

**FEDERAL AID IN WILDLIFE RESTORATION ACT**

AMERICAN SAMOA WILDLIFE INVESTIGATIONS

ANNUAL REPORT

FY 95

Department of Marine and Wildlife Resources  
American Samoa Government  
P.O. Box 3730, PagoPago, American Samoa 96799

December 1995

## TABLE OF CONTENTS

STUDY	JOB	PAGE
STUDY 1.	FRIUT BAT STUDIES	
	Job 2. Abundance, Distribution and biology.....	1
	Job 3. Home range and movement studies.....	6
STUDY 2.	BIRD STUDIES	
	Job 1. Abundance and Distribution.....	8
	Job 2. Habitat use.....	22
STUDY 6.	REMOTE ISLANDS	
	Job 3. Rat Eradication.....	30
STUDY 8.	TECHNICAL ASSISTANCE	
	Job 1. Technical Assistance.....	34
	Job 2. Scientific Exchange.....	35



**PROCEDURES:** Surveys for the Samoan bat are conducted on a monthly basis at 6 permanent sites on Tutuila Island. Surveys begin at first light and continue for the next two hours. Data are collected during 10-minute sample periods, separated by 5-minute breaks, for a total of eight samples for each site per census period.

For each of the six sites, DMWR calculates the average number of observed fruit bats per hectare. A grand mean ( $n = 6$ ) is used to determine the overall average number of bats observed per hectare per 10-minute sample. A population estimate is made by expanding the grand mean estimate to include areas of the island possessing native forest that were not sampled. Recent aerial photographs have shown that 76 km<sup>2</sup> remain of native forest.

Additional information on the distribution and status of the white-necked fruit bat is gathered in quarterly visits to all known communal roost sites on Tutuila. Unlike the Samoan fruit bat, the white-necked fruit bat typically roosts in large colonies that remain at the same location for months or years. Numbers of bats observed at all colonies is counted over a 3-day period to minimize double counting bats that may have changed roost sites. Counts are made both on land (from roads and other vantage points) and from the sea (to count the many roosts in inaccessible coastal locations). Presuming that DMWR does not presently know the location of all bat roost locations in the territory, this information will provide a "minimum estimate" of the number of white-necked fruit bats found here. Population counts at roosts are augmented by censusing bats at dusk as they leave the roosts whenever possible. Because of dense vegetation in some roosts, these exit counts give us a better estimate of P. tonganus populations than daytime roost counts.

**RESULTS:** Both species of fruit bat have shown an increase in population numbers since the hunting ban was enacted in 1992. In the absence of further hurricanes, both species appear to be recovering, however a prolonged recovery period is needed for them to reach the earlier abundance.

Pteropus samoensis The continued increase in numbers of the Samoan fruit bat is shown in Fig. 1.

The increase in numbers of bats is much greater than expected from reproduction within the population. While bat numbers are undoubtedly increasing, the recent dramatic gain in numbers is a reflection of improved survey techniques. If the current methodology had been used earlier, the original population estimates would have been greater.

Pteropus tonganus Survey data for P. tonganus is summarized in Fig. 2. The population has continued to expand during 1995 and has a realistic growth curve for a slowly reproducing mammal.

### Manu'a Islands

Data from the surveys conducted in Nov 1994 at Ta'u, Ofu and Olosega is presented in Table 1. The population of P. samoensis appears to be slowly increasing on the Manu'a islands although the Nov. 1994 survey was the first to document an increase in numbers. Further surveys are needed to validate this trend.

Preliminary work on the small population ecology study has been successful. Blood samples from the P. tonganus caught (Study 1, Job 3) have successfully been analyzed in the lab of Dr. Gary McCracken, University of Tennessee. The samples yielded large amounts of good quality DNA.

The investigation of behavioral ecology and territoriality of P. samoensis has been partially successful. Behavioral observations of territorial behavior have shown a pattern of adult male aggression while scent marking is limited to males, and only during mating season. The laboratory that had initially been contacted to analyze secretions has not responded again. This aspect of the project will be left to a later date.

### Table 1

Survey data for P. samoensis and P. tonganus in the Manu'a islands. Values given are the mean number of P. samoensis per count. N = the number of counts per island per year. Data from 1986 and 1989 are from Wilson and Ebring, 1992.

	Ta'u	Ofu	Olosega
July 1986	3.0 (n=2)	2.0 (n=3)	6.0 (n=3)
August 1989	2.0 (n=2)	1.7 (n=3)	4.7 (n=3)
August 1992	0.2 (n=7)	0.04 (n=5)	0.4 (n=4)
August 1993	0.3 (n=7)	0.3 (n=5)	2.0 (n=4)
November 1994	1.8 (n=6)	2.7 (n=5)	1.4 (n=4)

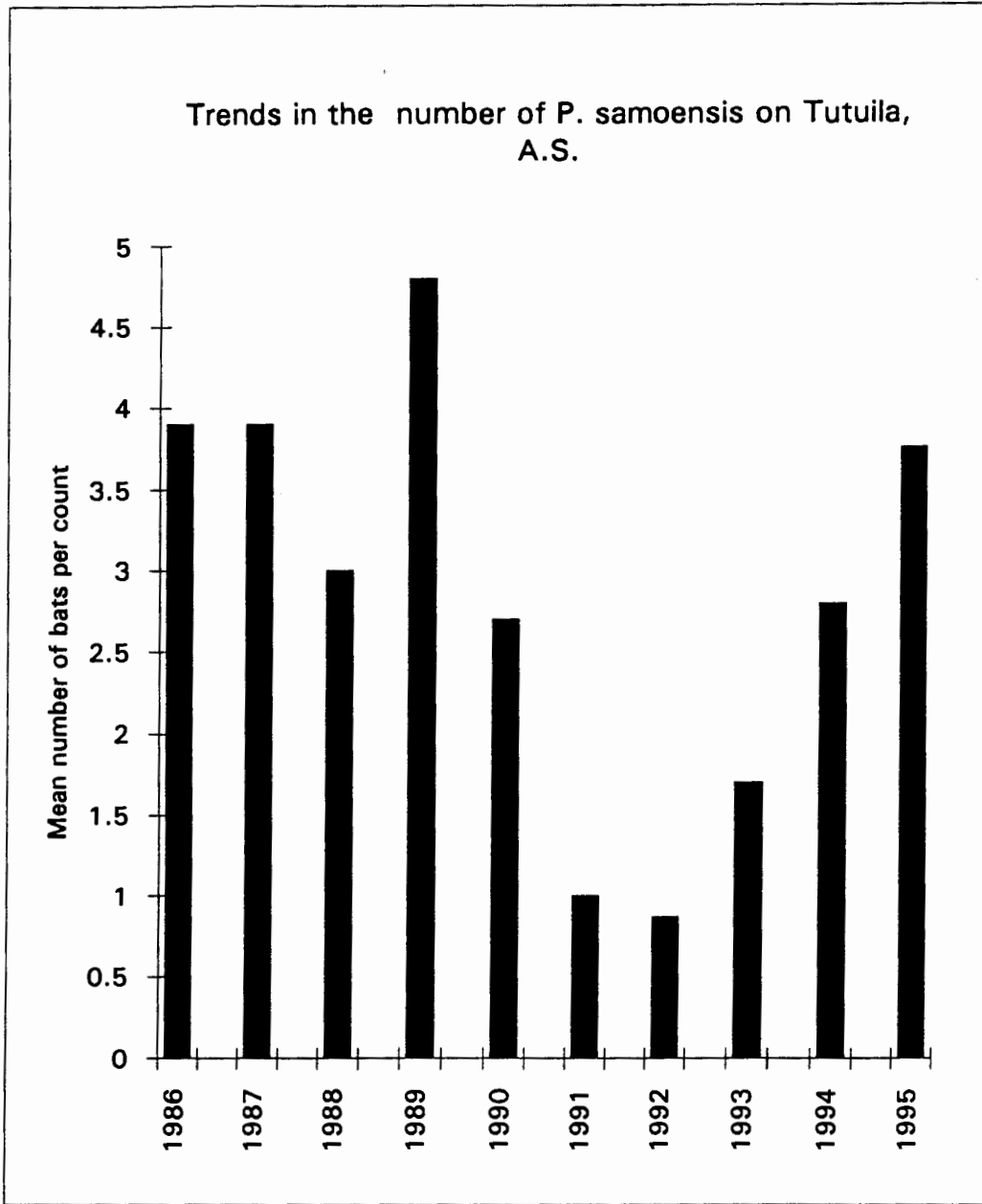


Figure 1. Decline and increase in the Samoan fruit bat population from 1986-October 1995. Data shown are the mean number of identified *P. samoensis* seen per count period. Data from 1987 and 1989 are from Wilson and Enbring, 1992, who used 30 minute count periods. Twenty minute count periods were used from 1987-1994. Ten minute counts were used in 1995. The number of counts are as follows: 1986, 21; 1987, 32; 1988, 90; 1989, 21; 1990, 38, 1991, 219; 1992, 579; 1993, 540; 1994, 600; 1995. 480.

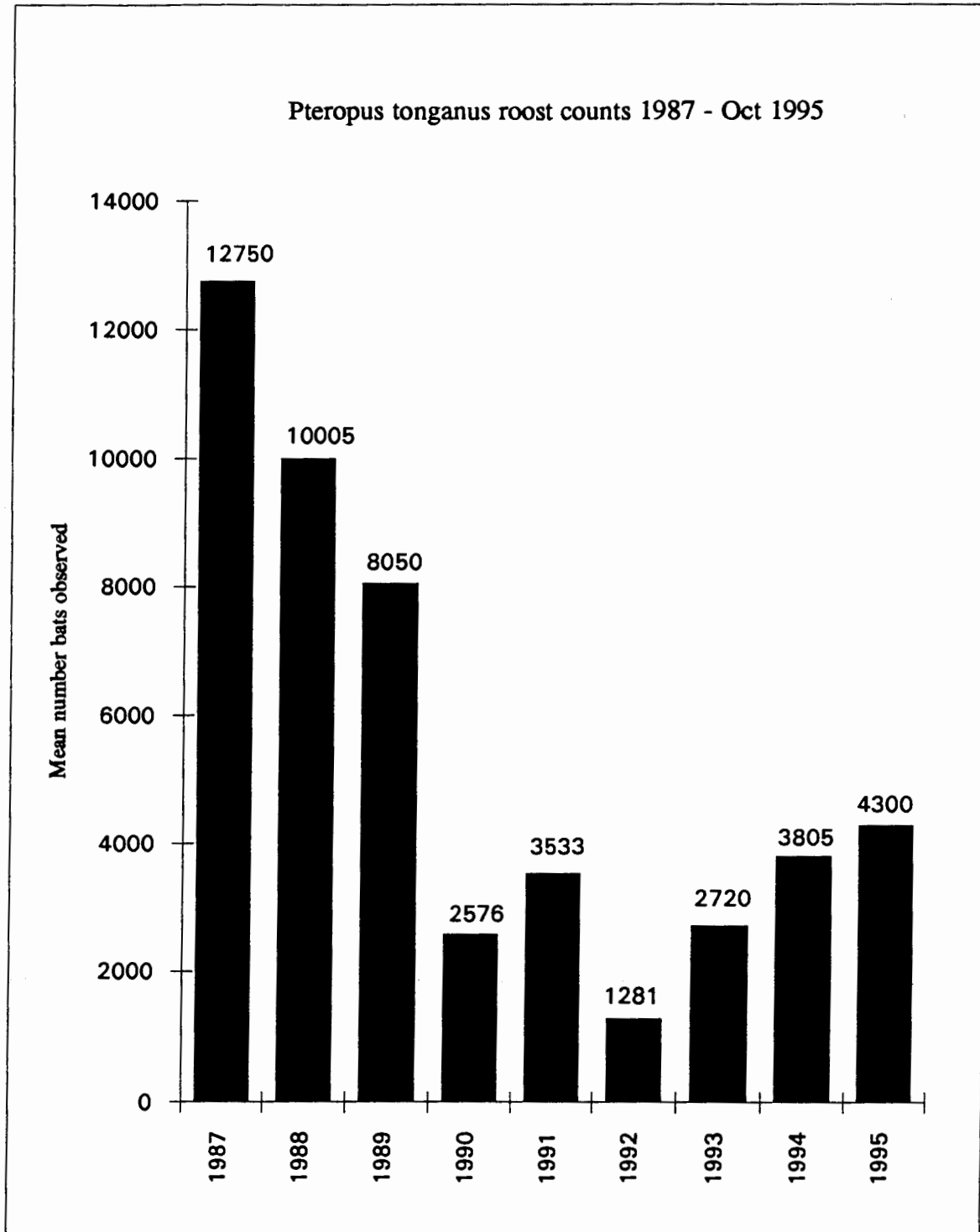


Figure 2. Results of the *Pteropus tonganus* roost counts on Tutuila, 1987- Oct. 1994. All known roost sites were surveyed for each count including those accessible only by sea. The number of counts each year is as follows: 1987,1; 1988, 1; 1989, 1; 1990,4; 1991, 3; 1992, 2; 1993,3; 1994,3.

PROJECT: American Samoa Wildlife Investigations

STUDY: Fruit Bat Studies

Study: 1

JOB: Home range and movement studies

Job: 3

### **OBJECTIVES:**

Determine home range sizes and activity patterns of the two fruit bat species in American Samoa through the use of radio tracking.

### **BACKGROUND:**

Two species of fruit bats, or flying foxes, occur in American Samoa: the White-necked (or Tongan) Fruit Bat, Pteropus tonganus, and the Samoan Fruit Bat, P. samoensis.

These bats are important pollinators and seed dispersers in the native rainforest, they are important in the folklore and culture of the Samoan people, and they are taken for food by hunters.

Effective conservation and management of the fruit bats of American Samoa require detailed information on their home range sizes, movement patterns, and activity cycles.

Visual observation can provide only a limited amount of data on these important parameters, for several reasons. The white-necked fruit bat, P. tonganus, is active primarily at night. Observations at the daytime roosts of this species are obviously inadequate to document ranging and activity patterns. Second, both species of bats are difficult to follow visually as they forage in the forest canopy. They often enter and leave a tree crown at different points, and may fly through the canopy for some distance before re-emerging. Also, the highly dissected topography of American Samoa, with many sharp ridges and narrow ravines, makes visual tracking difficult. Finally, without individually marked bats, it is almost impossible to be certain that the same individual is being followed as it enters and leaves the canopy. The only technique which will address these problems is to capture and radio-tag individuals of both species.

### **APPROACH:**

We will continue capturing fruit bats of both species with mist nets rigged near favored feeding sites. Our efforts will concentrate on P. samoensis which has been difficult to capture as they feed in crowns of forest trees. Once captured, the bats are weighed, measured, evaluated for general health and condition, and assessed for reproductive status. Each is then be fitted with a collar containing a radio transmitter, and released. Tracking will begin immediately in order to monitor of the location of the bat. We will continue monitoring the bat's activity until the daily pattern of activity is determined. Thereafter, we will continue to monitor at less frequent intervals to document ranging patterns. If consistent foraging areas are identified in the telemetry data, we will

attempt to reach those sites for visual observation of foraging activity. A new type of radio, smaller and lighter weight than those used previously, was obtained.

Our initial goal of gathering extensive telemetry data for five adults of each sex for each of the two fruit bat species. Five P. tonganus were fitted with transmitters in FY93, seven adult males and one adult female were radio tracked in 1994, and two adult male P. samoensis carried radios in 1994. Activity patterns and foraging sites vary tremendously from one bat to another and usage of feeding sites by a bat also varies from night to night. Equipping additional bats with transmitters and extensive monitoring will be undertaken in FY95 to further document these activities.

#### **RESULTS:**

Because P. samoensis have not been followed with radio telemetry, the FY95 effort has focused on capturing this species. After the new lighter radios were received four P. tonganus were captured. The new style radio and new type of collar attachment was tried on one. The radio functioned well and the bat was successfully followed. This work is ongoing and netting bats for more radio telemetry will continue in FY96.

**PROJECT:** Wildlife Investigations  
**STUDY:** Bird Studies  
**JOB:** Abundance and Distribution

**PROJECT:** W-1-R-8  
**STUDY:** 2  
**JOB:** 1

**PERIOD COVERED:** October 1, 1994 to September 30, 1995

### **OBJECTIVE**

To monitor the seasonal and interannual status of American Samoan forest birds, particularly of the Pacific Pigeon (*Ducula pacifica*), the Purple-Capped Fruit-Dove (*Ptilinopus porphyraceus*), and the Many-Colored Fruit-Dove (*P. perousii*).

### **SUMMARY**

Surveys of native forest bird species were conducted monthly at four sites on Tutuila (25 stations/month) during FY 95. No hurricanes or other natural disasters struck the islands during this period, and slight increases and decreases were observed among native land bird populations. However, populations of almost all land birds remain far below the levels documented before Hurricanes Ofa and Val (1990 and 1991). In particular, populations of the Purple-Capped Fruit-Dove (*Ptilinopus porphyraceus*) remain very low (15% of their 1986 level, Table 1), and the Many-Colored Fruit-Dove (*P. perousii*) probably numbers less than 50 individuals in all of American Samoa. The Pacific Pigeon (*Ducula pacifica*) appears to be in better shape, with a population level 73% of its 1986 value (Table 1). It is evident that recovery to pre-hurricane levels will take many years for most species.

### **BACKGROUND**

The first rigorous survey of forest bird populations in American Samoa was conducted in 1986 (Engbring and Ramsey 1989). This survey took place at the end of a 20-year period without a major hurricane in the Samoan archipelago, and of a 100-year period without a catastrophic hurricane. In March 1987, the Manu'a Islands in the eastern part of American Samoa were devastated by Hurricane Tusi. In February 1990 the entire archipelago was struck by another very severe storm, Hurricane Ofa, and in December 1991 the most damaging hurricane on record, Hurricane Val, caused catastrophic destruction throughout Western and American Samoa.

The American Samoa Department of Marine and Wildlife Resources (DMWR) began monitoring forest bird populations during the period between Hurricanes Ofa and Val in 1991. A more extensive monitoring program was begun in 1992, following Hurricane Val. This program is ongoing. These surveys reveal severe declines from pre-hurricane levels among virtually all species of native forest birds in American Samoa. In contrast to post-hurricane declines in other regions (e.g. following Hurricane Hugo in Puerto Rico), all ecological classes of birds were affected: frugivores, insectivores, nectarivores, and omnivores. The reason for these general declines appears to be the very long duration (3-5 days) of both Hurricanes Ofa and Val, which may have caused much mortality through

starvation. In response to these declines, the Governor of American Samoa declared a 3-year ban on all hunting of birds or fruit bats, effective April 1, 1992.

No severe storms struck American Samoa during the 1994-95 hurricane season. Populations of most species of forest birds increased during this period. In most cases, however, the increase was slight. It appears that a long period will be needed before forest bird populations in American Samoa return to pre-hurricane levels.

## PROCEDURES

1. Conduct monthly surveys of forest bird distribution and abundance on Tutuila, American Samoa. The methodology is a variable-circular plot design, with stations located 150m apart in areas of continuous native forest. All birds identified by sight or sound during an 8-minute count period are recorded, and their distance from the observer is estimated. This methodology is directly comparable with the 1986 survey (Engbring and Ramsey 1989), which in turn was modeled on the Hawaii Native Forest Bird Survey Program (Scott et al. 1986).

2. Conduct monthly visual surveys of Pacific Pigeons at six to eight sites around Tutuila. The methodology consists of four 20-minute counts separated by 10-minute intervals. As with VCP surveys, every effort is made to count individual birds only once.

3. Record information on the status and distribution of Manu'a birds during visits to those islands. Species of particular interest are those that do not regularly occur on Tutuila: the Blue-crowned Lory (*Vini australis*), Friendly Ground-Dove (*Gallicolumba stairii*), Spotless Crake (*Porzana tabuensis*), and Fiji Shrikebill (*Chytorhynchus vitiensis*).

## RESULTS/DISCUSSION

### 1. Variable Circular Plot Surveys

#### a. Interannual trends in Forest Bird Populations on Tutuila

Figure 1 summarizes the available data on the relative abundance of eight species of native forest birds in areas surveyed on Tutuila since 1986. These are all the species for which the variable-circular plot forest surveys are an appropriate census technique. Other native species are not accurately detected by this method; for example White-rumped Swiftlets (*Collocalia spodiopygius*) are usually above the canopy and not accurately counted from within the forest, and the Banded Rail (*Gallirallus philippensis*) and Purple Swampphen (*Porphyrio porphyrio*) are primarily birds of agroforest and forest edge, not forest interiors.

All species declined sharply following Hurricane Ofa (February 1991), as shown by the 1991 values (Fig. 1), which are based on surveys from July-November 1991. Most species showed further declines following Hurricane Val in December 1991, as shown by the 1992 values (surveys from September-December 1992)(Fig. 1, Table 1). The apparent exceptions were the Collared Kingfisher and the Wattled Honeyeater, both of which

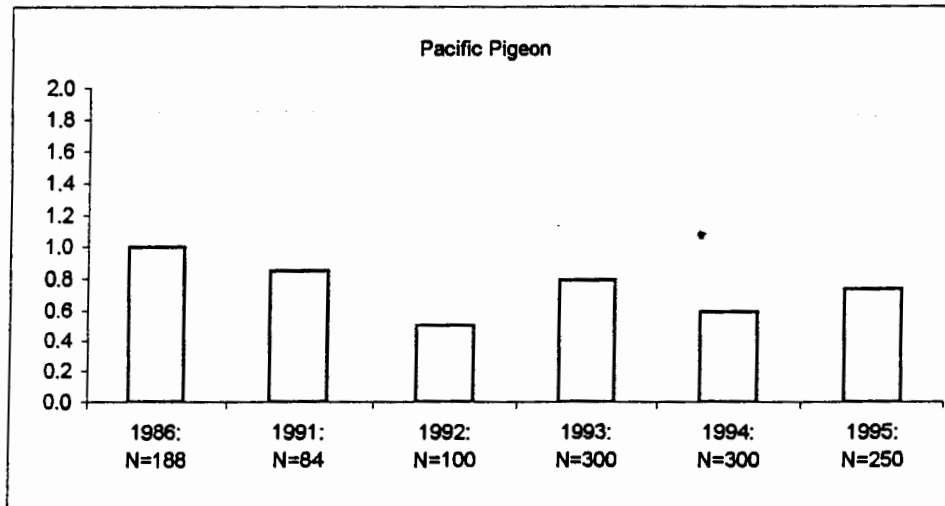
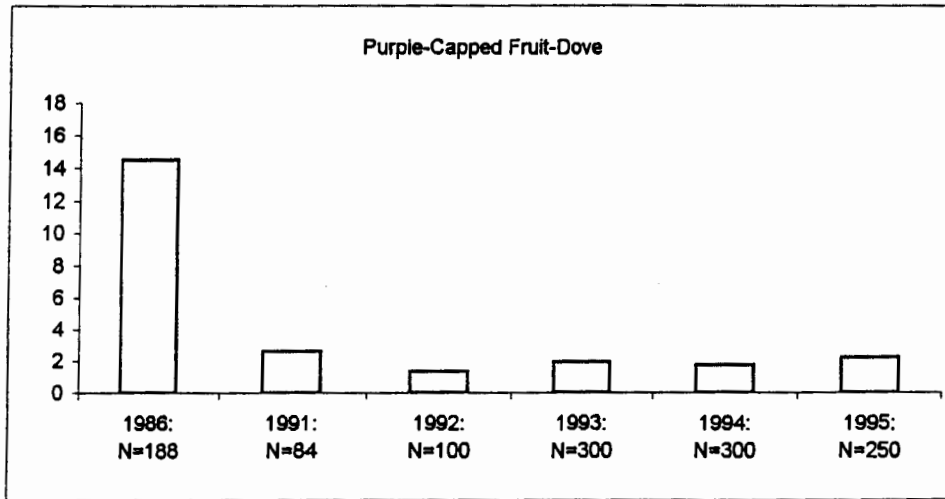
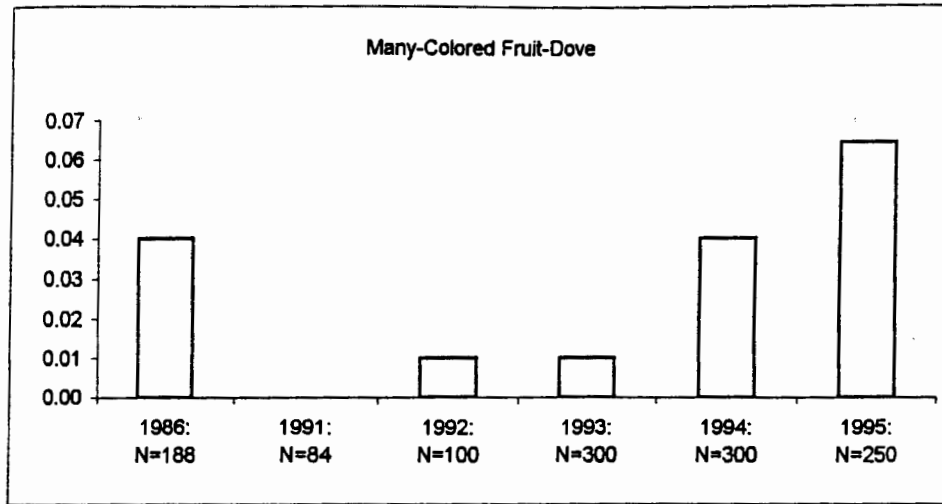
increased slightly. However, all increases were modest, and four of the eight species remained at less than half the abundance recorded in 1986.

The hiatus from severe storms has continued through September 1995, as has the hunting ban. Although six of the eight species show some increase in numbers between 1994 and 1995, the data do not show consistent trends for all species between 1992 and 1995 (Fig. 1, Table 1). Purple-Capped Fruit-Doves show the greatest absolute increase from 1994 to 1995 (0.5 birds per eight-minute count), though this figure may be misleading (see below). Several species show slight declines. For example, the number of Wattled Honeyeaters recorded has dropped by 0.5 birds per eight-minute count since 1993, despite a slight increase between 1994 and 1995. This species still shows the greatest absolute post-hurricane increase, however. Population levels of Pacific Pigeons and Samoan Starlings in 1995 remain lower than 1993. None of these scant decreases has brought a population below its 1992 level. In contrast, Many-Colored Fruit-Doves show the greatest relative increase from 1992 to 1995 (Fig. 1a, Table 1), and the only increase beyond the 1986 level. However, given the minuscule absolute increase (0.05 birds per eight-minute count) and total number of birds observed, to conclude that this extremely rare species is "recovering" would be premature.

In these meager increases and decreases we may be witnessing stochastic, interannual fluctuations that are not significant to long-term population trends. Alternatively, the slight decreases may signal the beginning of a lagged response to hurricane damage to the forest or a response to some other perturbation. Continued monitoring will reveal whether these 1995 changes are indicative of anomalies or trends.

In sum, of the eight species monitored with VCP censuses, two appear to be approaching their 1986 benchmarks (Collared Kingfishers and Pacific Pigeons at 99% and 73% of 1986 figures, respectively) and one is over half-way there (Wattled Honeyeaters at 58%). These optimistic figures must be interpreted with caution. Seasonal variation in detection of some species may lead to artificially inflated annual averages (see below). We do not have sufficient information about the life history and behavior of Samoan birds to be certain that the increases in means since 1992 are real. However, it is important that no species shows a sustained decline during this period.

The overall picture shows clearly that recovery from catastrophic events (such as hurricanes Ofa and Val) is a slow process for most Samoan forest birds. Many species remain at less than half their 1986 recorded abundance (the Purple-Capped Fruit-Dove (15% of 1986 value); the Cardinal Honeyeater (22%); the Polynesian Starling (19%), and the Samoan Starling (38%)). Populations of most forest birds are still highly sensitive to disturbance. Hunting pressure or another severe storm could take some species' numbers below viable levels. Continuous protection from those disturbances we can influence (hunting, forest clearing) will give avian populations time to recover to former (pre-hurricane) levels.



**Figure 1. Summary of available data on relative abundance of forest birds from variable circular plot surveys on Tutuila Island. N=number of eight-minute censuses.**

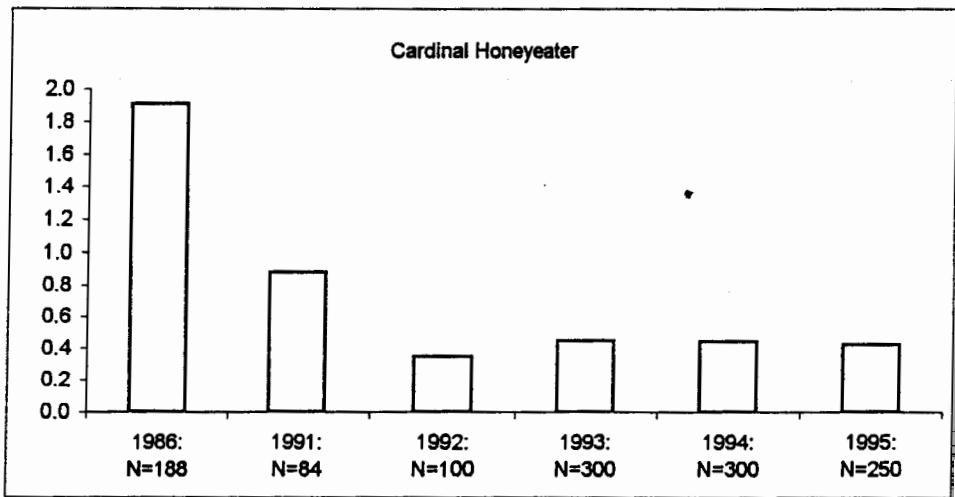
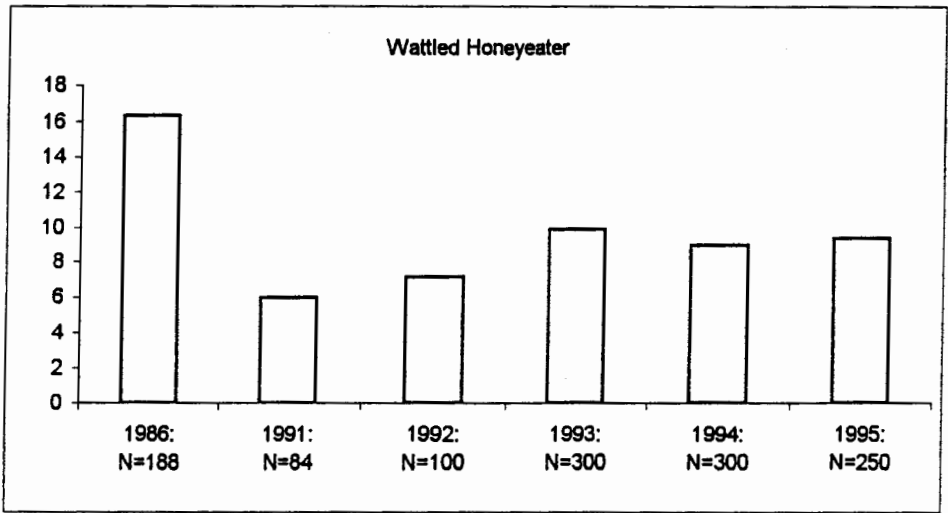
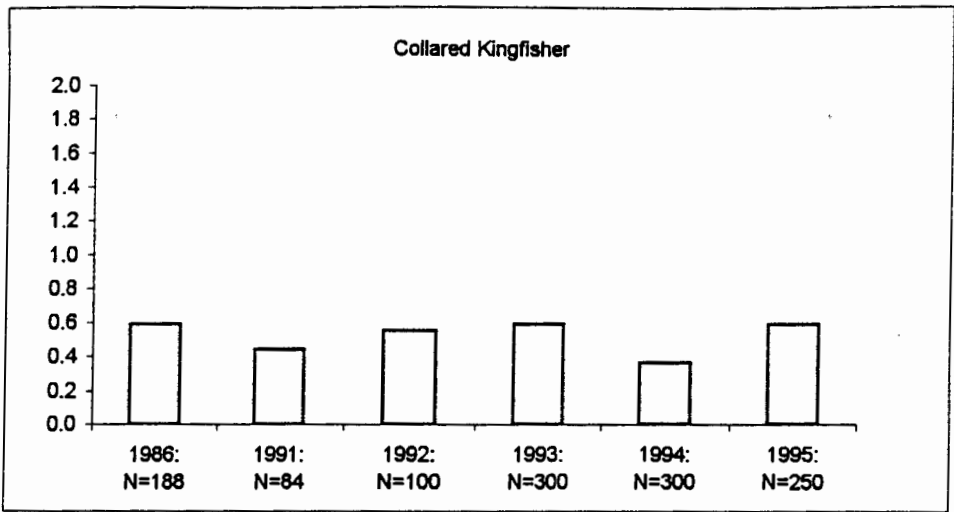


Figure 1, continued.

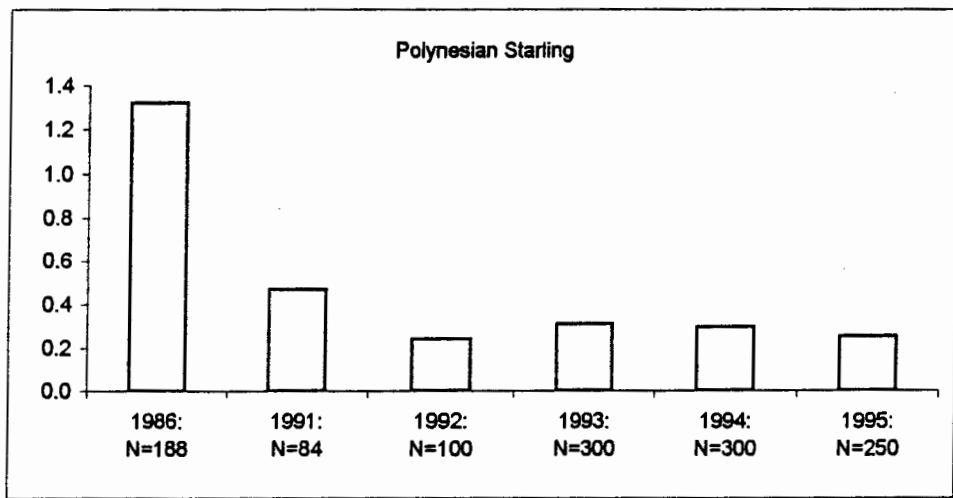
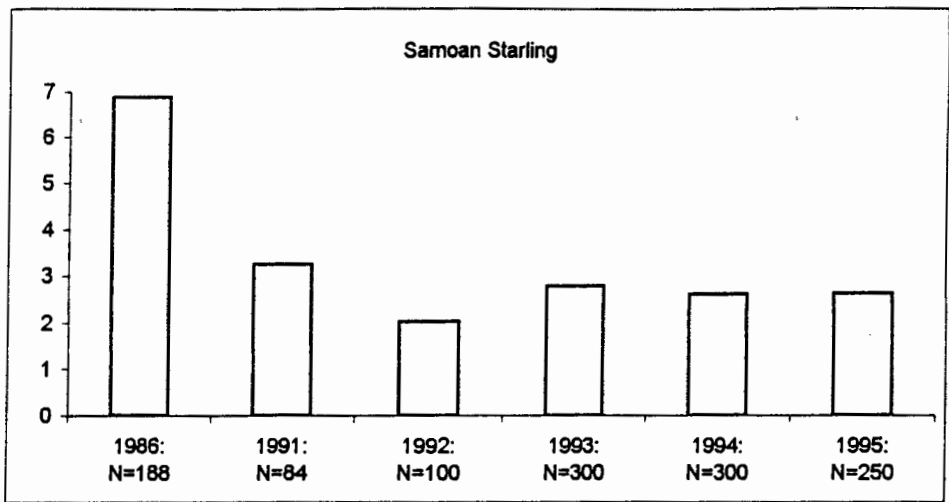


Figure 1, continued.

Table 1. Mean numbers of birds recorded per eight-minute count in 1986 (Engring and Ramsey), from 1991 to 1995. "1992-95 CHANGE" is the difference between 1992 and 1995 data for each species. This time period represents the span of continuous monthly censusing. "1995 % of 1986" is the proportion of 1986 number recorded in 1995 for each species.

SPECIES	1986	1991	1992	1993	1994	1995	1992-95	
							CHANGE	1995% of 86
Many-Colored Fruit-Dove	0	0	0	0	0	0	0	161
Purple-Capped Fruit-Dove	14	3	1	2	2	2	1	15
Pacific Pigeon	1	1	1	1	1	1	0	73
Collared Kingfisher	1	0	1	1	0	1	0	99
Wattled Honeyeater	16	6	7	10	9	9	2	57
Cardinal Honeyeater	2	1	0	0	0	0	0	22
Polynesian Starling	1	0	0	0	0	0	0	19
Samoan Starling	7	3	2	3	3	3	1	38

**b. Seasonal Variation (Purple-Capped Fruit-Doves)**

We have now collected three years of continuous monthly census data from the 25 VCP stations in forest habitat on Tutuila Island. These data enable us to identify seasonal peaks in the detection of some forest bird species. These peaks in turn inform analysis and interpretation of interannual patterns. Seasonal peaks are most apparent for the Purple-Capped Fruit-Dove (Fig. 2) and the Pacific Pigeon, although better census data on the latter species have been collected through visual censuses (see below).

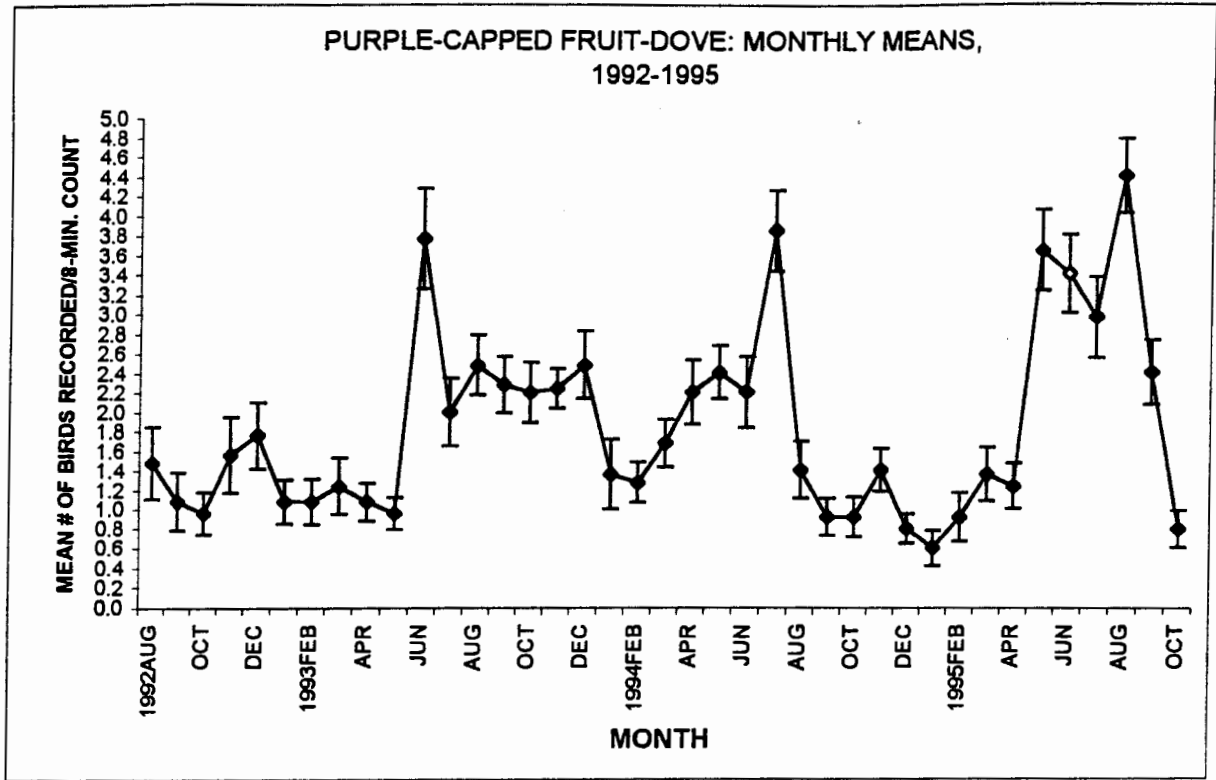


Figure 2. Mean and error for monthly survey of Purple-Capped Fruit-Doves (*Ptilinopus porphyraceus*) illustrating seasonal peaks in detection. N=25 stations in native forest surveyed each month. (Note:  $\diamond$  = data incomplete for July 1995.)

Figure 2 shows that seasonal peaks in Purple-Capped Fruit-Dove detection were restricted to a single month in 1993 (June) and 1994 (July). In 1995, however, the peak was sustained from May through August, with the typically distinct drop taking place in September. Interpretation of these peaks in terms of population trends is difficult because we have little concrete behavioral or breeding phenology information about this species. Nevertheless, observations of birds carrying nesting material, of actual nests and of juvenile birds coincide seasonally with peak vocalizations, thus supporting the conclusion that this peak detection corresponds with breeding activity.

The unusual four-month peak in vocalizations in 1995 may be interpreted in different ways:

1. There has been a significant recruitment of adult birds into the population since last year, and more males were packing into desirable habitat and defending smaller territories.
2. There were fewer breeding birds this year than last year, and males were competing for fewer females. Unsuccessful birds continued to vocalize throughout the breeding season.

The correct interpretation may be partly deduced by analyzing the data from non-peak months separately from peak months. When this is done, the results suggest that peak-month data is significantly inflating both the annual averages and the interannual trend. If in fact the population of fruit-doves has increased, we would expect to see an increase in numbers during non-peak months as well as an increase in the duration of peak detection. When peak months are removed from the data for 1993, 1994 and 1995, the annual mean drops from 1.9 in 1993 to 1.2 birds per 8-minute count in 1995 (Fig. 3). This drop stands in sharp contrast with the increase evident when all data, including peak months, are displayed.

Although the fluctuations depicted by each set of bars in Figure 3 are small, the contrast between all the data and the non-peak data nevertheless suggest conflicting interpretations. These small changes in the mean number of birds per eight-minute count do not necessarily constitute a definite population trend. Continued monitoring is necessary to determine this. However, this analytic exercise offers several warnings. First, the non-peak data for 1993-1995 suggest a potential decline rather than an increase in fruit-dove numbers, clearly a cause for concern when we are expecting to document post-hurricane recovery.

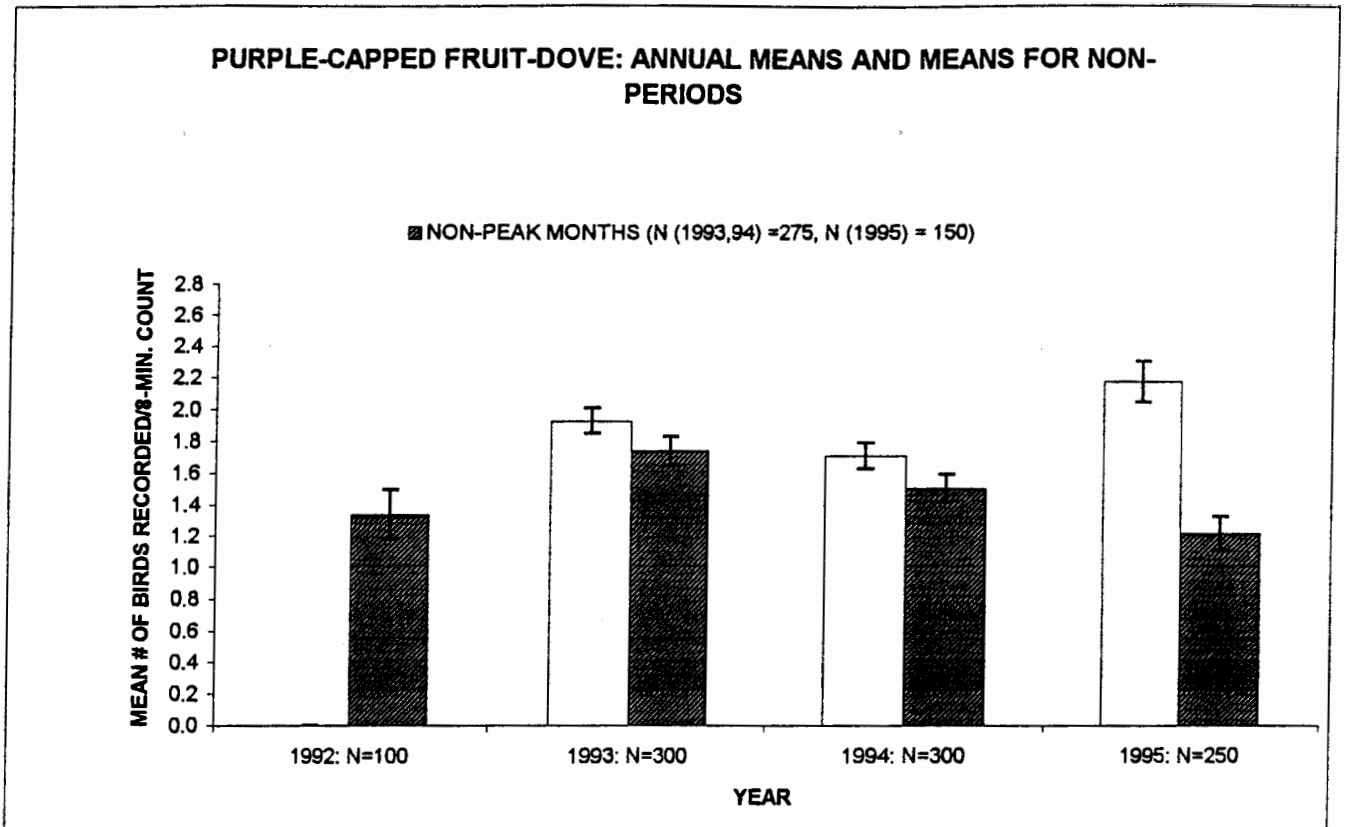


Figure 3. Average Purple-Capped Fruit-Doves recorded per eight-minute count. White bars=data for all months, hatched bars data for non-peak months only.

Second, all forest bird species experienced severe declines in the wake of hurricane Val, and not all species show uniform recovery. Purple-Capped Fruit-Doves trail the pack in terms of recovery rate since 1992. If indeed this species is actually declining, then its population has either sunk below a critical level and is experiencing an intrinsic failure, or some environmental variables (e.g., patchy post-hurricane habitat, land-clearing for agriculture, poaching) are hampering its recovery. The dynamics of the post-hurricane environment and the growing human population of Tutuila probably operate differently on the recovery of each forest bird species. In the case of the fruit-doves this operation may merit close investigation.

Finally, the masking effect of seasonal variation in detection alerts us to the need for more information about this and other species' behavior and life history in order to properly interpret the census data and long-term trends. This last is a critical point for natural resource managers trying to systematically monitor non-migrant forest bird populations. To identify this seasonal variation as a systematic component rather than an anomaly in our censusing required three years of continuous monthly monitoring -- a considerable effort. In many areas where forest bird surveys are conducted for management purposes, surveys with substantial sample sizes are rarely taken so frequently. Often, surveys are conducted quarterly, annually, opportunistically, or whole islands or archipelagos are surveyed once over a period of years.

A sampling scheme that does not recognize seasonal variation in detection (or, perhaps, abundance), cannot be used to assess the status of forest bird populations. When density estimation is included in the survey methodology and population estimates are extrapolated from such sporadic or short-term data, there is little chance that these estimates reflect even ballpark numbers. Further, it is not possible to set up a temporally adequate monitoring program without first knowing what the intra-annual, cyclic variation in detection is for various species. In this respect, the monthly forest bird survey in American Samoa stands as a unique example in the Pacific region of long-term, fine-scale sampling in order to detect seasonality as well as interannual trends. We hope this may serve as a model for other monitoring surveys in the Pacific region.

## **2. Visual surveys of Pacific Pigeons**

Since February 1995 we have conducted visual surveys of Pacific Pigeons at six to eight sites around Tutuila. Because this is the first year of this monitoring survey, our data do not yet suggest any trends in the population of pigeons on Tutuila. However, we detect greater numbers of pigeons for our effort using this method than we have using the VCP method (Fig. 4). These data will document population trends or fluctuations in this species more reliably than VCP data. The nine months of data represented in Figure 4b seem to document an increasing trend in the population. However, pigeon data collected opportunistically during bat surveys from 1992 to 1994 indicate that there is a seasonal peak in visual detection in September and October, and we expect mean numbers to fall again in late 1995. As with all monitoring data, multiple years are required to document bona-fide population trends (rather than anomalies or seasonal variations).

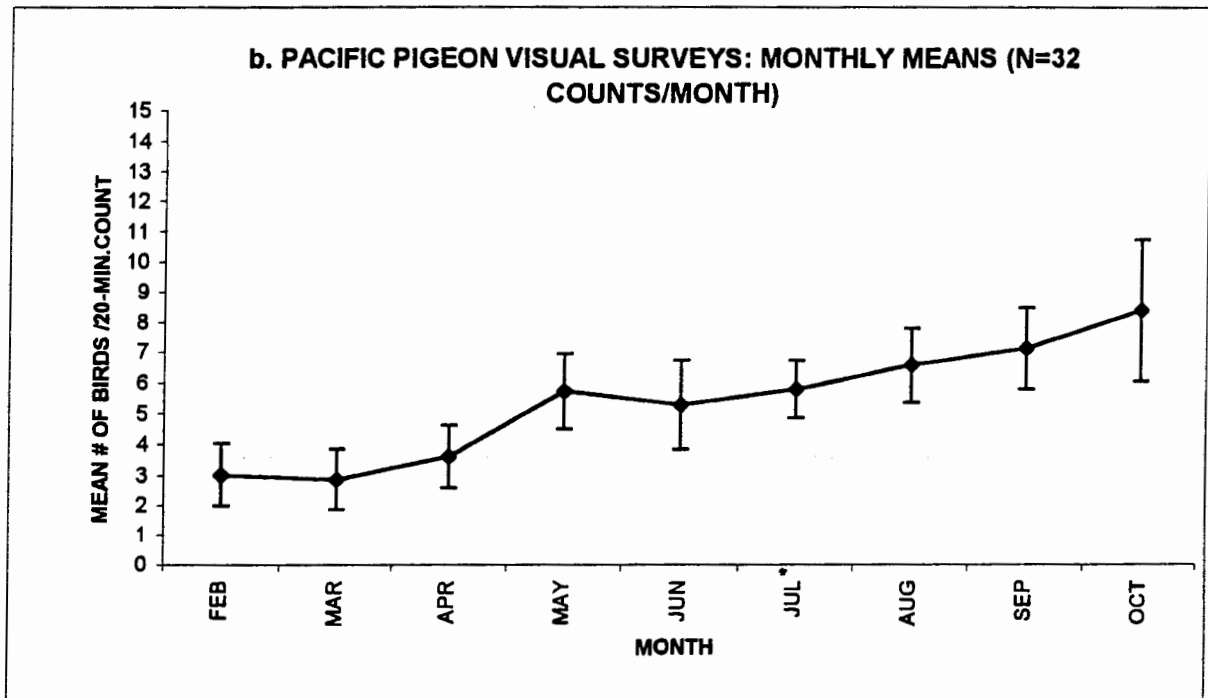
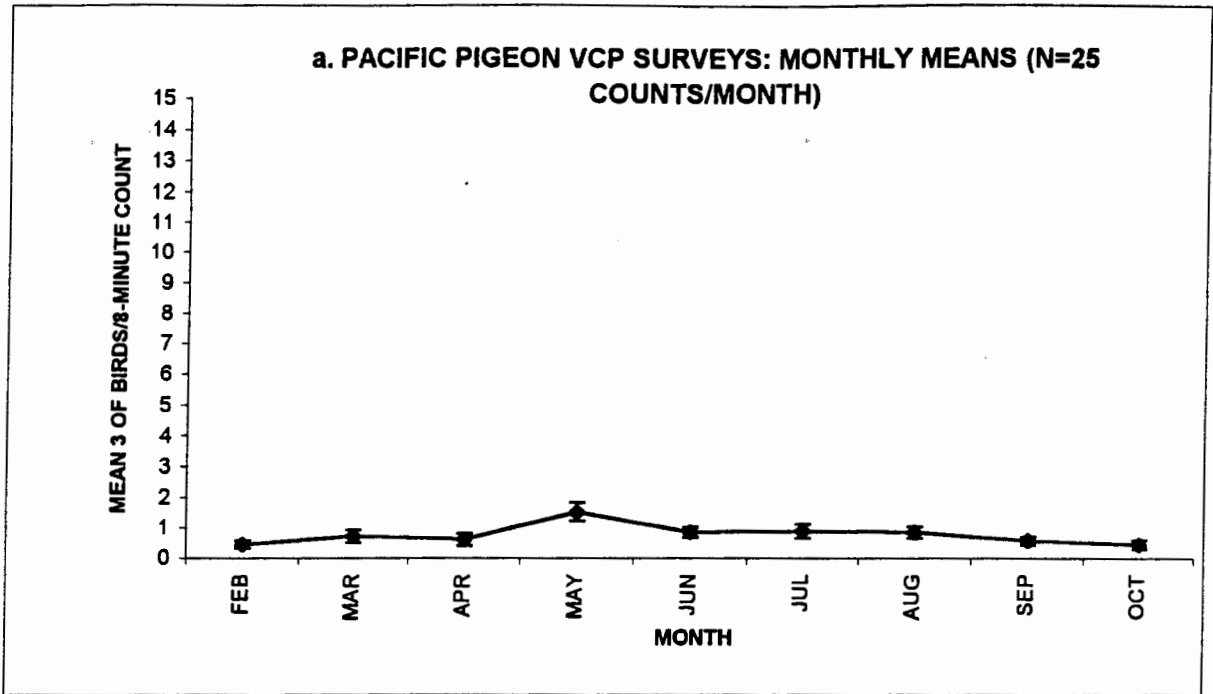


Figure 4. Comparison of variable circular plot (VCP) data(a) and visual census data (b) for Pacific Pigeons, February-October 1995.

### **3. Status of Manu'a birds**

Due to logistical difficulties, we were unable to make observations of birds in Manu'a during this fiscal year. Dr. Pepper Trail's proposal for Manu'a bird surveys was submitted to NBS and to FWS for funding, and was turned down. Since two of the three bird species that are candidates for listing under the Endangered Species Act are restricted to Manu'a (*Porzana tabuensis* and *Gallicolumba stairii*), we were puzzled and disappointed to receive no material support from either Department of Interior agency to investigate the status of these species.

### **Literature Cited**

Engbring, J. and Ramsey, F.L. 1989. A 1986 survey of the forest birds of American Samoa. U.S. Fish and Wildlife Service.

Scott, J.M., Mountainspring, S., Ramsey, F.L, and Kepler, C.B. 1986. Forest bird communities of the Hawaiian Islands: their dynamics, ecology, and conservation. Studies in Avian Biology No. 9.

**PROJECT:** Wildlife Investigations  
**STUDY:** Bird Studies  
**JOB:** Habitat use

**PROJECT:** W-1-R-8  
**STUDY:** 2  
**JOB:** 2

**PERIOD COVERED:** October 1, 1994 to September 30, 1995

### **OBJECTIVE**

Assess the influence of various habitat variables on the abundance and diversity among variable circular plot stations.

### **SUMMARY**

We have initiated a multivariate data base of habitat measurements collected at 67 VCP stations. Some of the variables on which we are collecting data are: canopy and understory vegetation, vegetation height and structure, elevation, aspect, and slope. To date, we have collected elevation data from 46 stations, aspect data from 30 stations, and have collected vegetation data from two 60m transects at each of 16 stations. These data illustrate the variation in habitat we can expect to document with data from all stations. Statistical analysis comparing the bird survey data with these habitat variables will yield valuable information about specific areas and specific kinds of habitats in Samoa are important for Samoa's native forest birds.

### **BACKGROUND**

Hurricanes play an important role in the configuration of habitat for native birds. Fluctuations in habitat ensuing from these storms are a normal part of Tutuila's ecology, and by themselves probably do not threaten native species with extinction. However, as the human population of American Samoa grows (with a doubling rate of only 19 years), more forested land is being cleared for agriculture and other development, resulting in the long-term loss of native habitat. The available habitat for forest birds is thus being reduced and fragmented by human activities as well as being altered by natural disturbance.

Understanding the importance of certain places or conditions as habitat for native birds is key to developing realistic management and conservation strategies for these species. Knowledge about how human activities affect native birds will help in the development of management plans for viable populations of pigeons and doves for future human use, and of all forest birds for the long-term health of the native forest. This knowledge will also help to guide future public outreach, education, and regulation and enforcement activities of DMWR.

### **PROCEDURES**

To assess significant differences in habitat use by forest birds, it is first necessary to define the habitats they are using. We have initiated a multivariate data base of habitat measurements collected at 67 VCP stations. These 67 stations comprise the 25 native forest sites that have been monitored since 1992, plus 10 stations in plantation forest that

have been monitored for the same period and 32 additional stations in other locations that have been monitored since August 1995 (Table 1). When this data set is complete, it will be compared quantitatively with the bird census data collected monthly at each station. This analysis will reveal the importance of various landscape features as controls on the presence and abundance of forest bird species at different locations.

Canopy and understory species composition is quantified by walking two 60m transects in random directions originating at the station. At 5m intervals, the nearest canopy tree and understory plant are identified and their diameter at breast height (dbh) measured. This method is modified from the point-centered quarter method described by Mueller-Dombois and Ellenberg (1974, p. 110) and used by Merlin (1985, 1991) to describe woody vegetation in the Cook Islands.

The modifications (sampling at 5m rather than 10m intervals and recording data only for mature over- and understory plants in stead of all woody plants, Mueller-Dombois and Ellenberg 1974, p. 110-112) were introduced because the goal is to sample the area in which birds are recorded and the resources birds are using rather than to sample and describe total floristic composition. Seedlings, ground layer and non-fruiting plants are not included because young, non-fruiting plants do not now contribute to the resources used by birds (although the seedlings present now will determine the composition of the canopy in the future).

Species dominance is determined by calculation of both basal area and numeric abundance for each species from the transect data. A range of other environmental variables, including elevation, slope, aspect, canopy height, vertical complexity, and general character of the vegetation, are also collected from each station.

## **RESULTS/DISCUSSION**

To date, we have collected elevation data from 46 stations, aspect data from 30 stations, and have collected vegetation data from two 60m transects at each of 16 stations.

A graph of elevation by station (Fig. 1) indicates that the stations for which we have data (69% of the total number of stations) represent a gradient from near sea-level to 300m. The aspect data for 30 stations, or 45% of all stations, similarly graphed, represent the north-to-east side of the compass better than south-to-west (Fig. 2). This lopsidedness is likely an artifact of missing data and should be corrected when the remaining 37 stations are added.

The vegetation data from 16 stations have been analyzed to produce graphs of taxonomic dominance by proportion of total basal area and by proportion of total number of trees. Graphs of canopy tree data from three stations (Fig. 3) illustrate the contrast between these two expressions of species dominance as well as the wide variation in composition and diversity. A species represented by one individual may be

dominant by basal area. The extreme example of this is *Barringtonia asiatica* at Station 18 (Fig. 3b). This species is not numerically well-represented in this area (Vatia Transect). The numerically dominant species at this station, *Diospyros samoensis* (Fig. 3b), ranks third by basal area.

The range of species composition and diversity among stations is well-illustrated by a comparison between Stations 12, 18 and 21. Stations 12 and 18 are both located in native forest. However, Station 12 is dominated by *Rhus taitensis*, which accounts for 79% of the 24 trees recorded. *Rhus* is typically dominant in secondary forest where it forms relatively homogeneous stands (Whistler 1980). Station 18 is in older, apparently more stable ridge forest, which is typically more taxonomically diverse. The numerically dominant species here, *Diospyros*, accounts for only 25% of 24 trees recorded. Station 21, in agroforest, stands in sharp contrast with 12 and 18. Only three canopy species are recorded. Two are cultivated (*Cocos nucifera* and *Artocarpus altilis*) and one is a native (*Erythrina variegata*, a typical "invader" of plantations).

This preliminary analysis of vegetation data and other environmental indicates the wide range of habitat variation likely to be represented when data for all stations have been collected. Statistical analysis comparing the bird survey data with these habitat variables will yield valuable information about specific areas and specific kinds of habitats in Samoa are important for Samoa's native forest birds.

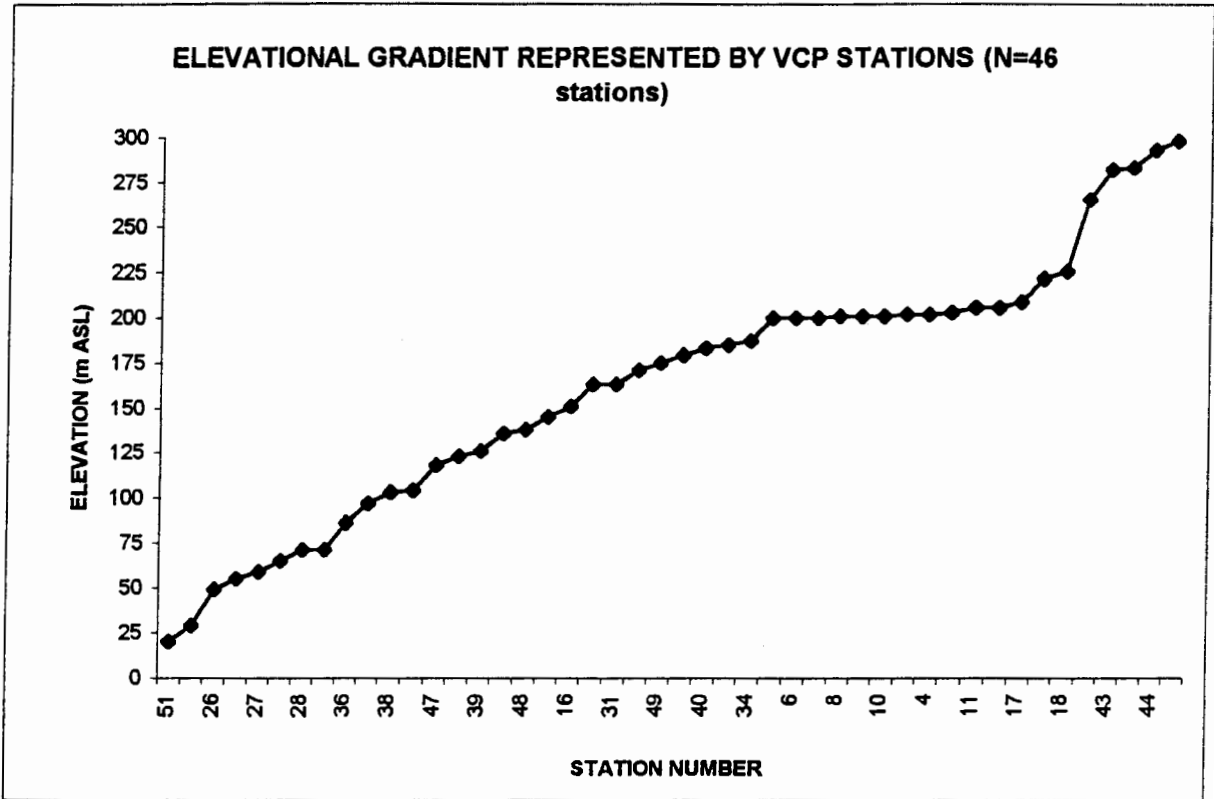


Figure 1. Elevational gradient represented by 45 VCP stations.

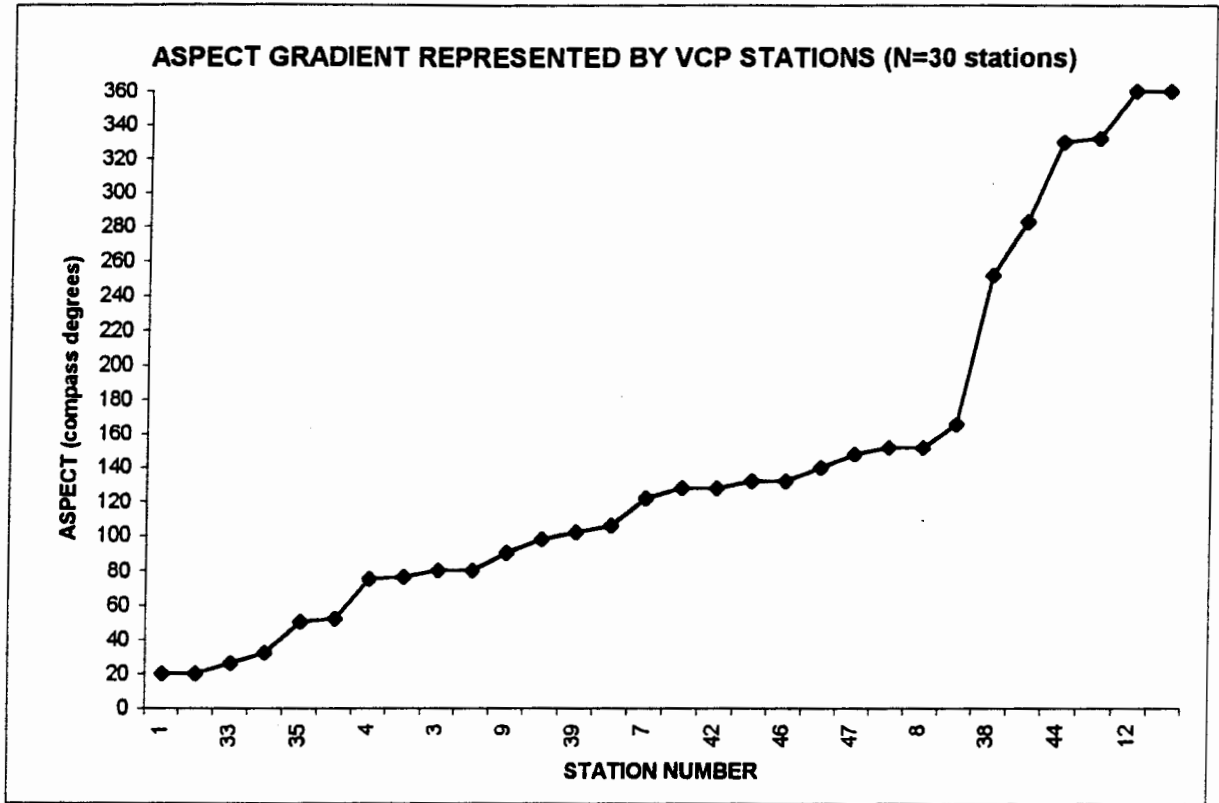


Figure 2. Aspect gradient represented by 30 VCP stations.

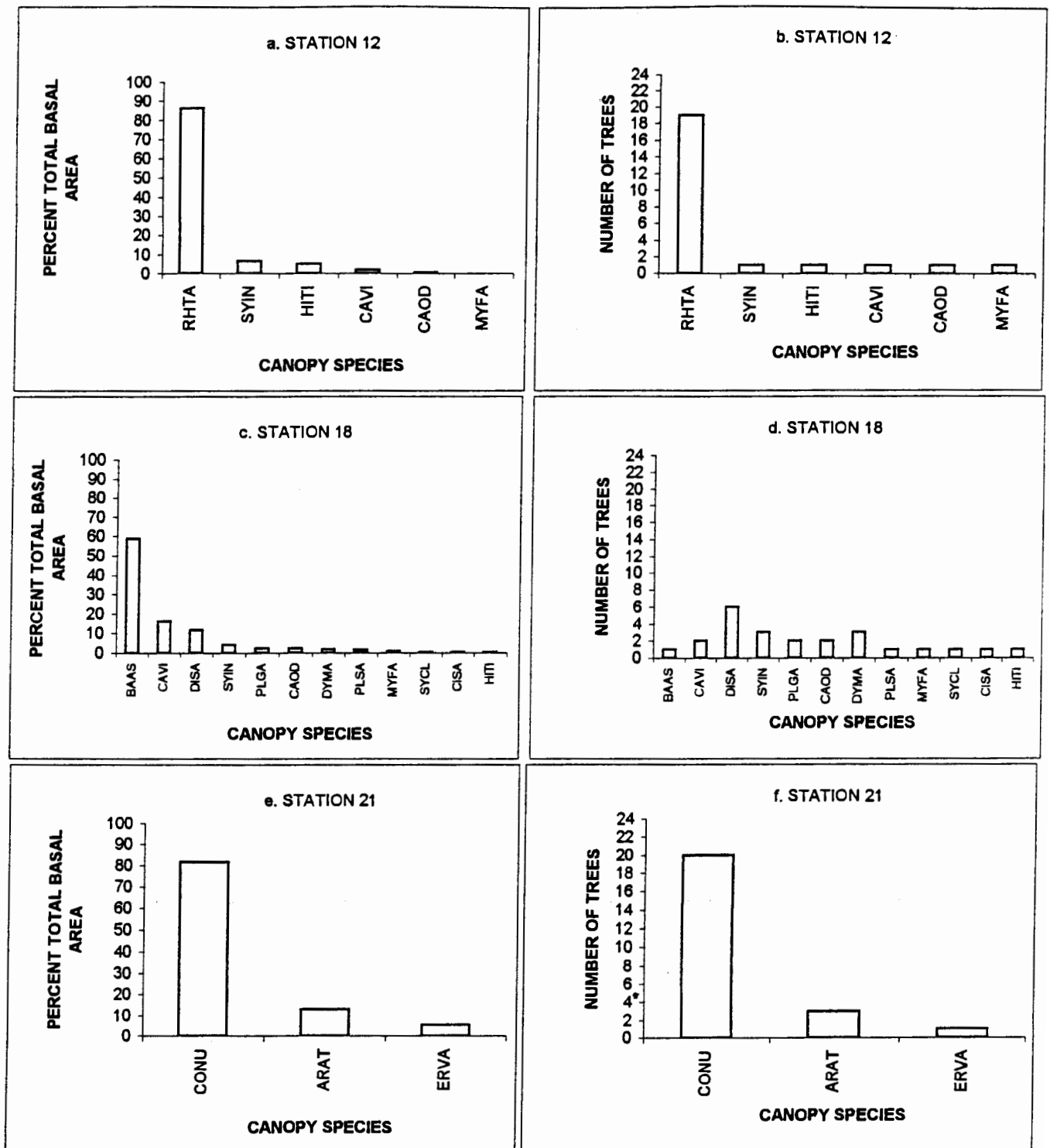


Figure 3. Vegetation data for three stations, graphed by percent total basal area (left) and by number of trees (right). BAAS=*Barringtonia asiatica*, CAVI=*Canarium vitiense*, DISA=*Diospyros samoensis*, SYIN=*Syzygium inophylloides*, PLGA=*Planchonella garberi*, CAOD=*Cananga odorata*, DYMA=*Dysoxylum maota*, PLSA=*Planchonella samoensis*, MYFA=*Myristica fatua*, SYCL=*Syzygium clusiiifolium*, CISA=*Cintronella samoensis*, HITI=*Hibiscus tiliaceus*, RHTA=*Rhus taitensis*, CONU=*Cocos nucifera*, ARAT=*Artocarpus atilis*, ERVA=*Erythrina variegata*.

Table 1. Summary of VCP transects and stations in various forest types.

TRANSECT	CLIMAX FOREST (# OF STATIONS)	SECONDARY FOREST	PLANTATION FOREST	DEVELOPED/ URBAN AREA
FAGATOGO (10)	5	5	0	0
ALOFU (10)	0	5	5	0
VATIA (5)	2	3	0	0
LOGOTALA (5)	0	0	5	0
VAITOGI (5)	0	0	5	0
MALOATA (7)	3	2	2	0
TAFUNA (6)	0	0	0	6
PAGO PAGO (10)	0	0	0	10
OLO (9)	5	4	0	0
total:	15	19	17	16
				total stations: 67

### Literature Cited

Merlin, M.D. 1985. Woody vegetation in the upland region of Rarotonga, Cook Islands. *Pacific Science* 39 (1): 81-99.

\_\_\_\_\_. 1991. Woody vegetation on the raised coral limestone of Mangaia, Southern Cook Islands. *Pacific Science* 45(2): 131-151.

Mueller-Dombois, D. and M. Ellenberg. 1974. *Aims and Methods of Vegetation Ecology*. John Wiley, New York.

Whistler, W.A. 1980. The vegetation of Eastern Samoa. *Allertonia* 2(2): 45-190.

**PROJECT:** Wildlife Investigations  
**STUDY:** Remote Islands  
**JOB:** Rat Eradication

**PROJECT:** W-1-R-8  
**STUDY:** 6  
**JOB:** 3

**PERIOD COVERED:** October 1, 1994 to September 30, 1995

### **OBJECTIVE**

To monitor seabird nesting populations and quantify vegetation recovery following the elimination of rats.

### **BACKGROUND**

Rose Atoll National Wildlife Refuge is an important seabird breeding site in the south-central Pacific Ocean. It also provides the last remaining breeding habitat for the "threatened" green sea turtle. However, the habitat had been degraded by the activities of a very dense population of Polynesian rats. The rats preyed on bird eggs and nestlings, sea turtle hatchlings, and plant seeds and seedlings. In order to enhance the value of Rose Island for breeding seabirds, a rat trapping and poisoning program was initiated in 1990.

The initial trapping/poison effort in 1990 yielded a known kill of 914 rats. A second trip (Apr-May 1991) yielded one rat, a third trip (Aug-Sept. 1991) took 4 rats, and a fourth trip (June 1992) took a single rat, the last one taken by trap. No rats were caught during trapping in Sept. 1992, in 1993 or in 1994. We visited Rose Island between 22 and 25 October, 1995. We did not set traps in 1995 but searched for evidence of rats and did not encounter any. We also conducted a seabird census and collected data from 19 vegetation monitoring plots. In 1995 as in 1994, the vegetation appeared very healthy and we observed considerable growth since last year.

### **RESULTS**

#### **Rats**

We observed no evidence of rats (ratted eggs, chewed vegetation, feces).

#### **Seabirds/Shorebirds**

H. Freifeld, D. Woodside and A. Tualaulelei conducted a seabird census on 24 October. Using the east-west gridlines, we walked from point to point, counting and staging all seabirds seen within 5m. Each observer censused individual gridlines. These data are summarized in Tables 1 and 2. One objective on this trip was to document Procellariid nesting activity. Unfortunately, we did not hear or see any shearwaters or petrels, or see any sign of burrow excavation.

Table 1. Total number of birds observed at each stage

SPECIES	EGGS		CHICK STAGE										ADULT TTL						
	1	2	1	2	3	4	5	6	6A	6B	6C	7		8	9	10			
<i>Phaethon rubricauda</i>	1														7	3	10		
<i>Sula dactylatra</i>		1											3				13	16	
<i>Sula leucogaster</i> *													1	3			4	8	
<i>Sula sula</i>				3		2	5		5	6	69						130	220	
<i>Fregata minor</i>			1														1		
<i>Fregata ariel</i>																	0		
<i>Fregata sp. **</i>																		2	2
<i>Sterna fuscata</i> ***	31			22	18	59	7	28									52	186	
<i>Anous stolidus</i> ****	6			3	1		2	11									31	48	
<i>Anous minutus</i>	1						2	70									187	259	
<i>Gygis alba</i>	23		1														93	94	

\*There were considerably more BRBO than reflected by census -- ca. 200 adults and stage 9 birds.

\*\*There were considerably more frigates than reflected by census -- ca 500 roosting birds.

\*\*\*There were probably about 3,000-5,000 roosting/non-breeding birds

\*\*\*\*The BRNO colony on rubble on NW shore of island had ca. 75 pairs and 40-50 stage 5 and 6 chicks. Few eggs. The smaller (40-50 pairs) arboreal colony at S end of island had about half eggs and half stage 2 chicks.

TABLE 2. Proportion of total birds at each stage

SPECIES	EGGS		CHICK STAGE										ADULT totals					
	1	2	1	2	3	4	5	6	6A	6B	6C	7		8	9	10		
<i>Phaethon rubricauda</i>	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	70	30.00	100
<i>Sula dactylatra</i>	0	6.25	0	0	0	0	0	0	0	0	0	0	0	18.8	0	0	81.25	100
<i>Sula leucogaster</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	12.5	38	0	50.00	100
<i>Sula sula</i>	0	0	0	1.36	0	0	0.91	2.27	0	2.27	2.73	* 31	0	59.09	100	0	59.09	100
<i>Fregata minor</i>	0	0	0	100	0	0	0	0	0	0	0	0	0	0	0	0	0.00	100
<i>Fregata sp.</i>	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	100.00	100
<i>Stema fuscata</i>	16.7	0	0	11.8	9.68	31.7	3.76	15.1	0	0	0	0	0	0	0	0	27.96	100
<i>Anous stolidus</i>	12.5	0	0	6.25	2.08	0	4.17	22.9	0	0	0	0	0	0	0	0	64.58	100
<i>Anous minutus</i>	0.39	0	0	0	0	0	0.77	27	0	0	0	0	0	0	0	0	72.20	100
<i>Gygis alba</i>	24.5	0	0	1.06	0	0	0	0	0	0	0	0	0	0	0	0	98.94	100

We observed bristle-thighed curlews, golden plovers, ruddy turnstones and wandering tattlers on the island. Golden plovers were by far the most abundant shorebirds, numbering about 20. We only saw three curlews together at any one time, and estimate that there were no more than five on the island. Turnstones and tattlers were few, perhaps three to five birds total for each species.

#### **Vegetation Plots**

Nineteen of 20 vegetation plots were surveyed. Overall, the height and density of *Tournefortia argentea* appeared to have increased from last year. This change was particularly noticeable at the north end of the island, which had been completely denuded after Hurricane Val in 1991. The *Pisona* forest, in contrast, appeared to have decayed somewhat since last year. It looked like there were more trees down, and there is still no indication of regeneration.

#### ***Cenchrus* Control**

Three small individuals of *Cenchrus echinatus* were found in the same location as last year. Both plants were removed (by D. Woodside and H. Freifeld) along with as many seeds as we could recover.

PROJECT: American Samoa Wildlife Investigations  
STUDY: Technical Assistance  
JOB: Technical Assistance

STUDY: 8  
JOB: 1

**OBJECTIVE:**

Provide technical information and assistance regarding wildlife issues in American Samoa to government agencies and the public. DMWR will provide technical assistance to individuals, groups, village councils, or agencies seeking information. This includes reviewing documents, reports, and permit applications from various governmental agencies and individuals. As warranted, technical information will be disseminated through DMWR reports, meetings, or local media.

**RESULTS:**

DMWR attended monthly meetings as a board member of the American Samoa Soil and Water Conservation District.

We provided information to Chris Stein, National Park Service on biological issues in the American Samoan National Park.

Holly Firefeld submitted an article to the Samoa News on hatchling turtles.

DMWR provided judges for both the Pacific Horizons and Pago Pago elementary schools science fair.

Holly Freifeld and Anne Brooke provided information about wildlife to a number of walk in visitors to DMWR. During coast weeks we led wildlife walks to the National Park. Chris Solek and Ailao Tualualelei led a wildlife walk for a Leone high school science class. A. Tualualelei gave numerous presentations to primary and secondary school children on the native wildlife of American Samoa.

Presentations were made by H. Freifeld and A. Brooke to the Governor and his cabinet, classes at the American Samoan Community College, and the Earth Day Summit.

We provided logistical support for several students who worked out of the DMWR office: as an undergraduate, Tyra Toluiva, U. Hawaii; and as graduate students: Susan Thomson, U. Aberdeen, Scotland; Suzy Nelson, U. Illinois; Simon Holzaphel, Carleton College; Kim Whitman, Rutgers University.

A. Brooke assisted the Western Samoan Dept of Land, Surveys and The Environment in conducting a census of the P. samoensis on 'Upolu and Savaii.

PROJECT: American Samoa Wildlife Investigations

STUDY: Technical Assistance

JOB: Scientific Exchange

STUDY: 8

JOB: 2

**OBJECTIVE:**

Disseminate information to the scientific community by presenting papers at meetings and submitting articles to scientific journals.

**RESULTS:**

Talks were given on research conducted in American Samoa by A. Brooke at the International Bat Research Meetings in Boston and the Australian Mammal Society, Townsville, Australia.

H. Freifeld attended a workshop in Honolulu on dealing with tropical forest bird ecology. New methods of censusing forest birds were discussed and have been applied to our work at DMWR.

The following papers were published from work conducted by DMWR personnel:

Grant, G. 1994. Decline of the sheath-tailed bat Emballonura semicaudata (Chiroptera: Emballonuridae) on American Samoa. *Micronesia* 27:133-137

Grant, G. 1994. Observations of Pteropus tonganus on Niue, South Pacific Ocean. *Bat Research News* 35:64-65

Morrell, T. and P. Craig 1995. Temporal variation in fruit bats observed during daytime surveys in American Samoa. *Wildlife Society Bulletin* 23:36-40.

P. Craig, P. Trail and T. Morrell. 1994. The decline of fruit bats in American Samoa due to hurricanes and overhunting. *Biological Conservation* 69:261-266.

Talks were given on research conducted in American Samoa by A. Brooke at the International Bat Research Meetings in Boston and the Australian Mammal Society, Townsville, Australia.

H. Freifeld attended a workshop in Honolulu on dealing with tropical forest bird ecology. New methods of censusing forest birds were discussed and have been applied to our work at DMWR.