Condor, 81:404–408
© The Cooper Ornithological Society 1979

NATURAL HISTORY OF THE GUAM RAIL

J. MARK JENKINS

The Guam Rail (*Rallus owstoni*) is a flightless species, endemic to Guam of the Mariana Islands. Little has been published on this rail except Baker's (1951) brief notes, Perez's (1968) note on breeding seasons, Kibler's (1950) description of the call note, and Carpenter and Stafford's (1970) work on its salt glands. Lint (1968) published a popular article on the Guam Rail containing little biological information. A study of the biology of the species appears especially appropriate in light of numerous recent extinctions of flightless rails from oceanic islands (Ripley 1977), and current declines in Guam Rail populations.

Systematists have variously interpreted phylogenetic affinities of *R. owstoni*. Olsen (1973) reclassified *R. owstoni* into the genus *Gallirallus*. Ripley (1977) questioned this classification and continued to place the Guam Rail in the genus *Rallus*; that nomenclature is used herein. Generally, *R. owstoni* is believed to have colonized Guam through the Philippines from stock probably resembling the Banded Land-Rail (*R. philippensis*; Baker 1951, Olsen 1973) or the Barred Rail (*R. torquatus*; Ripley 1977).

Since 1960, staff biologists of the Guam Division of Aquatic and Wildlife Resources have collected field notes on the Guam Rail and monitored population sizes through roadside counts. These data form the basis for the present paper.

STUDY AREA

Guam is the largest and southernmost island of the Marianas Archipelago. Lying at approximately 13° 13'N, 145°E, Guam is 45 km long, 6 to 13 km wide, and has a uniformly warm and humid climate throughout the year. Rainfall is heaviest from July through November, with an average annual rainfall of 219.6 cm. Guam is divided into a northern half, a limestone plateau or "mesa" with coralline limestone soils predominating, and a southern half which is primarily volcanic in origin, with laterite soils. Stone (1970) described the predominant vegetation of the northern plateau as "typhoon forest" and recognized seven subtypes, including *Pandanus* forest and holophytic-xerophytic scrub forest, widely used by the Guam Rail. Dominant vegetation on the southern volcanic soils includes ravine forest and savanna.

METHODS

Roadside counts of 40.8 km and 39 km were conducted over northern and southern Guam, respectively. The northern route encompassed primarily mixed woodland and second growth habitats, while the southern route covered savanna and mature ravine forest habitats. Since 1961, counts have been conducted at dawn from vehicles moving between 20–30 kph, first weekly and later bimonthly. In addition, roadside counts during 1968 recorded the number of rails seen in four different habitat types: savanna, mowed grass with brush, mature mixed forest, and mixed woodland with brush. Total numbers of rails and rail broods observed monthly and yearly were converted to rail and rail broods per 160 km of travel.

Food habits were determined by examining gizzards and proventriculi, primarily from road-killed individuals (N = 34). The degree of digestion of stomach contents often limited the specific identification of food items. Weights and measurements were obtained from specimens collected during the early 1960's and from road-killed birds in good condition.

RESULTS AND DISCUSSION

GENERAL DESCRIPTION

Rallus owstoni is a large rail with dark brown head, neck, back, rump, tail, legs, feet, and bill. The wings, lower breast, abdomen and under tail coverts are barred black and white, while extensive areas of ash gray occur on the neck, upper breast, and in a superciliary stripe (Fig. 1). Plumages of the sexes are similar (Mayr 1945, Baker 1951). As in other *Rallus*, the body is elongated and laterally compressed, particularly in the neck and breast regions, allowing the birds to move rapidly through dense vegetation. Males are larger than females (Table 1); the sexes often are distinguishable by their sizes when seen together in the field.

DAILY ACTIVITIES

The Guam Rail is a monogamous territorial species. The sizes of daily or seasonal ranges are unknown. Recorded incidents of fighting, presumably between males, probably are related to territoriality.

These birds are often seen during the early morning and late evening when they venture from cover to forage and bathe along field edges and roadsides. They also forage at night, a trait considered common among *Rallus* species (Ripley 1977). The Guam Rail is wary, seldom wandering far from the shrub growth to which it retreats when alarmed. Though capable of short bursts of flight of 1–2 m, the bird seldom flies.

Nothing is known of the rail's behavior when under cover, but in open areas it devotes much time to plumage care. Bathing and preening occupied 35% of 113 min of observation of 26 rails. Birds frequently

FIGURE 1. The head of a Guam Rail.

preen or bathe in small puddles along secluded roadsides following early morning rain showers.

HABITAT PREFERENCES

The Guam Rail formerly occurred in most habitats on Guam. Table 2 shows the mean number of rails observed per 160 km of travel in four habitat types in 1968. Mowed grass with brush habitats included maintained areas of mowed grass along roadsides, telephone lines and antenna fields, bordering scrub communities. The number of rails recorded in the mature mixed forest habitat is likely an overestimate as a result of roadside censuses being conducted along the edge of these habitats, where rails were abundant. Rails are seldom seen or heard in the interior of the mature limestone forest, and this habitat is best considered marginal for the species, as are savanna habitats occurring in southern Guam (Table 2). The species does not occur in the freshwater wetland habitats of Guam.

FORAGING BEHAVIOR

Guam Rails most frequently peck food items directly from the ground. This technique is of primary importance in securing snails and slugs, especially following rain showers. Birds also "hawk" low flying insects, particularly butterflies. They first locate a prey item while standing still and then attempt capture with a quick burst of speed. Baldwin (1947) observed similar behavior in the now extinct Laysan Rail (*Porzanula palmeri*). *R. owstoni* obtain seeds and flowers from low grasses and shrubs. They can stretch their bodies nearly perpendicularly, reaching food 40 cm or more above ground.

Adult rails may locate specific foraging spots and allow their chicks to peck there, often moving away and permitting the juveniles to forage independently. Alternately, adults may secure food (usually insects) and then allow the chicks to peck the items from their bills, or they may lay them in front of the chicks.

FOOD

Rallus owstoni apparently prefer animal over vegetable foods (Table 3). The extensive use of gastropods, particularly snails, is probably related to the accidental introduction in 1945 of the giant African snail (*Achatina fulica*). Believed introduced from a ship at commercial port, the African snail rapidly expanded its range into most habitats on the island and has become an important food for the rail. The birds also have been observed eating carrion and geckos (*Hemidactylus frenatus*), although these items were not found in the 34 stomachs examined. Insects, representing at least three orders (Othoptera, Dermaptera, Lepidoptera), are important in the Guam Rail diet.

Vegetable foods included unidentified seeds and palm leaves. During the dry season rails have been reported to damage crops such as cucumbers, tomatoes, and various melons, though such damage probably results from the birds' securing moisture rather than food.

Snail shells, or their pieces, may be ingested in the course of feeding, but also appear to function as grit. Coral chips ranging

TABLE 1. Body measurements (mm) and weights (g) of male and female Guam Rails.

	Wing	Tail	Culmen	Tarsus	Weight
Male					
Mean	124.8	51.7	39.0	52.1	241.4
Range	120–133	50–53	33–43	50–56	174.0–303.0
N	6	3	6	4	27
Female					
Mean	119.2	47.6	38.1	47.0	211.9
Range	122–125	45–52	34–42	43–54	170.0–274.2
N	7	5	7	6	20

TABLE 2. Number of Guam Rails recorded in four habitat types during 1968 on roadside counts totaling over 800 km.

Habitat type	Number (%)	Rails per 160 km
Savanna	2 (1.0)	1.6
Mowed grass with brush	83 (40.1)	65.3
Mature mixed forest	54 (26.1)	43.8
Mixed woodland with brush	68 (32.8)	56.2
Total	207	

TABLE 3. Stomach contents of 34 Guam Rails.

Material	Number of times occurring in 34 stomachs	Percent occurrence in 34 stomachs
Snails	22	64.7
Slugs	4	11.8
Insects	13	38.2
Vegetable matter	4	11.8
Coral chips (grit)	14	41.2
Snail shells (grit)	12	35.3

in diameter from 1–9 mm are eaten specifically as grit; eight chips were the maximum number found in one gizzard.

NESTING

Guam Rails nest on the ground, both sexes sharing in the construction of a shallow nest of interwoven loose and rooted grasses. One nest measured 13 cm in diameter and 3 cm deep. The eggs are white to pinkish with small spots of pink or blue concentrated at the large ends. Nine eggs averaged 39 mm (37–41) in length and 29.3 mm (28–30) in width.

The typical clutch consists of 3–4 eggs, representing a smaller clutch size than congeneric species in the north temperate regions (Baldwin 1947). I interpret the small clutch size of the Guam Rail as being an evolutionary result of year-round breeding in a formerly predator-free, tropical environment. One clutch hatched at 19 days. Both sexes share in the incubation duties. It is suspected that renesting occurs, but the number of clutches per year is unknown.

Although the species nests year-round, Perez (1968) suggested the existence of a peak breeding period during the rainy season from July through November, based on the average number of rail broods seen per month on weekly roadside counts (Fig. 2). These data probably do indicate an increase in nesting activities during rainy months. However, if a peak nesting period does exist, it probably is not of the magnitude suggested in Fig. 2 because adult rails also are more frequently observed then. Since adult rails are more visible during this period, it is not surprising that broods also are more visible, as chicks closely follow adults. I interpret these data as indicating a behavioral characteristic of *R. owstoni* in response to increased food items, principally snails and slugs, in open areas during the rainy season, while not discounting increased nesting activity at the same time.

YOUNG

The eggs hatch asynchronously and the young are highly precocial, leaving the nest within 24 h after hatching. The eggshells are consumed by an adult, presumably the female. Brood nests, which have been observed in other rails, have not been reported for *R. owstoni*.

Guam Rail broods range from one to four chicks, with two being the mean and median size. In 172 broods, there were 54 with one chick, 77 with two, 35 with three, and 6 with four chicks. Both sexes brood the young.

One female chick was raised in captivity and was weighed daily. At one week, it weighed 38.6 g, two weeks 75.2 g, three weeks 122.2 g, four weeks 135.3 g, five weeks 175.1 g, six weeks 195.2 g, seven weeks 211.3 g, and eight weeks 205.8 g. The young bird was covered with black natal down through its first three weeks, gradually developing juvenile contour feathers during the fourth week. Feathers on the ventral and crural pterylae developed rapidly, giving the chick a noticeable ventral barring by the end of the fourth week. Between the fourth and sixteenth week of life, birds in the juvenal plumage are identifiable by the less extensive areas of gray on the neck, breast and superciliary stripe. Thereafter, first-year birds are indistinguishable from adults in the field. The age at sexual maturity is unknown, as is the longevity of the species, although one of ten Guam Rails sent to the San Diego Zoo in 1968 is over 11 years old.

POPULATION AND DISTRIBUTION

Rail populations have fluctuated considerably since the beginning of roadside counts over northern and southern Guam in 1961 (Fig. 3). The increase of rails during the 1960's may be related to the introduction of the giant African snail, particularly on the northern plateau. Recently, the species has

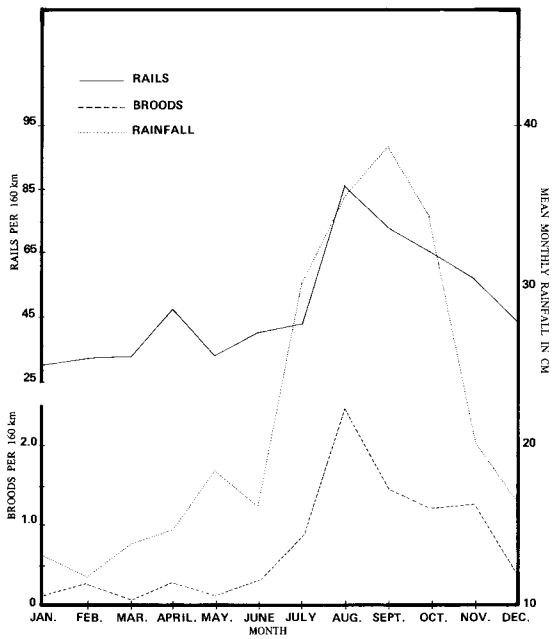

FIGURE 2. Mean number of Guam Rails and broods seen monthly per 160 km of travel on north and south routes and mean monthly rainfall for years 1961–1975.

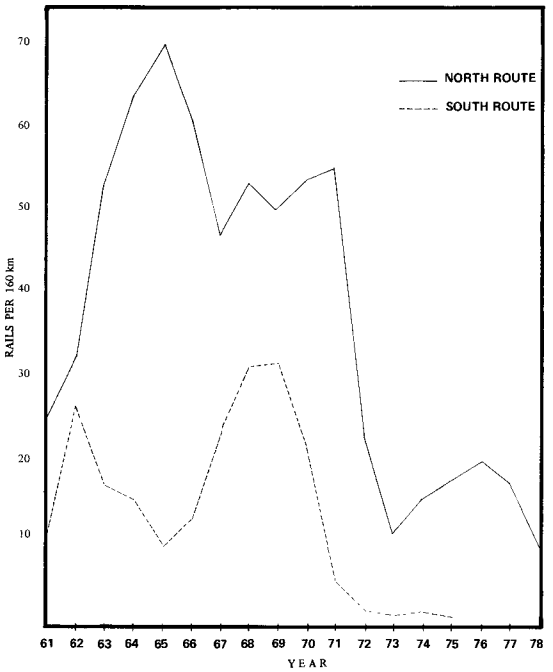

FIGURE 3. Mean number of Guam Rails seen yearly per 160 km of travel from 1961 to 1978 on north route and from 1961 to 1975 on south route.

severely reduced its range, virtually disappearing from southern Guam and the central portion of the northern plateau, becoming localized in small areas around the fringes of the plateau.

Causes for this decline in populations are uncertain. However, circumstantial data suggest that pesticide poisoning may be involved. These data include: 1) the fact that DDT was dusted on Guam weekly by U.S. military units during and following World War II, with the use of pesticides continuing by the military, developers, and by local farmers, 2) the findings that a native species, the Vanikoro Swiftlet (*Collocallia vanikorensis*), tested in 1975 contained body tissue concentrations of DDE averaging 0.27 ppm (0.17–0.39), and 3) the virtual disappearance of the entire native avifauna from the southern half of Guam, combined with the fact that southern Guam with its rivers and streams received heaviest pesticide applications.

Predation, by a number of introduced predators, cannot be discounted as a possible factor in declining rail populations. Nest predation by the Philippine rat snake (*Boiga irregularis*), monitor lizard (*Varanus indicus*), three species of introduced rats (*Rattus norvegicus, R. rattus, R. exulans*), as well as feral dogs, cats and pigs may affect the reproduction of the Guam Rail. Yet for this to be a major factor in recent declines would require some evidence that predation has increased over the past decade, since all predators were present on Guam during the relatively high rail populations of the 1960's. No data are available on past or present predator populations.

Habitat destruction probably has not been a major factor in rail declines of the 1970's. Development has occurred primarily in northern and central Guam and it is difficult on this basis to explain the disappearance of the rail from its southern habitats. Habitat destruction cannot be overlooked as a future detriment to the species in its northern range, as areas of localized rail populations are under increasing pressure from development.

Conservation measures initiated for *R. owstoni* include a proposal by the Government of Guam to add the species to the U.S. Endangered Species List, with designation of appropriate critical habitats. Studies are being undertaken to determine precise causes for declining rail populations. Should present declines continue, the southeastern portion of the northern plateau encompassing a contiguous portion of federal lands, including Mangilao Communication and Marbo Annexes of Andersen Air Force Base, and the U.S. Naval Golf Course and Communication Station, may represent the best opportunity for maintaining a wild pop-

ulation of these birds. All use of pesticides and herbicides should be discontinued in this area, combined with a sustained effort at predator control. The success of these and future conservation measures may well determine the continued existence of the Guam Rail.

SUMMARY

The Guam Rail is an endemic flightless bird, occurring in greatest abundance in the mixed woodland, second growth and scrub habitats of northern Guam, and uncommonly in savanna and mature forest habitats. It is not found in wetlands. The rails are omnivorous, preferring animal material, particularly gastropods and insects, over vegetable matter. The typical clutch consists of three or four eggs, with brood sizes ranging from one to four ($\bar{x} = 2.0$) chicks. Nesting occurs year-round, but activity appears to increase during the rainy season (July–November). The young are highly precocial, achieving adult weights in the seventh week of life and adult-like plumage after the sixteenth week. Formerly distributed island-wide, the Guam Rail recently has undergone severe range restrictions, virtually disappearing from southern Guam, and has become localized around the fringes of the northern plateau.

ACKNOWLEDGMENTS

This study was supported by Federal Aid to Wildlife Restoration (Pittman-Robertson Act). I thank the following former staff biologists who contributed field notes for this paper: Terry A. McGowan, Maurice H. Taylor, Alan Courtwright, Nick Drahos, Jack Jeffrey, and Gerald S. A. Perez, who also reviewed the manuscript. The conservation officers of the Government of Guam conducted many of the roadside counts.

LITERATURE CITED

BAKER, R. H. 1951. The avifauna of Micronesia, its origin, evolution, and distribution. Univ. Kans. Publ. 3:1–359.

BALDWIN, P. H. 1947. The life history of the Laysan Rail. Condor 49:14–21.

CARPENTER, R. E., AND M. A. STAFFORD. 1970. The secretory rates and the chemical stimulus for secretion of the nasal salt glands in the Rallidae. Condor 72:316–324.

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

LINT, K. C. 1968. A rail of Guam. Zoonooz 41:16–17.

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

OLSEN, S. L. 1973. A classification of the Rallidae. Wilson Bull. 85:381–416.

PEREZ, G. S. 1968. Notes on the breeding season of the Guam Rail, *Rallus owstoni*. Micronesica 4:133–135.

RIPLEY, S. D. 1977. Rails of the world. David R. Godine, Boston.

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

Division of Aquatic and Wildlife Resources, Department of Agriculture, P.O. Box 23367, GMF Guam, Mariana Islands 96921. Accepted for publication 30 May 1979.

Condor, 81:408
© The Cooper Ornithological Society 1979

RECENT PUBLICATIONS

Research is a Passion With Me.—Margaret Morse Nice. 1979. Consolidated Amethyst Communications Inc. 336 p. Paper cover. $9.95. Available: C. A. C. Inc., 60 Barbados Blvd., Unit 6, Scarborough, Ontario M1J 1K9, Canada. Margaret Morse Nice completed her autobiography about ten years ago, a few years before she died in 1974. It has been edited here by Doris Huestis Speirs, president and founding member of the Margaret Nice Ornithological Club in Toronto, which sponsored its publication. Woven into the principal themes of Nice's work on the birds of Oklahoma and on Song Sparrows are her family history, experiences with other ornithologists and participation in ornithological meetings. The story is fascinating and well-told. Konrad Lorenz, a long-time friend, has written an appreciative Foreword and an appendix in which he explains his intellectual debt to her. This is a valuable contribution to the history of American ornithology. Photographs, references (including a list of Nice's publications), and index.

My World of Birds: Memoirs of an Ornithologist.—George J. Wallace. 1979. Dorrance & Co., Philadelphia. 345 p. $10.00. Those who know of Dr. Wallace as the author of an ornithology textbook may not be aware that he previously did a classic life history study of Bicknell's Gray-cheeked Thrush and that he taught at Michigan State University for many years. These and other professional accomplishments were motivated by his sheer enjoyment of birds out-of-doors. He here recounts his career with characteristic ingenuousness and humor. An engaging autobiography, it will be enjoyed especially by those who know the man, himself. Photographs, many from the family album.