. The subspecies *A. o. guami* is found on Guam, Rota, Tinian, and Saipan; *A. o. aeneus* is found on the northern Mariana Islands of Alamagan, Pagan, Agrihan, and Asuncion. Five additional subspecies occur on the Caroline Islands and Palau (Baker 1951).

Habitats.—The starling formerly appeared in all habitats on Guam. It is now most common in scrub, second growth, mixed woodland, and mature forest habitats, where the birds form small to moderate size flocks. The species is found

TABLE 5

PLANT FOOD OF THE MICRONESIAN STARLING (*APLONIS OPACA GUAMI*)[a]

Plant species	Seeds	Fruits
Artocarpus sp.		x
Carica papaya	x	x
Casuarina equisetifolia		x
Cestrum diurnam	x	x
Ficus sp.	x	x
Melanolepis multiglandulosa		x
Momordica charantia	x	
Muntingia calabura	x	
Pithecellobium dulce		x
Premna obtusifolia		x
Scaevola taccada		x
Triphasia trifolia	x	x
Vitex parviflora		x

[a] Data based on single observations.

also, alone or in pairs, around ranches, agricultural areas, and villages, but is more abundant in forested areas. It is not an agricultural pest. Bryan (1936) stated that *A. o. guami* was common in savanna habitats, and Stophlet (1946) recorded flocks of eight to 10 birds in the grassland and scrub near the southern mountains. He noted that they were more common in forested habitats. The birds are also found in coastal strand and around the edges of wetland areas where they may use hollow or broken coconut palms as nesting sites.

Behavior.—Flocks of Micronesian Starlings often gather in the larger trees of the forest and make raucous calls that dominate all other forest sounds. During this study, I saw groups of three to 13, usually five to seven, starlings. These groups were dynamic, and often broke apart into pairs only to reform minutes later in the same large tree. The age classes of the groups varied considerably. Groups were composed entirely of adults, of adults and immature birds, or frequently, entirely of immatures. Of 138 total birds sighted, 51.4% were immature, suggesting a high reproductive rate, or the retention of juvenal plumage for a long time.

While nesting, Micronesian Starlings forsake their gregarious habits and defend their nesting territories both intraspecifically and interspecifically. The birds have been observed defending their nesting territories aggressively against the monitor lizard (*Varanus indicus*), the White-tailed Tropicbird (*Phaethon lepturus*), the Micronesian Kingfisher, and the Mariana Crow, as well as adjacent nesting conspecifics or an intruding solitary starling. Both sexes participate in these interactions.

The vocalizations of this species are highly varied. One song includes a series of whistles and other notes, often given by a bird in a chorus with other individuals. A more frequent call is a single clear whistle, often inflected or repeated. This call is similar to the call note of *Myzomela cardinalis saffordi* and may be confused with it by the casual observer. A soft chipping sound, possibly a contact note, is uttered by birds in flight.

Baker (1951) described what he interpreted to be courtship behavior of *A. o. guami*. He observed two birds perched on a palm frond; one bird spread its tail

TABLE 6

NESTING ACTIVITIES OF THE MICRONESIAN STARLING (*APLONIS OPACA GUAMI*) IN A SINGLE NEST CAVITY, ANDERSEN AIR FORCE BASE, MAY–NOVEMBER1979

Nesting attempt	Date	Reproductive stage
1	9 May	one large chick
	14 May	one young fledged
2	7 June	nest with two eggs
	10 June	one egg hatched, one egg addled
	1 July	one young fledged
3	5 July	adult in cavity, no eggs
	15 July	nest with three eggs
	29 July	three eggs hatched
	23 August	one young fledged
	24 August	two young fledged
4	24 September	nest with two eggs
5	26 November	nest with two eggs

and wings in a ritualized fashion while singing. I witnessed no such behavior. On several occasions, however, I saw an unusual flight display in which a pair of starlings touched in flight and produced a single high-pitched note during the descending portion of each undulation.

Food habits.—The Micronesian Starling is omnivorous but apparently prefers vegetable material to animal matter. Previously reported foods of this species include ripened papaya (Seale 1901; Baker 1951), other fruits, seeds, and insects (Marshall 1949). My data indicate that *A. o. guami* probably consumes less animal matter than the also omnivorous Mariana Crow and, unlike it, is strictly arboreal. The plant matter used as food by the starling on Guam is summarized in Table 5. Wasps and unidentified insect larvae were found in two starling stomachs examined by DAWR staff.

Aplonis o. guami perched often in *Casuarina* and *Guettarda* trees, whereas the crow perched in *Pandanus* and *Hibiscus.* Both native omnivores frequently perched in *Ficus.* In 259 observations, the starling was recorded only twice in *Hibiscus,* a plant used often by the crow. I recorded starlings 17 times, but never observed crows or fruit doves in *Artocarpus* trees.

Nesting.—*Aplonis o. guami* nests primarily in cavities and prefers hollow or broken branches of dead or dying coconut palms or other trees (*Delonix regia, Artocarpus* sp., *Guettarda speciosa, Ficus* spp., and *Pandanus* spp.). Other recorded nest sites include the tops of decaying telephone poles, outcroppings of limestone cliffsides, and the leaf bases of coconut palms and *Pandanus* spp. Nesting material such as dried twigs and grasses, *Ficus* and *Pandanus* leaves, and *Casuarina* needles are placed at the bottom of the nesting cavity by both sexes. At four nest sites,this material was removed and replaced after each nesting. Heights of nesting cavities above the ground vary from 2.0 to 12.3 m with an average of 8.3 m (n = 7).

The eggs of *A. o. guami* are pale blue-green with splotches of red concentrated toward the large end. Six eggs averaged 30.1 mm (range = 29.0–31.3) long with a diameter of 22.0 mm (range = 21.3–22.7). Three clutches I observed contained

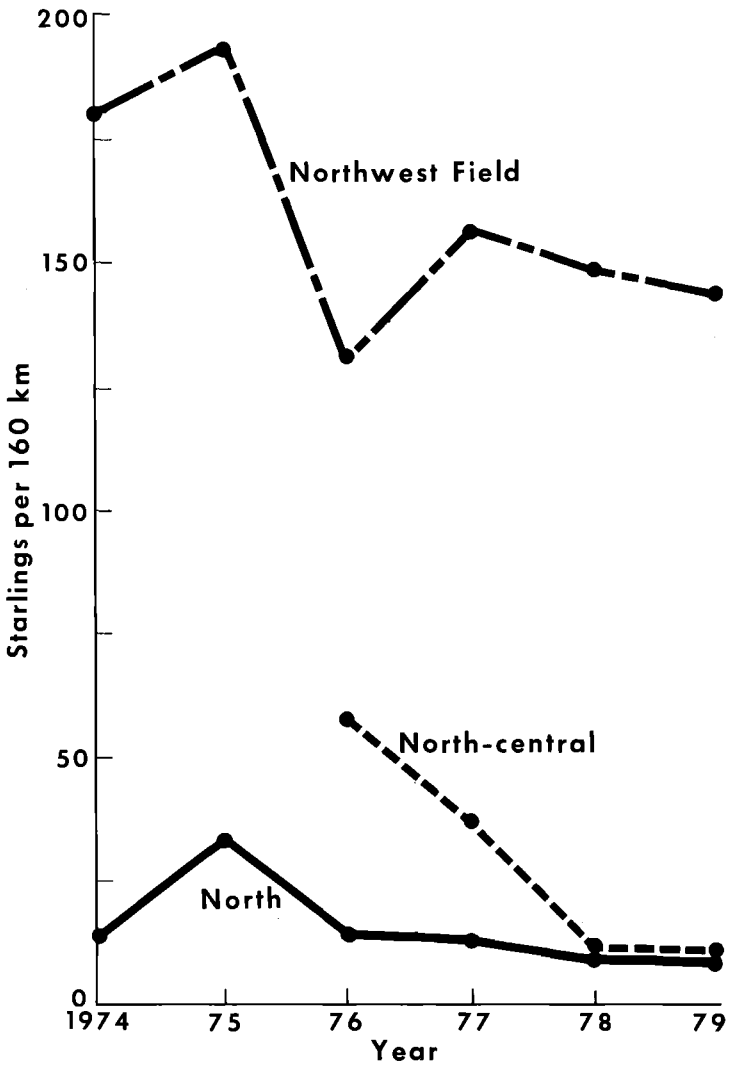


FIG. 20. Mean number of Micronesian Starlings (*Aplonis opaca guami*) observed per 160 km of travel during roadside counts on North and Northwest Field Routes (1974–1979) and on the North-central Route (1976–1979).

two eggs, and one contained three eggs. Hartert (1898) and Baker (1951) reported clutches of two eggs, and Seale (1901) described clutches of three to four eggs. Both sexes incubate; the incubation period is unknown but was less than 24 days at one nest.

In *A. o. guami,* both sexes brood, feed, and care for the young, which are altricial. The eggshells are consumed or carried away by the adults. I observed three broods of one chick each, and one brood of three chicks. Typically, one adult remains in or near the nesting cavity while the other adult forages. Upon the return of the foraging adult, the attending adult departs, often carrying away fecal material. The returning adult stands on or near the edge of the nesting cavity and regurgitates food from its crop to feed the young, one item at a time. I have observed an adult

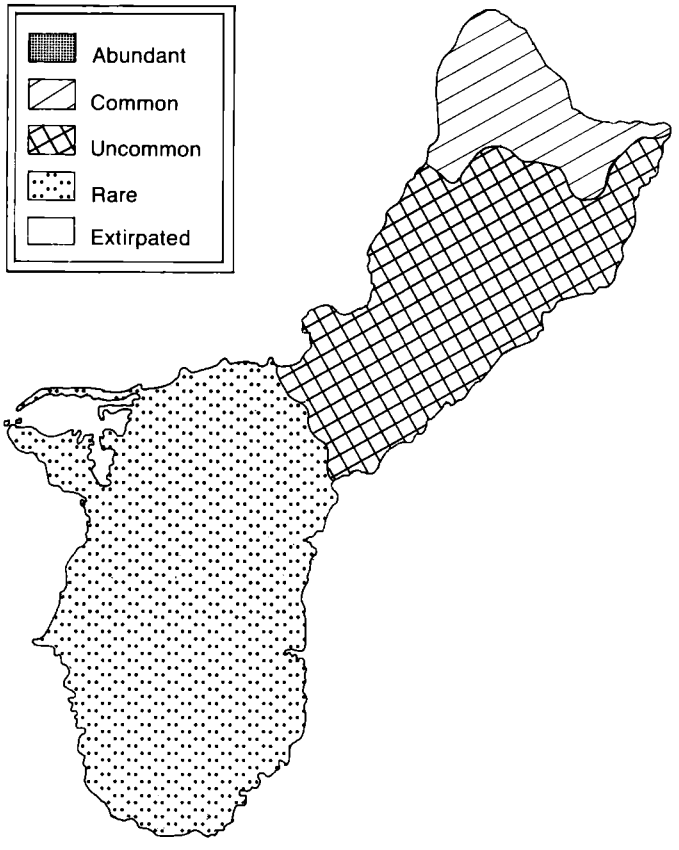


FIG. 21. Distribution and abundance of the Micronesian Starling (*Aplonis opaca guami*) on Guam, 1978–1979.

bird regurgitate as many as six food items at a time. Nestling food includes insects, and fruits of *Piper, Ficus, Cestrum diurnam, Carica papaya, Triphasia trifolia,* and *Scaevola taccada.* Three nestlings from one nest fledged at 24, 25, and 25 days. One nestling from another nest fledged at 21 days.

As with some other starlings, the reproductive capability of *A. o. guami* is impressive and probably accounts in part for the fact that the species has fared somewhat better than Guam's other native forest birds. I observed nesting activities at one nesting cavity for 7 months during the latter half of 1979 (Table 6). The cavity housed five nests and fledged five chicks in the first three nestings; I was unable to follow the latter two nests. An adult female was in the cavity and presumably laying eggs for the third nesting attempt only 5 days after the young of the previous brood had fledged and during which time, all the nesting material had been replaced. This attempt produced three fledglings. I did not mark the birds, so I cannot state that the same pair was active throughout the period. If more than one pair was involved, then nest sites may be limiting for cavity-nesting species on Guam (*A. o. guami, H. c. cinnamomina*). Unlike *C. kubaryi, A. o. guami* apparently has a short dependent fledgling period, after which the young form flocks that can be found throughout the year.

Nests of *A. o. guami* have been recorded in every month (DAWR notes, this study). Marshall (1949) stated that some adults had undeveloped gonads while others were nesting, which suggests that a given pair may enter a quiescent period between nestings at some time during the year.

Status on Guam.—Many authors have referred to the abundance of *A. o. guami* on Guam (Seale 1901; Bryan 1936; Stophlet 1946; Kibler 1950; Tubb 1966). Baker (1947) recorded the species on all of the 125 roadside counts that he made in 1945; these birds represented 57.3% of all the birds recorded. Seale (1901) described *A. o. guami* as common throughout the island.

Although this species has suffered large population declines in recent years, it is currently the most common native bird in the northwest portion of the island where remnant populations of most native birds are found (Fig. 20). *Aplonis o. guami* is uncommon across most of the northern plateau and in central Guam, where only occasional nesting pairs or solitary individuals are found (Fig. 21). On rare occasion, an individual or pair is observed in southern Guam, making the Micronesian Starling the only native passerine still found there. The southern birds are so rare, however, that conservation of this species, as with other native birds, hinges on the preservation of the northern population.

Cardinal Honeyeater (*Myzomela cardinalis saffordi*)

Description.—The adult male of *Myzomela cardinalis saffordi* is scarlet, with black wings, tail, and lores (Frontispiece). Adult females show scarlet markings on the head, throat, and rump; the back is dark olive. The long decurved bill is black, as are the feet. The irides are brown. Three adult males taken by DAWR staff averaged 13.3 g (range = 10.5–15.5). For adult birds, the sexes are easily identified in the field.

Immature males are similar to adults, but scarlet areas are washed with brown, particularly on the back. Immature females are similar to adult females, but again, the scarlet areas of the adult are more extensive. In addition, immature birds have a bright yellow, easily identifiable rictus. With some practice, the sexes of immature birds can be distinguished positively in the field.

Distribution.—Several subspecies of *M. cardinalis* are found in Micronesia. *Myzomela c. saffordi* occurs on the Mariana Islands of Guam, Tinian, Saipan, Rota, Aguijan, Alamagan, Pagan, Agrihan, and Asuncion. Numerous other subspecies occur on southwest Pacific islands and Australia.

I conducted counts of *M. c. saffordi* on Saipan, Tinian, and Rota in 1979 (Jenkins and Aguon 1981). On Saipan and Tinian, Cardinal Honeyeaters appeared more numerous and more widely distributed than on Guam but were, nevertheless, uncommon. In 1978, *M. c. saffordi* was abundant and well distributed throughout Rota.

Habitat.—*Myzomela c. saffordi* formerly was found in all habitats on Guam. Several authors have referred to the bird's past abundance around village gardens (Seale 1901; Tubb 1966; Beaty 1967). Stophlet (1946) found the species in grassland and riparian habitats in southern Guam; Kibler (1950) noted it in open habitats and around mangrove swamps. *Myzomela c. saffordi* often was recorded near wetland areas and currently is found in coastal strand habitats where the birds visit the buds and flowers of coconut palms. Unlike most native forest birds,

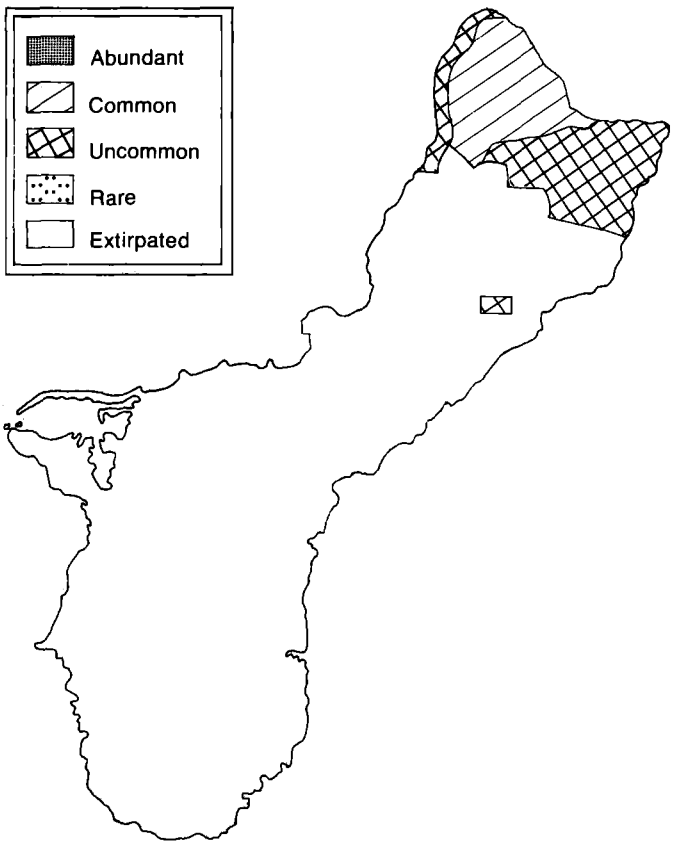


FIG. 22. Distribution and abundance of the Cardinal Honeyeater (*Myzomela cardinalis saffordi*) on Guam, 1978–1979.

this species is more common in scrub, second growth, and mixed woodland habitats of Northwest Field than in the mature limestone forest of the northern cliffline. These birds are observed more commonly in the coastal strand around Tarague Beach than in the adjacent mature limestone forest.

Behavior.—Mayr (1945) reported that male *M. cardinalis* outnumber females by about 4:1, but Baker (1951) found a ratio of slightly greater than 2.5:1 in the Marianas. Of 108 birds seen in this study, 65 were male, a ratio of about 1.5:1. Baker (1951) did not consider females more secretive than males, but I disagree. Often, I saw territorial males alight on open perches while calling or singing (Frontispiece). Such behavior attracted my attention. Territorial disputes involving males fiercely attacking one another in flight are common and are followed by the males perching apart and calling or singing. I recorded calls of females less frequently.

Courtship interactions take place at any time of day throughout the year. These interactions involve short (20–30 sec) flights in which the male usually pursues the female along circular, zig-zag, or vertical paths, the two often touching wingtips. Males may utter short, low-volume staccato notes during such flights. Mating

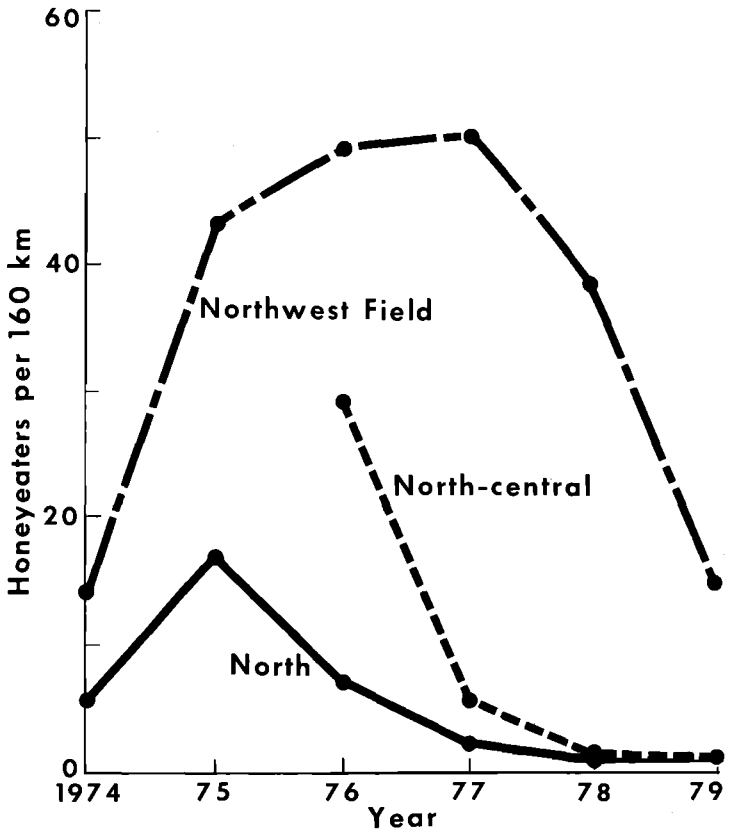


FIG. 23. Mean number of Cardinal Honeyeaters (*Myzomela cardinalis saffordi*) observed per 160 km of travel during roadside counts on North and Northwest Field Routes (1974–1979) and on the North-central Route (1976–1979).

was not observed, although birds usually perched together for a few seconds after a courtship flight.

Male Cardinal Honeyeaters sing primarily during the morning. More frequently, both sexes produce a call note that is similar to, but slightly softer and less harsh than, the call of the Micronesian Starling. Occasionally, a much softer scratchy or wheezing note is given, the significance of which is unknown. The only other known vocalizations are courtship notes described earlier.

Food habits.—Myzomela c. saffordi feeds about equally on nectar and insects (Seale 1901); Mayr (1945) estimated 60% nectar and 40% insects. Marshall (1949) reported that the species also feeds on snails.

In the Ritidian Point and Northwest Field areas during 1978 and 1979, territorial males perched in the tall *Casuarina* trees but foraged in *Morinda, Scaevola,* and to a lesser extent, *Premna.* Birds fed among flowers and also gleaned insects from the foliage. Hartin (1961) saw the species feed extensively on the flowers of *Hibiscus tiliaceus,* and Baker (1951) observed a preference for the flowers and insects found in *Cestrum* and *Cocos.* Other trees and shrubs in which I observed honeyeaters foraging included *Cassia occidentalis, Vitex parviflora,* and *Cynometra ramiflora.*

Myzomela c. saffordi is highly active when feeding. When foraging among flowers, the birds move among clusters and systematically insert their bills into every flower, presumably to extract the nectar. The birds may feed in as many as 30 flowers per minute.

Nesting.—*Myzomela c. saffordi* builds a deep, cup-like nest, loosely woven of fine grasses, *Casuarina* needles, rootlets, and leaves, intertwined with spider webs. Externally, two nests ranged from 5 to 7 cm in diameter and 5 to 8 cm high. The inner depth of the cup may be 3 cm or more. Nests are usually constructed on the outer branches of a tree, often where branches fork. Two nests reported in DAWR staff notes were 3.1 and 4.6 m above the ground. Seale (1901) reported nest heights of 2.5 to 4.6 m, but Hartert (1898) found nests from 1.2 to 2.5 m up in trees. Unlike the nests of flycatchers and fantails, the nest of this species is loosely constructed and fragile, often with daylight penetrating the walls. Nests recorded in DAWR field notes were built in *Casuarina* and in *Delonix regia.* Hartert (1898) reported one built in *Pithecellobium dulce.*

The eggs of *M. c. saffordi* are off-white or cream-colored with rufous brown spots concentrated at the large end. Hartert (1898) measured two eggs 17.1 and 19 mm long and 14 mm wide. One clutch recorded in DAWR staff notes contained two eggs; Hartert (1898) found clutches of two eggs. Mayr (1945) reported that *M. cardinalis* on other islands rarely may lay three-egg clutches. Staff notes of DAWR report two broods, each with one chick. Stophlet (1946) reported a pair of *M. c. saffordi* with two young. Incubation and brooding by both sexes is characteristic of the family Meliphagidae (Mayr 1945), but I have no data on the subject for *M. c. saffordi.* DAWR notes report that females feign injury when disturbed from the nest.

Evidence of nesting by *M. c. saffordi* is available for every month except November. DAWR staff recorded nests from January through March. Kibler (1950) observed an adult feeding a fledgling in April, Seale (1901) recorded nesting from May to July, and DAWR staff notes report a nest and nestling in August. I observed a recently fledged bird in September, Stophlet (1946) observed a pair with two young in October, and Kibler (1950) observed an adult feeding its young in December. These observations support Marshall's (1949) hypothesis that the species is a year-round breeder, although data are lacking to determine whether frequency of nesting activity fluctuates seasonally.

Status on Guam.—Nearly every observer has referred to the species as conspicuous and abundant on Guam (Hartert 1898; Baker 1951; Hartin 1961; King 1962). Seale (1901) referred to it as probably the most abundant species on the island, and Baker (1947) found it to be the fourth commonest species on his 1945 roadside counts, appearing on 37.6% of 125 counts, and constituting 3.9% of all birds seen. A DAWR staff note indicates that a bird was taken in Merizo (southern Guam) in 1963, and Tubb (1966) described the species as common throughout the island, as late as 1965.

At present, Cardinal Honeyeaters can be found regularly only in the northernmost portion of the island, particularly in the Northwest Field area of Andersen Air Force Base (Fig. 22). Rarely, they are found in the Marbo Annex (Andersen AFB-South), and around the housing areas of Andersen Air Force Base proper. Honeyeaters were more abundant in the wooded habitats of Northwest Field than in the relatively undisturbed mature forest habitats of the northern cliffline (Ap-

pendix II). Apparently *M. c. saffordi* has disappeared entirely from southern and central Guam, as well as from most of the northern plateau (Fig. 23).

BRIDLED WHITE-EYE (*ZOSTEROPS CONSPICILLATA CONSPICILLATA*)

Description.—*Zosterops c. conspicillata* is a small white-eye with green upperparts, yellowish-white underparts, and broad white eye-ring (Frontispiece). The back and sides of the neck are grayish-green. The legs and feet are dark olive, and the irides are light brown. The sexes are similar, but Baker (1951) found that adult females may be lighter on the underparts. This difference is not discernible in the field.

Distribution.—This subspecies is endemic to Guam. Two other subspecies are found in the Marianas, *Z. c. saypani* on Saipan and Tinian, and *Z. c. rotensis* on Rota. Related forms are found in the Caroline Islands and Palau.

Habitat.—*Zosterops c. conspicillata* has been recorded in most of the habitats on Guam. Baker (1951) observed the species in uplands and in the mature forests of the northern cliffs, and Tubb (1966) reported it in scrub. Stophlet (1946) found these birds in the grasslands and foothills of south-central Guam, and King (1962) observed the species in coastal strand near Tarague Beach. Staff notes of DAWR report *Z. c. conspicillata* to be common in the Agana Swamp, as well. This species apparently was common once in the mixed woodland and second growth of the northern plateau, from which it has almost disappeared. The only habitat in which I observed *Z. c. conspicillata* with any regularity was the mature forest of the extreme northwestern cliffline near Uruno and Ritidian points. I rarely saw the birds even in the most undisturbed woods of Northwest Field and only once found them in coastal strand near Pati Point Beach.

Behavior.—The white-eyes are active flocking birds whose behavior has been compared with that of goldfinches (Seale 1901), titmice (Safford 1902), and chickadees (Hartin 1961). This species is the only native passerine that appears to be nonterritorial even when nesting. I recorded flocks of three to eight individuals, with groups of three to five the most common. Seale (1901) reported flocks of 10 to 20 individuals, and Baker (1951) referred to a group of 12, but Stophlet (1946) reported flocks of only six or seven, and Tubb (1966), flocks of six to ten. My observations of smaller groups probably reflect the present rarity of this species on Guam. Flocks of these birds occasionally fly high above the forest canopy, which suggests a widely separated foraging circuit, as described by Marshall (1949) for *Z. c. semperi* in Palau. Mees (1969) described the movements of this species as typical of *Zosterops*. A flocking call is uttered by birds in flight, presumably as a contact note. These chipping calls may intensify when a group alights in the vegetation, but they become less frequent as the birds begin to forage. The chipping call, uttered at various intensities, is the only vocalization I have heard from this species. Marshall (1949) once heard *Z. c. conspicillata* sing.

White-eyes on Guam mob Micronesian Kingfishers (Marshall 1949) and Micronesian Starlings (pers. obs.).

Food habits.—*Zosterops c. conspicillata* feeds primarily on insects. Mayr (1945) stated that berries and other small fruits are taken by members of this genus, and Marshall (1949) recorded the food items of *Z. c. semperi* from Palau as seeds, fruits, caterpillars, ants, and other small insects. I have observed *Z. c. conspicillata*

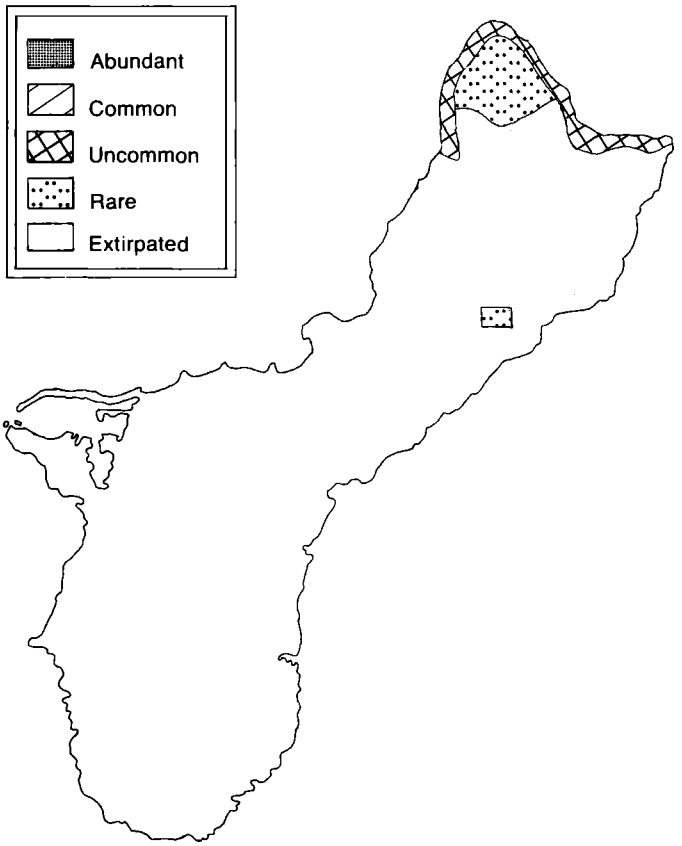


FIG. 24. Distribution and abundance of the Bridled White-eye (*Zosterops conspicillata*) on Guam, 1978–1979.

feeding only on insects gleaned from twigs or foliage; if fruits and seeds are taken, they probably comprise only a small portion of the diet.

During 1978–1979, Guam Bridled White-eyes fed frequently in large *Ficus* and *Guettarda,* two of the larger trees found in the mature limestone forest at Ritidian Point. The white-eye is primarily a canopy-feeder. Insects are gleaned or "hawked" mostly from twigs and small branchlets, but the birds also occasionally forage among leaf sprays. Their foraging is warbler-like as they creep along branches searching for and securing insects. The largest foraging group I observed consisted of six birds feeding in the twigs and branches of a dead *Ficus.*

Nesting.—Little is known of the nesting of this species on Guam. One nest recorded by DAWR staff was built 2.4 m up in a *Leucaena leucocephala* shrub. The nest was composed of fine fibers and rootlets woven into a hanging basket, externally 4 to 5 cm in diameter by 7 to 8 cm deep. It contained two light blue-green eggs. Seale (1901) reported a white-eye nest "some distance from the ground" in the outer branches of *Pithecellobium dulce.* Hartert (1898) stated that nests were found within 1 to 2 m of the ground in the forks of branches and contained 2 or 3 egg clutches. Hartert (1898) described and gave the measurements of several eggs. No information is available on incubation, nestling, or fledgling periods.

Evidence of nesting by white-eyes on Guam is available for scattered months. Hartert (1898) reported nests in February and March, Seale (1901) reported nesting from May to July, DAWR field notes record a nest in June, Baker (1951) reported a bird with enlarged gonads taken in August, and Stophlet (1946) observed an adult feeding a fledgling in October. These observations tend to support Marshall's (1949) assumption that the Bridled White-eye breeds year-round on Guam.

Status on Guam.—Apparently, *Z. c. conspicillata* formerly was distributed throughout the island, but little information is available as to its historic population levels in southern Guam. Stophlet (1946) recorded the species in the grasslands and foothills of southeastern Guam, and DAWR staff notes indicate that the species was found in central Guam in the early 1960's and apparently was common in the Agana Swamp. Seale (1901) and Hartert (1898) referred to *Z. c. conspicillata* as one of the common Guam birds; Bryan (1936) found it common along roadways, but Baker (1947) missed it in his roadside counts in 1945. Hartin (1961) saw white-eyes frequently, but found them less common than Cardinal Honeyeaters.

Today, the Bridled White-eye, along with the flycatcher and the swiftlet, is among the rarest native birds in a generally declining avifauna. I found the species uncommon along the northernmost cliffs and rare in the most northern areas of Northwest Field (Fig. 24). I once saw a small group of white-eyes in Marbo Annex (Andersen Air Force Base-South), my only plateau record outside Northwest Field (Fig. 24). The Guam Bridled White-eye has one of the most restricted ranges of any native bird and may be near extinction.

OTHER NATIVE SPECIES

Historically, Guam supported four native wetland species. Three of these, the Mariana Mallard (*Anas oustaleti*), the White-browed Rail (*Poliolimnas cinereus micronesiae*), and the Nightingale Reed-warbler (*Acrocephalus luscinia luscinia*), declined and disappeared, apparently in the 1960's and early 1970's, concurrent with the draining and development of much of Guam's freshwater wetland habitat. Breeding populations of the fourth wetland species, the Common Gallinule (*Gallinula chloropus guami*), are isolated and severely depleted. This subspecies has been recommended by the Governor of Guam for inclusion on the U.S. Endangered Species List.

Five other native resident birds show varying degrees of dependence on marine habitats. Reef Herons (*Egretta sacra*) breed around the island in small numbers with both the white and gray phases represented in the population. A small colony (20–30 birds) of Brown Boobies (*Sula leucogaster*) nests off-shore in the vicinity of the commercial port. White-tailed Tropicbirds (*Phaethon lepturus*) nest in small numbers at Amantes Point, and some nesting may occur at other isolated localities around the island. Nesting White Terns (*Gygis alba*) are evenly distributed around the shoreline of Guam, with perhaps some concentration at both northern and southern ends of the island. White Terns are a common sight on Guam, but nesting populations are small. Common Noddies (*Anous stolidus*) are by far the most abundant seabird, with several hundred pairs nesting around the island, mostly on shorelines just below the mouth of the commercial port. Noddies, while common along the coast, are very rarely seen at inland locations.

MIGRANT SPECIES

Fifty-three species or 65% of the birds known from Guam are migrants. Many of these species are more properly considered vagrants; I have designated these as rare migrants in Appendix I. Shorebirds (Families Charadriidae and Scolopacidae) are the most frequently encountered migrants, and wintering concentrations are found at Agana Bay and along the southeast coast (Jenkins 1981). Seabirds and terns occasionally are sighted in off-shore waters. Pintails (*Anas acuta*) and other waterfowl appear in freshwater wetlands in many years, but usually in small numbers. During 1978 and 1979, I observed six species previously unreported for Guam. These included one falcon (Northern Hobby, *Falco subbuteo*), four shorebirds (Common Ringed Plover, *Charadrius hiaticula*; Black-tailed Godwit, *Limosa limosa*; Spotted Redshank, *Tringa erythropus*; Rufous-necked Stint, *Calidris ruficollis*), one gull (Black-headed Gull, *Larus ridibundus*; Jenkins 1978), and one pratincole (Small Pratincole, *Glareola lactea*). In general, migrants are confined to coastal locations and seldom are observed inland. The only migrant I encountered in a forested area was a single Northern Hobby in the mature limestone forest near Ritidian Point in 1979.

NON-NATIVE SPECIES

Seven resident bird species have been introduced to Guam or have colonized it from populations introduced on adjacent islands. The Philippine Turtle Dove, introduced by the Spanish from the Philippines in ca. 1700, is common throughout the island and is managed for game. Chinese Painted Quail (*Coturnix chinensis lineata*) were more recently (1894) introduced from the Philippines by the Spanish (Seale 1901). In 1970, painted quail were no longer considered game animals on Guam because of dwindling populations. The Black Frankolin (*Francolinus francolinus*) was introduced to Guam from Southeast Asia in the early 1960's as a game animal. Francolins now nest in small numbers in Guam's southern savannas. In agricultural and suburban areas, Chestnut Mannikins (*Lonchura malacca jagori*) are a common sight. These birds possibly are progeny of cagebirds that escaped ca. 1957. The Black Drongo (*Dicrurus macrocercus*) is the most abundant avian species on Guam. Baker (1951) discussed the introduction of this species from Formosa to Rota by the Japanese in 1935. The drongo probably colonized Guam on its own; northern Guam and Rota are separated by only 48 km. Drongos are now common in all parts of Guam and remain well established on Rota. No clear record exists of the introduction of the Eurasian Tree Sparrow (*Passer montanus saturatus*) on Guam. It may have been introduced to nearby islands or directly to Guam. In either case it appeared on Guam following Baker's (1951) observations and is now common in urban areas. It is seldom seen in forested habitats. Rock Doves (*Columba livia*) also are common around urban areas. Bryan (1936) stated that some of these doves are progeny of escaped carrier pigeons formerly used by the United States Navy and Marine Corps.

DISCUSSION

At present, Guam harbors only remnant populations of most of its native land birds. With the exception of *Ixobrychus sinensis, Aerodramus vanikorensis bartschi,* and *Aplonis opaca guami,* the entire native avifauna is confined to the northern

portion of the island, particularly at the fringes of the northern cliffline. All of these species historically were found throughout the island (Safford 1901, 1902; Seale 1901). The Micronesian Megapod (*Megapodius laperouse laperouse*), the only forest species completely extirpated from Guam, disappeared in the early 19th Century, probably because of egg-gathering by humans (Baker 1951).

Most of the remnant native bird populations of Guam are presently confined to mature limestone forest and second growth of the northernmost portions of the island. Historically, species also occurred in other habitats such as mixed woodlands, scrub, coastal strand, freshwater wetland, mangrove swamp, and savanna. The present limited habitats of many species only partially reflect their historic habitat use.

The two doves, *Gallicolumba xanthonura* and *Ptilinopus roseicapilla,* apparently are the only entirely frugivorous native birds. Fruits of *Ficus* and *Guettarda* are particularly important foods. Three native birds (*Corvus kubaryi, Aplonis opaca,* and *Myzomela cardinalis*) are omnivorous, while four others (*Aerodramus vanikorensis, Miagra freycineti, Rhipidura rufifrons,* and *Zosterops conspicillata*) are insectivorous. Two species (*Ixobrychus sinensis* and *Halcyon cinnamomina*) feed entirely on small vertebrates (fish and reptiles) and large invertebrates (insects, snails, and others).

Except for *Ixobrychus, Aerodramus,* and *Halycon,* Guam's native birds breed year-round, and pairs of many species produce more than one clutch per year. A pair may enter a quiescent period between nestings, while other members of the population are actively nesting. Seasonal fluctuations probably occur in the prevalence of nesting activities of many species, although few data are available to adequately evaluate this.

Population Declines

Most of the native birds of Guam have undergone severe population declines during the last 20 years, with drastic reductions in their historically island-wide distributions. Causes of these declines have been the subject of much speculation in the absence of data. One hypothesis suggests that excessive use of pesticides has either directly or indirectly poisoned habitats beyond the tolerance of most of the native species. 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 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 1977c). Many of the insectivorous birds (*Rhipidura, Myiagra, Aerodramus,* and *Zosterops*) suffered greater declines and currently show more restricted ranges than the omnivorous or frugivorous species. The use of insecticides and herbicides by local farmers and developers has not subsided in recent years, and the military continues to use toxic substances in the control of pests, although the chemicals involved have changed. This pesticide hypothesis does not account for concurrent declines

of frugivorous and omnivorous species, which are not thought to be affected by pesticide use.

Introduced predators have caused concern on many islands, and predation may have contributed to the decline of the native birds on Guam. Historically a predator-free island, Guam currently supports populations of the Philippine rat snake (*Boiga irregularis*), monitor lizard (*Varanus indicus*), and three species of introduced rats (*Rattus norvegicus, R. rattus, R. exulans*), as well as feral dogs, cats, and pigs. All but one of these species (*B. irregularis*), however, were present on Guam in the 1890's when Seale (1901) recorded his observations, and probably long before. Yet no severe decline in the native bird populations was noticed until the 1960's. The Philippine rat snake was introduced more recently (ca. 1945), and its population apparently has increased as the native bird population has declined. It is now common on the island, and some local residents believe it is more common in southern than in northern Guam. The rat snake is known to take native birds and their eggs, and certainly its effect on native bird populations merits further study. No data are available on past or present sizes of predator populations.

Warner (1968) suggested that introduced disease may be a factor in the decline of the endemic avifauna of Hawaii. The role of disease in the declines on Guam deserves investigation. Disease could explain why omnivorous and frugivorous native birds have disappeared from undisturbed habitats in southern Guam, while one introduced frugivore (*Streptopelia bitorquata*) has not.

Habitat destruction or alteration, although probably a contributing factor in some areas, is not, in my estimation, a satisfactory explanation for the severe declines in native bird populations. Many of the southern ravine forests support extensive areas of native vegetation and, given their inaccessibility, should also support healthy native bird populations. Destruction of the northern cliffline habitats, however, would almost certainly be detrimental to the native birds, since the remaining native avifauna is concentrated there.

Because all of the native birds evolved in the presence of periodic devastating typhoons, the rapid avifaunal declines of the last two decades cannot be attributed to such storms. In 1976, the super-typhoon Pamela, with windspeeds in excess of 328 kph, affected many of the native bird populations at a time when most species were already suffering severe declines. Given the small populations and restricted ranges currently shown by most of the native birds, the effect of future severe typhoons on native birds and their habitats remains a serious question. Probably, the observed declines in native bird populations are a result of several of the previously mentioned factors operating in concert.

Conservation and Management

An intense program of conservation and management of the native birds of Guam is vital if stable populations are to be maintained in the years ahead. The single most significant factor, upon which all other management techniques will depend, is the protection of the northern cliff and northwesternmost plateau habitats. Because most of this land lies within the boundaries of Andersen Air Force Base, a heavy burden for the conservation of the native forest birds of Guam falls upon the armed services. The U.S. Air Force has recognized the value of the Pati Point area, declaring it a Research Natural Area in cooperation with

Guam's Department of Agriculture, the Society of American Foresters, and the Forest Service, U.S. Department of Agriculture.

In addition, I believe it is critical (1) that the nine native forest birds of Guam be added to the U.S. Endangered Species List immediately, and that the full power of the Endangered Species Act be exercised in the protection of the northern habitats essential for the preservation of these species. In conjunction with this, no new developments or alteration of existing facilities should be carried out in the essential northern habitats; (2) that use of all insecticides and herbicides be discontinued immediately in Northwest Field and along the northern cliffline, including at the Navy's Ritidian Point facility; (3) that studies be undertaken to identify and eliminate as much as possible the causes of the recent declines in native bird populations; (4) that one or more Federal biologists be placed on Guam; and (5) that biologists be encouraged to undertake detailed studies of the native birds of Guam.

It is difficult to assess the future of many of the native birds of Guam. The population declines of the last two decades are probably continuing, yet no intense conservation or management programs are presently in operation. Such programs are essential to stabilization of native bird populations. Recent history and current status of Guam's native forest birds suggest that many of these species may not survive the 20th Century.

ACKNOWLEDGMENTS

This study represents the cooperative effort of several agencies and many individuals. The study was carried out with funds provided by the Fish and Wildlife Service, U.S. Department of the Interior, authorized by the Pittman-Robertson (Federal Aid for Wildlife Restoration) Act. Publication of this report was funded by the Pacific Southwest Forest and Range Experiment Station, Forest Service, U.S. Department of Agriculture, through its Institute of Pacific Islands Forestry, Honolulu, Hawaii. The Institute is conducting research on the forest and related resources of the American Pacific Islands. I am indebted to C. D. Whitesell of the Institute staff for his interest and support in seeing the report completed.

The study was done while I was on the staff of the Division of Aquatic and Wildlife Resources, Department of Agriculture, Government of Guam. I thank H. T. Kami, Chief of the Division, for allowing me time to prepare this report after I completed a 2-year term with the Department, and R. D. Anderson, also of the Division, for his valuable assistance. T. A. McGowan, M. H. Taylor, A. Courtwright, G. S. A. Perez, N. Drahos, J. Jeffrey, M. Wheeler, and C. A. Aguon, all present or former members of the Division, contributed field notes in the study. The conservation officers, Government of Guam, conducted many of the roadside counts, and C. F. Aguon did most of the station counts.

Earlier drafts of the manuscript were reviewed by R. D. Anderson, M. D. Bruce, M. S. Foster, W. B. King, E. Kosaka, G. S. A. Perez, H. D. Pratt, C. J. Ralph, J. Verner, and C. D. Whitesell.

I am grateful to H. D. Pratt, Louisiana State University, Baton Rouge, D. Roberson, and the Guam Division of Aquatic and Wildlife Resources, for the use of photographs.

SUMMARY

I studied the native birds of Guam from January, 1978 to December, 1979 and collected data on habitat, food items, foraging behavior, general activities, and courtship and mating behavior of each species. When located, nests provided information on egg sizes, clutch and brood sizes, incubation dates, nestling periods, parental care, and fledging. All indications of breeding were recorded to determine the seasonality of nesting.

The native doves are the only frugivorous native birds. Three native bird species are omnivorous, while four others are insectivorous. Two species feed entirely on small vertebrates and large invertebrates. Most of Guam's native birds breed year-round, and pairs of many species produce more than one clutch per year. Seasonal fluctuations probably occur in the nesting activities of many species.

The entire native avifauna of Guam has been declining for about two decades. Historically, most native bird species occurred in all habitats on Guam. At present, however, most of the native bird populations are confined to mature limestone forest and second growth of the northernmost portion of the island, particularly along the northern cliffline. Only three native forest birds (*Ixobrychus, Aerodramus,* and *Aplonis*) are regularly found elsewhere. Population levels for most native birds are quite low, and many species may be unable to sustain further declines. Many species now occupy only 5 to 10 percent of their historical island-wide distributions; most are in immediate danger of extinction.

Reasons for the decline in native bird populations are unknown, but hypothesized causes include pesticide poisoning, introduced predators, disease, and typhoons. Two or more of these factors may be operating in concert to produce the observed declines.

A conservation program for the native birds of Guam is essential if populations are to stabilize. This program should include addition of the nine native forest birds to the U.S. Endangered Species List, protection of the northern cliffline habitats, studies of the causes of native bird declines, increased Federal involvement in the management of the native birds, discontinuation of pesticide and herbicide use along the northern cliffline, and detailed studies of the native birds. The effectiveness of this program will likely determine whether many of the native birds of Guam survive the 20th Century.

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.

BALDWIN, S. P., H. C. OBERHOLSER, AND L. G. WORLEY. 1931. Measurements of birds. Sci. Publ. Cleveland Mus. Nat. Hist. 2:1–165.

BEATY, J. J. 1967. Guam's remarkable birds. South Pacific Bull. 21:37–40.

BORROR, D. J. 1947. Birds of Agrihan. Auk 64:415–417.

BOWLES, J. B. 1962. The Guam Edible Nest Swiftlet. 'Elepaio 23:14–15.

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.

DELACOUR, J. 1947. Birds of Malaysia. Macmillan Co., New York.

DIVISION OF AQUATIC AND WILDLIFE RESOURCES (DAWR). 1964–1979. Annual reports. Federal Aid to Wildlife Restoration (Pittman-Robertson Act). Dep. Agric., Gov. Guam. Unpubl.

DOWNS, T. 1946. Birds on Tinian in the Marianas. Trans. Kansas Acad. Sci. 49:87–106.

DRAHOS, N. 1977a. Population dynamics of Guam birds. Div. Aquatic Wildlife Resour., Dep. Agric., Gov. Guam. Unpubl. Report.

DRAHOS, N. 1977b. The doves of Guam. Div. Aquatic Wildlife Resour., Dep. Agric., Gov. Guam. Unpubl. Report.

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

FRITH, H. J., L. W. BRAITHWAITE, AND T. O. WOLFE. 1974. Sexual cycles of pigeons in a tropical environment. Aust. Wildl. Res. 1:117–128.

FRITH, H. J., F. H. J. CROME, AND T. O. WOLFE. 1976. Food of fruit-pigeons in New Guinea. Emu 76:49–58.

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

GOODWIN, D. 1970. Pigeons and doves of the world. Br. Mus. Nat. Hist. 663:1–446.

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

HARTERT, E. 1898. On the birds of the Mariana Islands. Novit. Zool. 5:51–69.

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

HOLYOAK, D. T., AND J. C. THIBAULT. 1978. Notes on the phylogeny, distribution and ecology of frugivorous pigeons in Polynesia. Emu 78:201–206.

HOLYOAK, D. T. 1979. Notes on the birds of Viti Levu and Traveuni, Fiji. Emu 79:7–18.

JENKINS, J. M. 1978. Two new bird records for Guam. Micronesica 14:361.

JENKINS, J. M. 1979. Natural history of the Guam Rail. Condor 81:404–408.

JENKINS, J. M. 1981. Seasonality and relative abundance of Guam shorebirds. Micronesica 17:181–184.

JENKINS, J. M., AND C. F. AGUON. 1981. Status of candidate endangered bird species on Saipan, Tinian, and Rota of the Mariana Islands. Micronesica 17:184–186.

KIBLER, L. F. 1950. Notes on the birds of Guam. Auk 67:400–403.

KING, B. 1962. Guam field notes. 'Elepaio 23:29–31.

MARSHALL, J. T., JR. 1949. The endemic avifauna of Saipan, Tinian, Guam and Palau. Condor 51: 200–221.

MAYR, E. 1945. Birds of the southwest Pacific. Macmillan Co., New York.

MAYR, E., AND M. MOYNIHAN. 1946. Evolution in the *Rhipidura rufifrons* group. Am. Mus. Novit. 1321:1–21.

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. Natl. Mus. 36: 463–478.

MEES, G. F. 1969. A systemic review of the Indo-Australian *Zosteropidae* (Part 3). Zool. Verhand. Rijksmus. Natuur. Hist. Leiden 102:1–390.

MORAN, J. V. 1946. Birds of Saipan and Tinian. Bull. Mass. Audubon Soc. 30:261–262.

OWEN, R. P. 1977. A checklist of the birds of Micronesia. Micronesica 13:65–81.

PRATT, H. D., P. L. BRUNER, AND D. G. BERRETT. 1977. Ornithological observations on Yap, western Caroline Islands. Micronesica 13:49–56.

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, H. D., J. ENGBRING, P. L. BRUNER, AND D. G. BERRETT. 1980. Notes on the taxonomy, natural history, and status of the resident birds of Palau. Condor 82:117–131.

RALPH, C. J., AND H. F. SAKAI. 1979. Forest bird 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. Micronesian Area Research Center, Univ. Guam. Unpubl.

SAFFORD, W. E. 1902. Birds of the Mariana Islands and their vernacular names. Osprey 6:39–42, 65–70.

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

STONE, B. C. 1970. The flora of Guam. Micronesica 6:1–659.

STOPHLET, J. J. 1946. Birds of Guam. Auk 63:534–540.

STOTT, K., JR. 1947. Notes on Saipan birds. Auk 64:523–527.
TUBB, J. A. 1966. Notes on birds of Guam. Nat. Hist. Bull. Siam Soc. 21:135–138.
WARNER, R. E. 1968. The role of introduced diseases in the extinction of the endemic Hawaiian avifauna. Condor 70:101–120.
WATSON, R. J. 1946. Bird notes from Guam. Raven 17:40–42.
WHARTON, G. W. 1946. Observations on *Ascoschongastia indica.* Ecol. Monogr. 16:151–184.

APPENDIX I

THE BIRDS OF GUAM, STATUS AND ABUNDANCE

Scientific name	Common name	Status and abundance[a]
PROCELLARIIDAE		
Puffinus pacificus chlororhynchus	Wedge-tailed Shearwater	M, R
Puffinus tenuirostris	Short-tailed Shearwater	M, R
Puffinus lherminieri	Audubon Shearwater	M, R
Puffinus puffinus newelli	Manx Shearwater	M, R
HYDROBATIDAE		
Oceanodroma matsudairae	Matsudaira Storm Petrel	M, R
PHAETHONTIDAE		
Phaethon lepturus	White-tailed Tropicbird	N, U
SULIDAE		
Sula sula	Red-footed Booby	M, R
Sula leucogaster	Brown Booby	N, R
Sula dactylatra	Masked Booby	M, R
FREGATIDAE		
Fregata minor	Greater Frigatebird	M, R
ARDEIDAE		
Bubulcus ibis	Cattle Egret	M, C
Egretta intermedia	Plumed Egret	M, C
Egretta sacra	Reef Egret	N, C
Ixobrychus sinensis	Yellow Bittern	N, C
Dupetor flavicollis	Black Bittern	M, R
Butorides striatus	Little Heron	M, R
ANATIDAE		
Anas oustaleti	Marianas Mallard	N, E
Anas querquedula	Garganey Teal	M, R
Anas acuta	Pintail	M, R
Anas clypeata	Shoveler	M, R
Aythya fuligula	Tufted Duck	M, R
ACCIPITRIDAE		
Accipiter gularis	Asiatic Sparrow Hawk	M, R
PANDIONIDAE		
Pandion haliaetus melvillensis	Osprey	M, R
FALCONIDAE		
Falco peregrinus	Peregrine Falcon	M, R
Falco subbuteo	Northern Hobby	M, R
MEGAPODIIDAE		
Megapodius l. laperouse	Micronesian Megapode	N, E
PHASIANIDAE		
Francolinus francolinus	Black Francolin	I, C
Coturnix chinensis lineata	Chinese Painted Quail	I, U

APPENDIX I

CONTINUED

Scientific name	Common name	Status and abundance[a]
RALLIDAE		
Rallus owstoni	Guam Rail	N, R
Poliolimnas cinereus micronesiae	White-browed Rail	N, E
Gallinula chloropus guami	Guam Gallinule	N, R
Fulica atra	Common Coot	M, R
CHARADRIIDAE		
Pluvialis squatarola	Black-bellied Plover	M, R
Pluvialis dominica fulva	American Golden Plover	M, C
Charadrius dubius	Little Ringed Plover	M, R
Charadrius mongolus	Mongolian Dotterel	M, C
Charadrius leschenaultii	Great Sand Plover	M, R
Charadrius hiaticula	Common Ringed Plover	M, R
SCOLOPACIDAE		
Limosa limosa	Black-tailed Godwit	M, R
Limosa lapponica	Bar-tailed Godwit	M, U
Numenius phaeopus	Whimbrel	M, C
Numenius tahitiensis	Bristle-thighed Curlew	M, R
Numenius madagascariensis	Long-billed Curlew	M, R
Tringa nebularia	Common Greenshank	M, R
Tringa glareola	Wood Sandpiper	M, R
Tringa erythropus	Spotted Redshank	M, R
Actitus hypoleucos	Common Sandpiper	M, U
Heteroscelus brevipes	Gray-tailed Tattler	M, C
Heteroscelus incanus	Wandering Tattler	M, C
Arenaria interpres	Ruddy Turnstone	M, C
Gallinago gallinago	Common Snipe	M, R
Gallinago megala	Marsh Snipe	M, R
Calidris alba	Sanderling	M, U
Calidris acuminata	Sharp-tailed Sandpiper	M, U
Calidris subminuta	Long-toed Stint	M, U
Calidris ruficollis	Rufous-necked Stint	M, R
LARIDAE		
Larus ridibundus	Black-headed Gull	M, R
Chlidonias leucopterus	White-winged Black Tern	M, R
Sterna hirundo	Common Tern	M, R
Sterna sumatrana	Black-naped Tern	M, R
Sterna fuscata	Sooty Tern	M, R
Anous stolidus	Noddy Tern	N, C
Gygis alba candida	White Tern	N, C
GLAREOLIDAE		
Glareola lactea	Small Pratincole	M, R
COLUMBIDAE		
Columba livia	Rock Pigeon	I, C
Streptopelia bitorquata	Philippine Turtle Dove	I, C
Gallicolumba xanthonura	White-throated Ground Dove	N, R
Ptilinopus roseicapilla	Marianas Fruit Dove	N, R
STRIGIDAE		
Asio flammeus	Short-eared Owl	M, R
APODIDAE		
Aerodramus vanikorensis bartschi	Gray Swiftlet	N, R

APPENDIX I
CONTINUED

Scientific name	Common name	Status and abundance[a]
ALCEDINIDAE		
Halcyon c. cinnamomina	Micronesian Kingfisher	N, R
HIRUNDINIDAE		
Hirundo rustica gutturalis	Barn Swallow	M, R
SYLVIIDAE		
Acrocephalus l. luscinia	Nightingale Reed-warbler	N, E
MUSCICAPIDAE		
Myiagra freycineti	Guam Flycatcher	N, R
Rhipidura rufifrons uraniae	Rufous Fantail	N, R
ZOSTEROPIDAE		
Zosterops c. conspicillata	Bridled White-eye	N, R
MELIPHAGIDAE		
Myzomela cardinalis saffordi	Cardinal Honeyeater	N, R
ESTRILDIDAE		
Lonchura malacca jagori	Chestnut Mannikin	I, C
PLOCEIDAE		
Passer montanus saturatus	Eurasian Tree Sparrow	I, C
STURNIDAE		
Aplonis opaca guami	Micronesian Starling	N, U
DICRURIDAE		
Dicrurus macrocercus	Black Drongo	I, C
CORVIDAE		
Corvus kubaryi	Mariana Crow	N, R

[a] STATUS: E = Extirpated; I = Non-native resident; M = Migrant; N = Native resident. ABUNDANCE: C = Common; R = Rare; U = Uncommon.

APPENDIX II

INDICES OF ABUNDANCE FOR 11 SPECIES OF FOREST BIRDS AT 11 SITES[a] ON GUAM FROM OCTOBER, 1978 TO OCTOBER, 1979

Species	Tolang	Andersen South	Lajuna	Anao	Pati	Tarague	Northwest Field	Ritidian	Uruno	Haputo	Amantes	Total
a. *Species Frequency: the proportion of count periods during which a species was recorded*												
Myiagra freycineti	—[b]	.09	—	—	.09	.15	.10	.53	.60	.07	—	.21
Corvus kubaryi	—	—	.72	.48	.61	.70	.60	.63	.73	.66	.19	.52
Rhipidura rufifrons uraniae	—	—	—	—	.54	.89	.55	.91	.96	.32	—	.47
Ptilinopus roseicapilla	—	.04	—	—	.07	.15	.85	.74	.72	.48	—	.32
Gallicolumba xanthonura	—	.04	.17	.82	.09	.23	.20	.17	.16	.66	.05	.18
Myzomela cardinalis saffordi	—	.04	—	—	.13	.38	.55	.49	.13	.18	—	.19
Halycon c. cinnamomina	—	.69	.56	.58	.33	.79	.60	.73	.73	.98	.10	.62
Streptopelia bitorquata	.10	.87	.50	.26	.59	.60	.60	.26	.01	.30	.24	.37
Rallus owstoni	—	.98	—	.14	.17	.02	—	.20	—	.02	.05	.17
Aplonis opaca guami	.14	.42	.11	.26	.89	1.00	.90	.99	.97	.98	.14	.70
Zosterops c. conspicillata	—	—	—	—	.76	.02	—	.61	.54	—	—	.24
b. *Species Incidence: the total number of individuals of a species recorded, divided by the number of count periods during which it was recorded*												
Myiagra freycineti	—[b]	1.00	—	—	1.00	1.00	1.00	1.24	1.30	1.00	—	1.22
Corvus kubaryi	—	—	2.23	3.69	1.96	2.12	1.92	1.66	1.59	2.14	2.00	1.81
Rhipidura rufifrons uraniae	—	—	—	—	1.00	1.19	1.00	2.06	2.02	1.36	—	1.66
Ptilinopus roseicapilla	—	1.00	—	—	1.00	1.29	1.18	1.52	1.67	1.67	—	1.52
Gallicolumba xanthonura	—	1.00	1.00	1.00	1.00	1.18	1.25	1.17	1.27	2.34	1.00	1.57
Myzomela cardinalis saffordi	—	1.03	—	—	1.00	1.06	1.00	1.18	1.22	1.00	—	1.10
Halycon c. cinnamomina	—	1.23	1.00	1.17	1.33	1.22	1.50	1.75	1.43	1.91	1.00	1.45
Streptopelia bitorquata	1.00	2.13	1.00	1.37	1.52	1.39	1.00	1.28	1.00	1.23	1.20	1.49
Rallus owstoni	—	3.02	—	1.50	1.63	1.00	—	1.21	—	1.00	1.00	2.29
Aplonis opaca guami	1.00	1.74	1.50	1.84	2.66	2.81	1.17	3.80	2.98	3.58	1.00	2.88
Zosterops c. conspicillata	—	—	—	—	3.46	2.00	—	2.53	1.92	—	—	2.62
c. *Relative Abundance: the number of individuals of a species recorded during a count period, divided by the number of individuals of the most abundant species recorded during the same period*												
Myiagra freycineti	—[b]	.03	—	—	.03	.05	.09	.18	.27	.02	—	.12
Corvus kubaryi	—	—	1.00	.98	.45	.53	1.00	.28	.40	.40	1.00	.47
Rhipidura rufifrons uraniae	—	—	—	—	.21	.38	.48	.50	.66	.12	—	.39
Ptilinopus roseicapilla	—	.02	—	—	.02	.07	.87	.30	.41	.23	—	.24
Gallicolumba xanthonura	—	.02	.10	.12	.03	.10	.22	.05	.07	.44	.13	.14

APPENDIX II

CONTINUED

Species	Tolang	Andersen South	Lajuna	Anao	Pati	Tarague	Northwest Field	Ritidian	Uruno	Haputo	Amantes	Total
Myzomela cardinalis saffordi	—	.02	—	—	.05	.14	.48	.15	.06	.05	—	.10
Halycon c. cinnamomina	—	.29	.38	1.00	.17	.34	.78	.34	.36	.53	.25	.45
Streptopelia bitorquata	.67	.62	.31	.53	.34	.30	.52	.09	.01	.10	.75	.27
Rallus owstoni	—	1.00	—	.31	.11	.01	—	.06	—	.01	.13	.19
Aplonis opaca guami	1.00	.25	.10	.71	.90	1.00	.91	1.00	1.00	1.00	.38	1.00
Zosterops c. conspicillata	—	—	—	—	1.00	.02	—	.42	.36	—	—	.32
No. of count periods	21	45	18	73	46	47	20	70	67	44	21	472

[a] With the exception of Andersen South and Northwest Field, all sites are cliffline points.
[b] —: species not recorded in counts at that location.

No. 21. **Social Organization and Behavior of the Acorn Woodpecker in Central Coastal California,** by Michael H. MacRoberts and Barbara R. MacRoberts. 1976. $7.50 ($6.00 to AOU members).

No. 22. **Maintenance Behavior and Communication in the Brown Pelican,** by Ralph W. Schreiber. 1977. Price $6.50 ($5.00 to AOU members).

No. 23. **Species Relationships in the Avian Genus *Aimophila*,** by Larry L. Wolf. 1977. Price $12.00 ($10.50 to AOU members).

No. 24. **Land Bird Communities of Grand Bahama Island: The Structure and Dynamics of an Avifauna,** by John T. Emlen. 1977. Price $9.00 ($8.00 to AOU members).

No. 25. **Systematics of Smaller Asian Night Birds Based on Voice,** by Joe T. Marshall. 1978. Price $7.00 ($6.00 to AOU members).

No. 26. **Ecology and Behavior of the Prairie Warbler *Dendroica discolor*,** by Val Nolan, Jr. 1978. Price $29.50.

No. 27. **Ecology and Evolution of Lek Mating Behavior in the Long-tailed Hermit Hummingbird,** by F. Gary Stiles and Larry L. Wolf. viii + 78 pp., 26 text figures. 1979. Price $8.50 ($7.50 to AOU members).

No. 28. **The Foraging Behavior of Mountain Bluebirds with Emphasis on Sexual Foraging Differences,** by Harry W. Power. x + 72 pp., color frontispiece, 12 text figures. 1980. Price $8.50 ($7.50 to AOU members).

No. 29. **The Molt of Scrub Jays and Blue Jays in Florida,** by G. Thomas Bancroft and Glen E. Woolfenden. vii + 51 pp., 15 text figures. 1982. Price $8.00 ($6.50 to AOU members).

No. 30. **Avian Incubation: Egg Temperature, Nest Humidity, and Behavioral Thermoregulation in a Hot Environment,** by Gilbert S. Grant. ix + 75 pp., 35 text figures. 1982. Price $9.00 ($7.00 to AOU members).

No. 31. **The Native Forest Birds of Guam,** by J. Mark Jenkins. x + 61 pp., color frontispiece, VI color plates, 24 text figures. 1983. Price $9.00 ($7.00 to AOU members).

Like all other AOU publications, *Ornithological Monographs* are shipped prepaid. Make checks payable to "The American Ornithologists' Union." For the convenience of those who wish to maintain complete sets of *Ornithological Monographs* and to receive new numbers immediately upon issue, standing orders are encouraged.

Order from: **Frank R. Moore, Assistant to the Treasurer AOU, Department of Biology, University of Southern Mississippi, Southern Station Box 5018, Hattiesburg, Mississippi 39406.**

ORNITHOLOGICAL MONOGRAPHS

No. 1. **A Distributional Study of the Birds of British Honduras,** by Stephen M. Russell. 1964. $7.00 ($5.50 to AOU members).

No. 2. **A Comparative Study of Some Social Communication Patterns in the Pelecaniformes,** by Gerard Frederick van Tets. 1965. $3.50 ($2.50 to AOU members).

No. 3. **The Birds of Kentucky,** by Robert M. Mengel. 1965. $15.00 ($12.50 to AOU members).

No. 5. **A Comparative Life-history Study of Four Species of Woodpeckers,** by Louise de Kiriline Lawrence. 1967. $6.00 ($4.50 to AOU members).

No. 6. **Adaptations for Locomotion and Feeding in the Anhinga and the Double-crested Cormorant,** by Oscar T. Owre. 1967. $6.00 ($4.50 to AOU members).

No. 7. **A Distributional Survey of the Birds of Honduras,** by Burt L. Monroe, Jr. 1968. $14.00 ($11.00 to AOU members).

No. 9. **Mating Systems, Sexual Dimorphism, and the Role of Male North American Passerine Birds in the Nesting Cycle,** by Jared Verner and Mary F. Willson. 1969. $4.00 ($3.00 to AOU members).

No. 10. **The Behavior of Spotted Antbirds,** by Edwin O. Willis. 1972. $9.00 ($7.50 to AOU members).

No. 11. **Behavior, Mimetic Songs and Song Dialects, and Relationships of the Parasitic Indigobirds (*Vidua*) of Africa,** by Robert B. Payne. 1973. $12.50 ($10.00 to AOU members).

No. 12. **Intra-island Variation in the Mascarene White-eye *Zosterops borbonica*,** by Frank B. Gill. 1973. $3.50 ($2.50 to AOU members).

No. 13. **Evolutionary Trends in the Neotropical Ovenbirds and Woodhewers,** by Alan Feduccia. 1973. $3.50 ($2.50 to AOU members).

No. 14. **A Symposium on the House Sparrow (*Passer domesticus*) and European Tree Sparrow (*P. montanus*) in North America,** by S. Charles Kendeigh. 1973. $6.00 ($4.50 to AOU members).

No. 15. **Functional Anatomy and Adaptive Evolution of the Feeding Apparatus in the Hawaiian Honeycreeper Genus *Loxops* (Drepanididae),** by Lawrence P. Richards and Walter J. Bock. 1973. $9.00 ($7.50 to AOU members).

No. 16. **The Red-tailed Tropicbird on Kure Atoll,** by Robert R. Fleet. 1974. $5.50 ($4.50 to AOU members).

No. 17. **Comparative Behavior of the American Avocet and the Black-necked Stilt (Recurvirostridae),** by Robert Bruce Hamilton. 1975. $7.50 ($6.00 to AOU members).

No. 18. **Breeding Biology and Behavior of the Oldsquaw (*Clangula hyemalis* L.),** by Robert M. Alison. 1975. $3.50 ($2.50 to AOU members).

No. 19. **Bird Populations of Aspen Forests in Western North America,** by J. A. Douglas Flack. 1976. $7.50 ($6.00 to AOU members).

No. 20. **Sexual Size Dimorphism in Hawks and Owls of North America,** by Noel F. R. Snyder and James W. Wiley. 1976. $7.00 ($6.00 to AOU members).

(Continued on inside back cover)