

An overview of Pteropus tonganus population size
and habitat use in American Samoa, with discussion of bats
occurring within the National Park of American Samoa.

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Summary

Pteropus tonganus select "areas" for roost sites rather than specific trees. Sites are used repeatedly for many years although bats move within the site to roost in different trees. Human disturbance, such as hunting at roosts, causes bats to fly from roosts during the day and may be a cause of abandonment of roost sites. Hunting and predation by domestic animals caused a dramatic population decline after hurricanes Ofa and Val (Pierson et al, 1996; Dashback, 1990) although population numbers appear to have increased steadily. A small but potentially significant amount of illegal hunting is ongoing.

Introduction

Two species of Pteropus bats are found in American Samoa, Pteropus tonganus and P. samoensis. While both species roost and forage in the native forest, the social organization and use of roosting sites differs greatly between species. This report synthesizes data collected by personnel at DMWR on the location and movements of P. tonganus roosts, characterizes roost sites, tree species and locations, 1987-1996. This period of time includes a comparatively high population density before hurricane Ofa and low population density following hurricane Val.

Background

Pteropus tonganus roost gregariously in one or more large trees where bats typically hang on small branches in the crown. Large aggregations are sub-divided into 'harem' groups of a single dominant male and several females on the same branch, with

non-reproductive and younger males segregated from female groups on other branches (Grant and Banack, 1995). Occasionally a small roost contains only bachelor males. This pattern of social organization is similar to other colonial Pteropus species (Pierson and Rainey, 1992).

Young bats are born throughout the year. Grant and Banack (1994) suggested that females may be both pregnant and nursing juvenile young, implying that young may be born at nine-month intervals. We have no data on P. tonganus maturity rates, but young of other Pteropus species begin to fly when three months of age and are weaned after 4-6 months. Young may remain dependant on their mothers for a year, and females do not give birth until they are one to two years old (Mickleburgh, et al., 1992).

Methods

DMWR has monitored population numbers of P. tonganus since 1987 by conducting island-wide surveys of colonial roosting bats. Roosts are viewed from the water in a small boat or from land. Currently, we also count the number of flying bats as they exit from three roosts at dusk. Most roosts are visible only from the ocean so surveys are done from a small boat, a difficult situation in which to use binoculars in the best of weather. Roost counts are the average estimated number of bats observed per roost by several observers. Surveys were conducted annually 1987-1989, but after Hurricane Ofa in February 1990, surveys were increased to 2-4 times per year. Each specie of tree that bats were observed hanging from was recorded opportunistically from

1989 to 1993.

During each survey, DMWR attempts to do comprehensive population count; however it is likely that not all roosts are monitored. Roost sites may be located in the interior of the island, and are not visible by boat or from trails. Consequently, data from roost surveys are representative of roosts on Tutuila but not exhaustive.

Information on illegal hunting was solicited as part of an interview survey of Samoans on perceived changes in local fisheries. One hundred people were interviewed in 50 of the 64 villages (one to four people per village) on Tutuila, August 1994 - April 1995 (Tuilagi and Green, 1995). Interviews were conducted in the Samoan language in the homes of the villagers as free-form conversation. Each person was asked whether they had seen bats brought into the village by hunters during the past year.

Results and Discussion

Population

Estimates of the size of the *P. tonganus* population varied considerably before 1992 (Fig. 1). In 1987, 12,750 bats were counted at 11 of the 19 known roosts. When extrapolated for all 19 known roost sites, the population was estimated to be 28,000. In 1988, 18,000 bats were counted at 14 roosts, with an island-wide estimate of 24,000. The 1989 annual count has not been included because observers visited only 10 of the 19 roost sites, and numbers are considered too inaccurate to report. Following

hurricane Ofa in February 1990, the number of P. tonganus declined dramatically to approximately 4,300. Another smaller decline occurred after hurricane Val in December 1991, when the population dropped to approximately 1,700 bats. Since 1992 there has been a steady increase in the number of P. tonganus to approximately 5,700 individuals. This increase has been slower than expected, assuming that the population in 1992 had a 50/50 sex ratio and that females give birth to one young annually.

Natural disasters such as of hurricanes are expected in Samoa. Four extremely severe storms have occurred within the past 50 years (Skowron, 1987 in Elmquist et al., 1994), however the combination of Ofa and Val within 22 months was particularly destructive. The Hurricanes uprooted and defloiated trees, and caused extensive damage to the branches (Elmquist et al., 1994). Immediatly after hurricane Ofa, there were no reports of dead bats. However, about three weeks later, bats were reported in villages crawling on the ground in search of food (Pierson, et al., 1996; Dashback, 1990). During post-hurricane periods of food scarcity, fruit bats feed on leaves and buds of native and plantation trees and coconut flowers (DMWR data; Pierson, et al., 1996). While few bats apparently starved, predation by dogs, cats, and pigs was quite common (Pierson et al., 1996). On Savai'i, Pierson et al. (1996) considered domestic animals responsible for the death of at least 30,000 individuals. Bats were also easy targets for hunters; one village was reported to have killed so many bats that carcasses were dumped into the ocean (Pierson, et al., 1996). Following both Ofa and Val, no juvenile

bats were observed suggesting 100% mortality for young animals (Pierson et al., 1996). In addition to being easy prey, bats weakened by hunger are susceptible to disease; such disease has devastated fruit bats in Samoa historically (Stair, 1887: see also Pierson and Rainey, 1992).

Roosts

Currently, most roost sites (six of eight) are located in mature forest on steep hillsides or cliff faces above the ocean (Fig. 2d). Two large roosts on the north coast cover small seamounts and adjacent hillsides. Several roost sites are known to have been used by P. tonganus for at least 15 years: Fagatele Bay, Olavalu crater, and Olomoano mountain. In the past single, roosts on Tutuila have been used by 5,000-10,000 individuals. However, the largest roost currently has only slightly more than 2,000 bats.

A total of 22 tree species were used at 29 roost sites between 1989-1993 (Table 1). Roost trees are common forest species that attain large size with the exception of one secondary growth species, Hybiscus tiliaceus, found at only one roost. Eighteen tree species (75%) used for roosts are also used for food (Table 1).

Within roost sites, bats frequently utilize different trees. At 14 sites where data was recorded for more than one visit, bats were observed hanging in the same tree species (n=6, Table 1). Presumably, the same trees were being used repeatedly. At 8 sites, bats moved to different tree species within the roost. Grant and Banack (1995) described the movement of bats to

different trees at Olavalu crater between August 1992 and July 1994. Bats moved in a counter-clockwise direction around the crater starting from trees on the eastern side. Occasionally, bats use several trees of the same species that are growing adjacent to each other, such as Cananga odorata (moso'oi) and Alphitonia zizypoides (toi) at Olovalu Crater. Moving to different trees within a roost is a common behavior of other colonial Pteropodid species and may be a way to avoid ectoparasite infestations (Marshall, 1982).

Not all P. tonganus roosts are used consistently. The number of individuals observed at roosts varies between visits. Pteropus tonganus take flight when approached by people on foot or by boat at the major north coast roosts. Disturbance may be one of the reasons that bats relocate to temporary roosts. After hurricanes Ofa (1990) and Val (1991), bats relocated initially because roost trees had been damaged or destroyed. As large colonies split apart, the number of roosts sites increased as bats temporarily moved closer to villages and plantations (Fig. 2b).

Hunting

Bats have traditionally been hunted in small numbers as a delicacy but have never been a staple part of the Samoan diet (Sinavaiana and Enright, 1992). After the dramatic decline in bat numbers following hurricanes Ofa and Val, a ban on all hunting was declared by the Governor. Since 1992, some hunting has continued although it is difficult to determine the number of bats killed illegally.

Fifteen percent of the people interviewed in village surveys (n=15) responded that they had seen 'a few' to 'many' dead bats brought in from hunts within the past year. Unfortunately, no numerical estimate of the number of bats shot is available.

Another instance of hunting occurred when the line crew of American Samoan Power Authority shot between 50-200 bats at the Olomoana mountain roost in October 1994. In the following months, P. tonganus roosted across the Aoa valley on the ridge east of Sailele. Bats have now has returned to roost on Olomoano mountain in a slightly different location, away from the television tower and road at the mountain top.

In places where bats are not hunted, roosts are commonly out in the open and easily seen. In Kolovai, Tonga, P. tonganus roost in trees along the road in the village where they can be approached without bats taking flight (Brooke, personal observation). Another very conspicuous roost is in the front yard of a house on Queen Elizabeth Drive, a major thoroughfare in Suva, Fiji (Brooke, personal observation). The roosts at Suva and Kolovai are subjected to noise and human activity, however bats are not hunted at either site. This suggests that that the remoteness of roosts on Tutuila, the movement of bats to alternate roosts and the skittishness of bats, is a direct result of hunting.

Pteropus tonganus roosts in the National Park of American Samoa

At the time of this report, there are two P. tonganus roosts within the boundaries of the National Park on Tutuila. One roost

near the access road at Mt. Alava, west of the television tower, is not used continuously by bats. Until recently, two roosts were present on Polauta Ridge, north of Vatia. The western most of these sites had a landslide in late 1995 and bats moved to a large roost at Puaneva point. A temporary roost formed above the waterfalls at Amalau valley in 1994 but has not been used since that time.

Conclusion and recommendations

Pteropus tonganus roosts presently occur in the least-accessible areas of Tutuila and even these at sites, bats continue to be hunted. People should be discouraged from approaching roost sites, either landing boats near roosts or walking on beneath the roosts. The roost at Mt. Alava is accessible by road and probably has some hunting pressure. The sites north of Vatia should be left undisturbed and knowledge about these roosts sites should be limited to as few people as possible.

The drastic decline of Pteropus bats on Tutuila after hurricanes in 1990 and 1991 was not solely a natural consequence of the storms. Reduction of the native forest, hunting and predation by dogs, cats, and pigs contributed greatly to the population devastation. If both the amount of native forest continues to decline and the human population to expand, the forest may be unable to support the minimum viable population of bats during post-hurricane recovery periods. Extremely low population numbers leaves the population open to extinction from other sources, such as hunting or disease.

Pressure to utilize undeveloped forested land will increase as the human population continues to increase by 3.5% annually on Tutuila (EDPO, 1995). Without additional protected habitat, the long term survival of both Pteropus species is questionable. Large tracts of mature native forest remain only on the north coast of Tutuila; not surprisingly, this is also where the greatest numbers of fruit bats are found. Mature forest provides refuge for native forest birds such as the rare many colored fruit dove (Ptilinopus perousii) and possibly blue crowned lory (Vini australis). In addition, such mature forest provides nesting habitat for pelagic birds such as White-tailed Tropicbird, White terns, and Brown Noddies.

Protection of land on the north coast is the only way that fruit bats and native forest birds will continue to survive. Without active protection, forested lands will be utilized by villages for plantation. The only way that the National Park of American Samoa can ensure the survival of the native fauna is to increase the amount of land held on Tutuila. The remaining native forest, from west of the present Park boundary at Fagasa to Maloata, should be considered for possible expansion of the existing Park.

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Table 1 Number and species of trees used by roosting P. tonganus at 29 roost sites, 1989-1993. Species with number or * before the name are also used as food; * DMWR observations; 1) Cox, 1983; 2) Mickleburg et al., 1992; 3) Rainey et al., 1995.

Species	Samoan common name	# roosts	# trees
* <i>Barringtonia asiatica</i>	futu	15	26
* <i>Calophyllum inophyllum</i>	fetau	13	20
1 <i>Dysoxylum maota</i>	maota	12	37
* <i>Erythrina variegata</i>	gatae	12	17
2 <i>Rhus titiensis</i>	tavai	9	25
* <i>Alphitonia zizypoides</i>	toi	8	44
* <i>Ficus</i> spp.	aoa	7	9
* <i>Planchonella samoensis</i>	mamalava	6	15
<i>Myristica</i> spp.	'atone	5	17
1 <i>Dysoxylum samoense</i>	tufaso	4	5
* <i>Cananga odorata</i>	moso'oi	2	30
* <i>Syzygium inophylloides</i>	asi	2	5
<i>Pisonia grandis</i>	pu'a vai	2	3
<i>Fagraea berteriana</i>	pualulu	2	3
* <i>Diospyros samoensis</i>	'au'auli	1	1
3 <i>Terminalia richii</i>	malili	1	1
* <i>Inocarpus fagifer</i>	ifi	1	1
3 <i>Canarium vitiense</i>	ma'ali	1	1
<i>Neonauclea forsteri</i>	afa	1	1
* <i>Artocarpus altilis</i>	ulu	1	1
* <i>Hibiscus tiliaceus</i>	fau	1	1
3 <i>Garuga floribunda</i>	vi vao	1	1

Fig. 1 *Pteropus tonganus* population estimate from roost counts on Tutuila, 1987-1996.

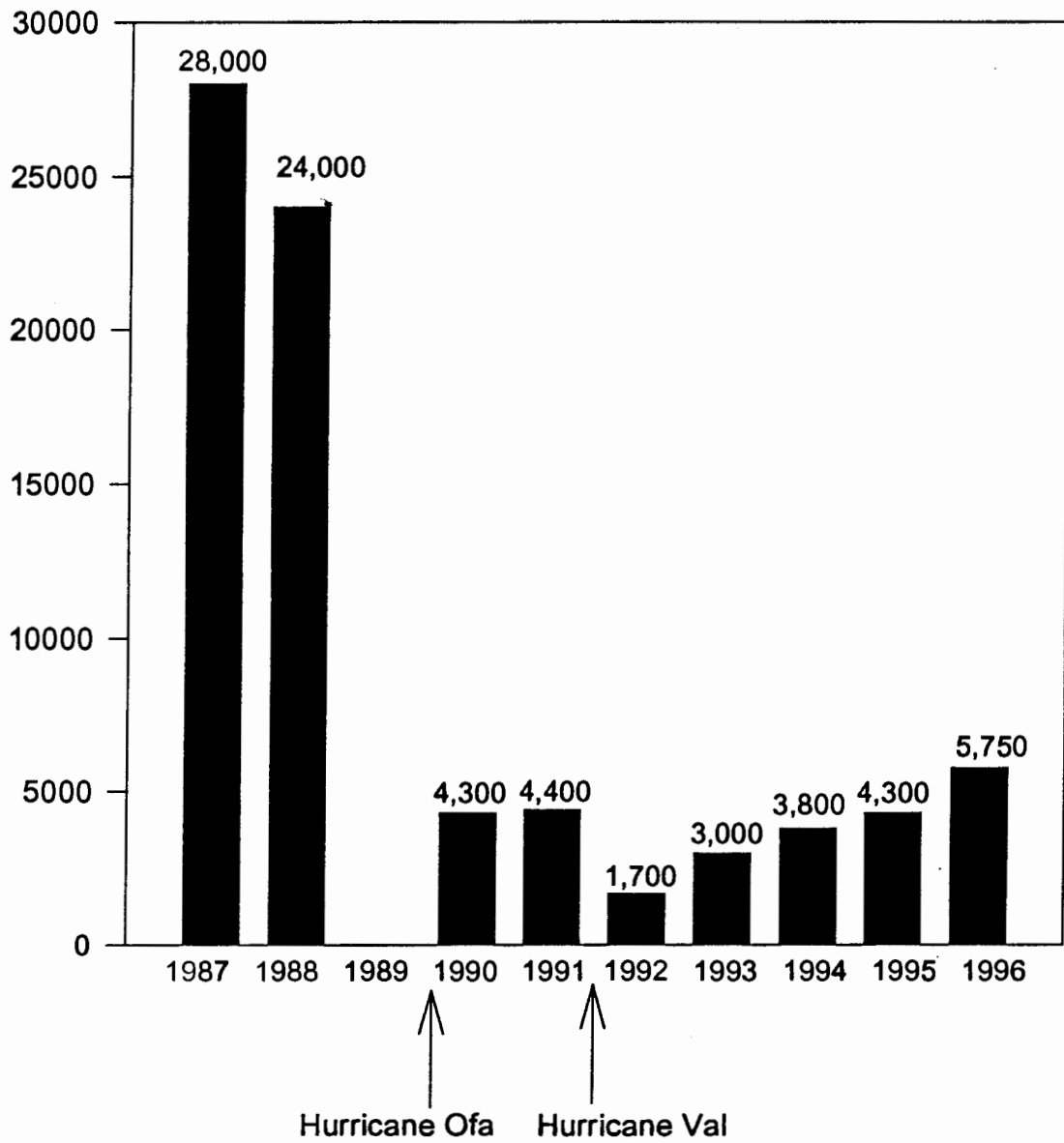
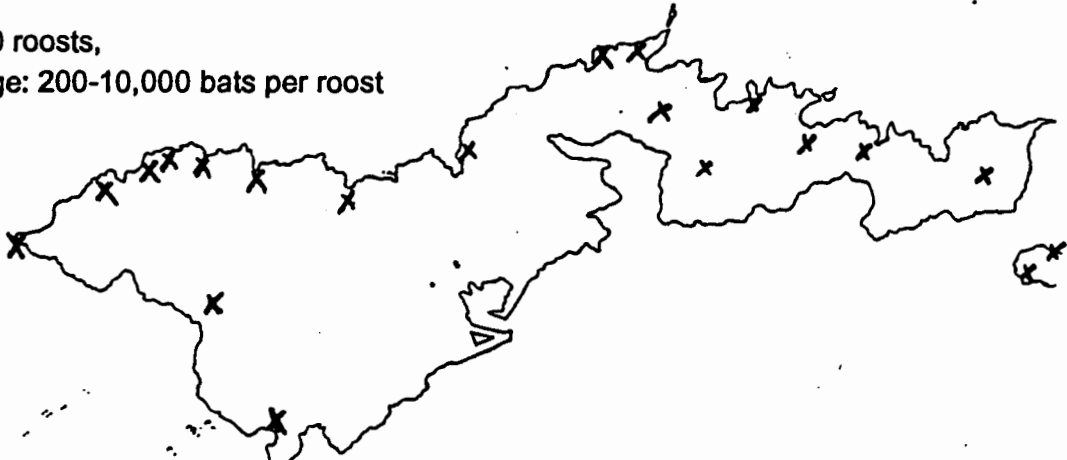


Fig. 2 Size and location of roosts on Tutuila, 1987-1996.

A. 1987 20 roosts,
size range: 200-10,000 bats per roost



B. 1990 16 roosts after hurricane Ofa,
size range: 30-500 bats per roost.



C. 1992 7 roosts after hurricane Val,
size range: 50-150 bats per roost.



D. 1996 8 roosts,
size range: 200-2,000 bats per roost.

