Observations of Guam Bats

GERALD S. A. PEREZ[1]

Abstract

Heavy poaching and changes in the landscape appear to be the two most significant factors responsible for the general overall decline in the number and distribution of Guam fruit bats. Miscellaneous ecological and life history data are also presented.

INTRODUCTION

Because of Guam's relative isolation, the island's original mammifauna must have been limited to those capable of traveling considerable distances over water or of surviving long trips on floating logs or other conveyances. It is thus likely that the three bat species recorded on the island are original inhabitants. These include two fruit bats (*Pteropus mariannus* and *P. tokudae*) and a possible member of the genus *Emballonura*. Thompson (1942) noted an insectivorous bat believed to be *Emballonura sulcata*, although a specimen from Guam likely has not been collected (Eldredge, 1968). The occurrence of *Emballonura* on Guam is not improbable as it is found on neighboring islands to the south (Sanborn, 1949; Johnson, 1962; and others) and a subspecies, *E. sulcata rotensis* was described by Yamashina (1943).

Early bat accounts in Micronesia (Oustalet, 1895; Sanborn, 1931; Yamashina, 1932; Tate, 1934) were generally limited to lists of field collections and taxonomic descriptions. Among others, papers by Crampton (1921), Linsley (1934), Bryan (1939), Nicholson (1945), and Beaty (1967) merely described the relative abundance, distribution, and occasional habits of *P. mariannus*. Although of some value, ecological data presented were generally scanty at best. Thus, despite their long history on the island, little information is available on the ecology and life history of Guam bats.

The objective of this paper is to present unpublished data on the biology and general status of Guam bats. The author hopes that the following observations will be of some value to future bat studies and that the lack of conclusive data will stimulate bat research interest on Guam.

DESCRIPTION OF STUDY AREA

With a land area of about 210 square miles, Guam is located at lat. 13°28′ N.,

[1] Division of Fish and Wildlife, Department of Agriculture, Agana, Guam 96910; *Present Address*: Department of Land Management, Agana, Guam.

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long. 144°45′ W., and lies approximately 6,000 miles southwest of San Francisco. Being generally mild in temperature, the island's climate has been described as closest to Koeppen's Amwi climatic type (Hosokawa, 1967).

Two geologic provinces dominate the island and are largely responsible for the resulting soil types presently found. Except for several volcanic outcrops, the northern half of Guam is basically an elevated limestone plateau. In contrast, the southern half is largely volcanic and hilly. The island's geology and hydrology has been described in detail by Tracy *et al.* (1964).

The northern plateau generally supports a variety of mixed broadleaved evergreens, whereas the southern half is generally savanna grassland with scattered woodlands and mesic volcanic ravine forests. Fosberg (1960), Stone (1967), Hosokawa (1967), and others have described Guam's vegetation in more detail.

METHODS AND PROCEDURES

Field observations between June, 1966 and July, 1968 comprised the major portion of this study. With the exception of regular bat count surveys conducted from 1962 through 1968, data were gathered unsystematically. Miscellaneous biological data were obtained during chance encounters with hunters and from occasional collections.

Monthly area bat counts were made at one volcanic forest area (Fena Lake) and two mixed limestone forest areas (Naval Communications Station and Taragüe Cliffs). These areas were selected because of their easy access, geographic location, physiographic and vegetative uniformity, and relative bat abundance indicated by earlier reconnaissance observations. Located along the northern margins of the island, NCS and Taragüe Cliffs support a wide variety of limestone plant communities. The Fena Lake sample represented a more mesic habitat type rather typical of many southern volcanic ravine forests discussed by Fosberg (1960).

Two bat count stations were established at each of the two cliff limestone forests. An upper station above the cliff allowed an observer to count all bats seen in the upper plateaus and cliffsides not visible from below. A station at the foot of the cliff covered areas not visible from the upper station. Areas not visible from either station were covered by an observer driving slowly (5–15 mph) through pre-determined routes. Each station count lasted about 10–15 minutes, with another 10 minutes required to move between stations and also count bats along the driven routes. Fena Lake bat counts were conducted differently. An observer counted bats while slowly cruising (5 mph) on a motorboat once around the lake margins.

The roosting areas at NCS and Taragüe were generally surveyed within an hour after sunrise when fruit bats generally returned from their nocturnal activities. Early morning counts were usually later at Fena Lake. Since it is located within a Navy installation, escort service was required, and this was usually not available as early as desired.

From a distance it is difficult to distinguish between *P. mariannus* and *P. tokudae*. Consequently, census data reflect the combined numbers of both species. Searches for the insectivorous bat involved only occasional searches of caves when such caves were reported or found during the course of other work. Search efforts were concentrated in the northern part of Guam where caves and limestone fissures are most abundant.

Results of monthly fruit bat counts were converted into bats per 100 acres and averaged for each year. Based on these monthly censuses, a frequency index was used to show the relative consistency with which fruit bats were seen.

RESULTS AND DISCUSSION

Monthly counts showed wide variations. On an annual basis; however, it appeared that a decline in fruit bat populations might be taking place, particularly at Fena Lake (Fig. 1). Assuming such a trend is in fact taking place, it is most probably due to poaching and continued land clearing.

Fruit bats, being "delicacies" among many people, can easily be sold for $5.00 each. And although fruit bats are protected by law, market hunters can often make fantastic profits even after paying a maximum fine when they get caught. The highly gregarious behavior of fruit bats make them especially vulnerable to poachers. Indeed, it is not rare to find empty shotgun shells at varous roosting or feeding areas.

Continued land clearing in the name of "progress" can only aggravate the near-precarious status of fruit bats. For instance, the seemingly endless expansion of Naval facilities probably contributed significantly to the continuing decline in the number of fruit bats observed at Fena Lake (Fig. 1). Research in the area is made very difficult by strict security measures.

Although bat populations at Tarague and NCS Cliffs indicated a slight reversal of this apparent decline in recent years, the techniques employed were not sufficiently reliable to permit optimism. Two observations of small colonies at Tarague contributed to the gross variation in 1968 (Fig. 1). The unknown influence of such factors as population density, behavior, food supply, time, and weather also make difficult the assessment of population trends.

On the other hand, colonies—one of them reportedly including "about a thousand" fruit bats—have been sighted in three different areas around Tarague since July, 1968, so extreme pessimism is not warranted either.

Unlike NCS and Tarague, where the frequency index showed fluctuations of under 20%, the consistency of bat observations at Fena Lake dropped from a five year average of 100% to 54% in 1968 (Fig. 1). A considerable number of caves and cliff limestone fissures were visited in 1967, but no guano or other evidence of insectivorous bats was observed. In February, 1968, about a dozen small brown bats were seen in a small cavern at the base of Tarague Cliff. Further observations of this finding and notes on individual species follow.

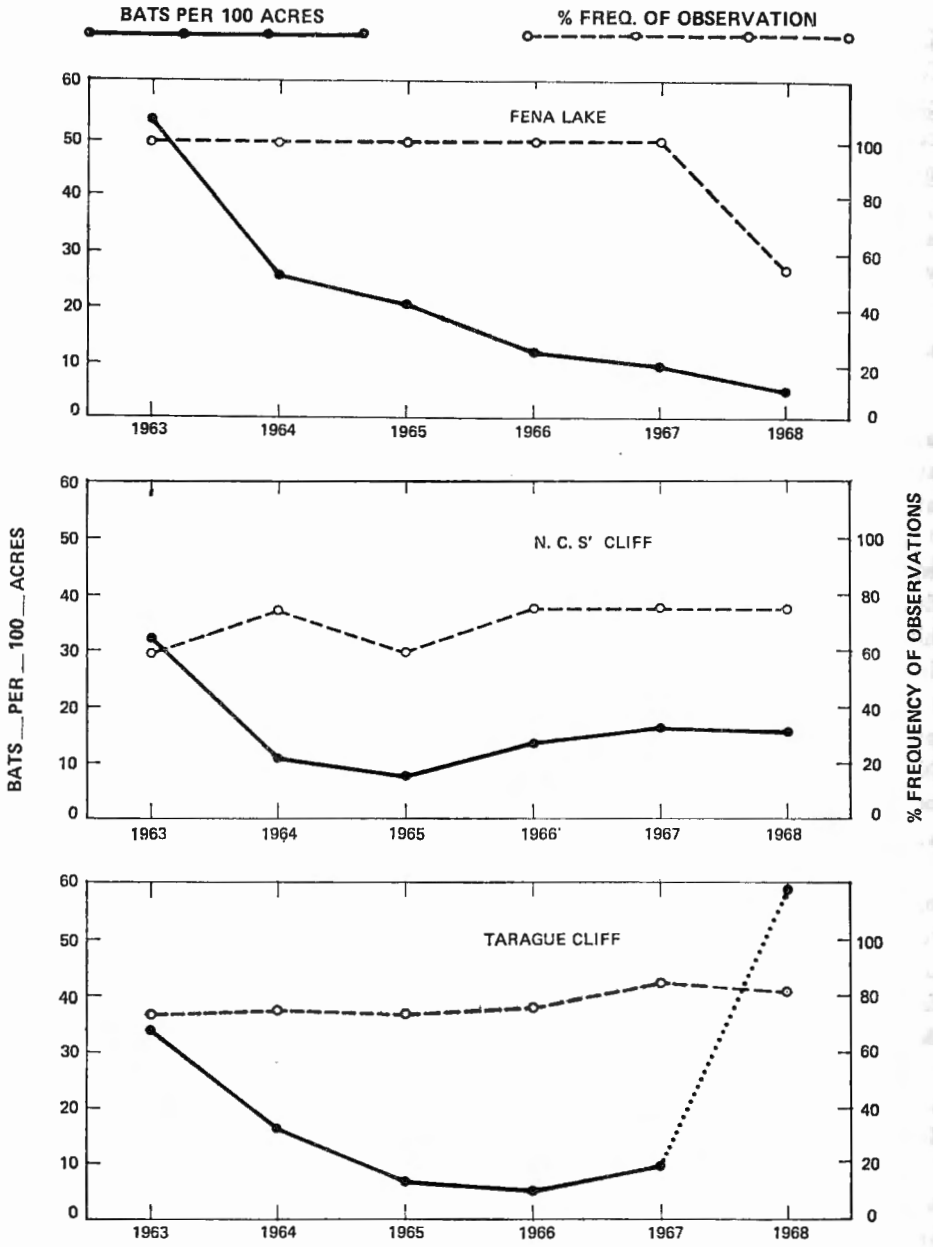

Fig. 1. Annual monthly average of fruit bat counts.

Pteropus mariannus and P. tokudae

Of the three known bats on Guam, it appears that *P. mariannus* represents the most common and widely distributed on the island. Since *P. mariannus* and *P. tokudae* occupy the same habitats, census data reflect both species. However, *P. mariannus* probably represents the bulk, if not all, of the count data. Hunters and old timers consider *P. tokudae* extremely rare or "extinct". Of over 100 fruit bats collected and examined, all but one specimen appeared to be *P. mariannus*. Unlike *P. giganteus*, which in India reportedly roost in the neighborhood of human activity (Allen, 1939), *P. mariannus* and *P. tokudae* seem confined to the unpopulated or inaccessible cliff limestone vegetation and the interior volcanic ravine forests. Two specimens of *P. mariannus* were sent to the American Museum of Natural History (Cat. No. AMNH 213119 and 213120).

Scattered small colonies of fruit bats were observed at various parts of the island and at various times of the year. During late winter and early spring of 1967 and 1968, a number of reliable observers reported a colony of about 300 bats at Orote Cliff along the west central coast. Several other colonies numbering up to about 500 bats were observed along Tarague Cliff throughout 1967 and 1968. Mr. Maurice Taylor, former Government of Guam biologist informed the author of seeing at least two colonies of about 850 and 600 bats during several visits to the area in 1965 and 1966. A Division of Fish and Wildlife Conservation Officer reported seeing a colony of "about 1,000" bats in the Tarague area in 1968 when they flew up from a roost, apparently disturbed by poachers.

On March 4, 1967, about 40 bats were seen flying off Ritidian Cliff. On December 17, 1967, Mr. Carl Gutierrez, an avid sportsman, reported seeing "about a hundred" bats in the same area. At other times, as many as half a dozen bats were observed, and although a colony was never located, the presence of one in the area was quite possible. As many as half a dozen or more bats were also seen flying along NCS Cliff during monthly bat counts. But if they were part of a colony, evidence of the main body was never confirmed. Although a number of farmers reported seeing several colonies along the northeastern coastline, these reports were never confirmed. Because southern ravine forests were more inaccessible, data from these areas are quite limited. However, scattered sightings indicate at least their presence within the island's southern interior.

Irregular observations made difficult the determination of any mating season of Guam fruit bats. In Ponape (lat. 7° N.), unweaned *P. molossinus* have been collected in February, September, and November (Jackson, 1962), suggesting at least a prolonged mating period for this neighbor species. Unlike the definitely limited breeding season of *P. geddiei* that Baker and Baker (1936) observed in the New Hebrides (lat. 15° S.), fruit bats on Guam (lat. 13° N.) appeared capable of breeding throughout the year (Table 1). Because of the limited data and difficulty of in-the-field differentiation of *P. mariannus* and *P. tokudae*, Table 1 shows the combined reproductive data obtained from field observations and periodic collections of both species.

Meaningful data on sex and age ratios for Guam fruit bats are limited. In March 1967, security personnel reported that males numbered 13 out of 29 fruit bats taken by hunters at Orote Naval Station. Species and age data were not reported. At Tarague Cliff, male to female sex and age ratios for 23 *P. mariannus* specimens collected (January and February, 1969) in one roosting site were as follows:

Gross sex ratio = 92: 100 (23 specimens)
Ad. sex ratio = 80: 100 (18)
Juv. sex ratio = 100: 67 (5)

Adult female to juvenile sex ratios were as follows:

Ad. ♀: total young = 100: 50 (15)
Ad. ♀: juv. ♀ = 100: 20 (12)

No data on sex and age ratios were obtained for *P. tokudae*, as only one female specimen was encountered.

For record purposes, average and extreme measurements of the 23 *P. mariannus* specimens collected at Tarague cliff are presented in Table 2. Measurements of the only *P. tokudae* specimen collected were as follows: whole weight 151.8 gms; total length 225 mm; body length 151 mm; wing span 650 mm; forearm 95 mm; right hind foot 70 mm (without claw); and ear 20 mm. When shot at Tarague Cliff, this specimen was nursing a young, which escaped capture. Generally smaller and odorless in comparison to *P. mariannus, P. tokudae* is considered rare by hunters and old timers alike. In a short taxonomic note, Tate (1934) provides the only other published account of *P. tokudae.*

Because both fruit bats apparently occupy the same habitats, census data reflect both species combined. However, an unrecorded number of fruit bats randomly examined during the hunting seasons were *P. mariannus.* It seems likely that this species represents the bulk, if not all, of the bat count data taken.

While it is not known whether *P. mariannus* and *P. tokudae* integrate in a colony, such behavior is not improbable among *Pteropus.* Nelson (1965a) reported colonial integration among Australian species, and indicated the possibility of detrimental competition between *P. gouldi* and *P. poliocephalus.* Since *P. gouldi* is larger and more aggressive, he offered evidence of it replacing *P. poliocephalus* in certain areas of Australia (1965b). Whether the same situation is found between the larger, more common *P. mariannus* and the smaller, less common *P. tokudae* on Guam, can only be determined by more detailed research.

During April of 1967, Dr. Hebert, a U. S. Navy doctor, reported some interesting observations regarding group behavior of fruit bats at Orote Point. Before the main body of the colony left its day camp, one or several "scouts" would fly overhead for about five minutes, return to the vicinity of the colony, and then join the "mass" migration of bats in their flight to nocturnal feeding grounds further inland. This pattern was observed on several occasions, with as many as 300 or more bats seen on a "good night".

At about 8:00 a.m. on October 26, 1967, the author observed a number of bats returning to their day camps at Tarague Cliff. Several early arrivals were first seen,

Table 1. Numbers of unweaned (A) and unborn (U) *Pteropus* spp. observed on Guam (M. H. Taylor and G. S. A. Perez, unpublished data).

Fiscal Year	J	A	S	O	N	D	J	F	M	A	M	J
1963						1A	1A			1A		
1964					1A				1A			
1965			1U									
			1A	9A								1A
1966	1A					1A						2A
1967					1A	1A			3U			
									3A			1A
1968							4A	1A				1A

Notes: (1) Irregular collections and observations and hence trends cannot be inferred.
(2) Exact species unconfirmed in the field. However, data from field observations were combined with identified collections to facilitate table presentation.

Table 2. Average and extreme weights and measurement of 23 *P. mariannus* from Guam.

Weight (gms)	Forearm (mm)	Wingspan (mm)	Right Hind Foot without Claw (mm)
10 Adult ♀			
412.5	141.3	950	97.8
(345.3–486.9)	(134–145)	(860–1000)	(93–101)
2 Juvenile ♀			
201.7	115.0	785	85
(173.2–230.3)	(112–118)	(770–800)	(85)
8 Adult ♂			
513.2	146.7	1018.3	102.5
(475.5–577.0)	(135–154)	(930–1085)	(92–112)
3 Juvenile ♂			
210.6	114.0	785.0	87.3
(156.7–278.2)	(110–117)	(760–825)	(84–92)

followed by groups of two to four bats close together. Two "waves" of about 15 and 25 bats each were observed going from the interior flat portion southwest of the cliffline to the eastern cliff margins.

Although old timers claim that mass migration of fruit bats from one island to another was often observed in the past, such observations were never documented and are difficult to substantiate, as only a few such observations have been reported in recent years. An inter-island boat captain casually mentioned that on a "few" occasions between 1964 and 1967, he observed numerous bats spiraling high in the air and then gliding to Rota or Guam. On December 17, 1967, Mr. Carl Gutierrez, a Government of Guam employee, reported seeing about 100 fruit bats flying from the direction of Rota Island (some 40 miles away), and alighting at Ritidian Point Cliff.

Guam fruit bats appear to be strictly vegetarians. Among the preferred foods are kapok (*Ceiba pentandra*) blossoms, screw pine (*Pandanus* spp.) fruits, seedy bread-

fruit (*Artocarpus mariannensis*), papayas (*Carica papaya*), and the sweet sap from young coconut (*Cocos nucifera*) blossoms.

Man excluded, there are no natural predators of Guam fruit bats. The black drongo (*Dicrurus macrocercus*) might be considered an "enemy" of sorts, as they were occasionally observed attacking solitary bats in flight. In one instance, three drongos were seen attacking a bat, pecking it on the body and wings. Although the significance of such "predations" remains unknown, the author believes it not too important in terms of the overall bat population. Furthermore, fruit bats and drongos generally differ in habitat preference and hours of greatest activity.

Of some 30 or more *P. mariannus* examined from Tarague Cliff, none were infested with ecto-parasites such as the flies (Nycteribiidae) and mites (Laelapidae) found on *P. pelewensis* in Palau (Perez, 1968). At the height of the rabies outbreak, 25 *P. mariannus* heads from Tarague (an area within the island's highest rabies incidence region) were sent to U. S. Public Health Laboratories for rabies examinations. All were found negative. The only *P. tokudae* specimen examined appeared healthy.

There is little doubt that the increasing human population, accompanied by changes in the island's landscape, is most responsible for the general decline of Guam bats. Although it has apparently been the species most tolerant to change, *P. mariannus* seems incapable of withstanding the rate of abuse it is currently receiving from man. Unless effective measures are taken, it is not inconceivable that this species will become as rare and as threatened with extinction as *P. tokudae* apparently is today.

Emballonura sp.

In March of 1968, a hunter reported seeing about a dozen "small bats" flying near several caves at Tarague Cliff. The following month, the author observed about half a dozen small brown bats clinging to the roofs of these same caves. When disturbed, they flew from one cave to another, occasionally fluttering outside. Four attempts to capture specimens proved unsuccessful, even with the aid of thin mist nets. According to old timers, small cave bats were once extremely abundant in limestone caves and fissures; and, like *P. tokudae*, are now considered extremely rare. The small cave bats observed at Tarague might have been *Emballonura sulcata*, but the absence of specimens preclude definite identification beyond the probable genus *Emballonura*.

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