GOVERNMENT OF AMERICAN SAMOA
DEPARTMENT OF MARINE AND WILDLIFE RESOURCES
ANNUAL REPORT: FY1997

PROJECT W-I-R-12: American Samoa Wildlife Investigations
STUDY 1: Fruit Bat Studies
JOB 1: Abundance and distribution

PERIOD COVERED: 1 October 1996 to 30 September 1997
IMPLEMENTED BY: Dr. A. F. Brooke, C. Solek, and R. C. B. Utzurrum
REPORT PREPARED BY: R. C. B. Utzurrum

SUMMARY: P. samoensis surveys on Tutuila were reduced to a quarterly schedule beginning with the 2nd quarter of the fiscal year. As in the previous two years, surveys consisted of eight 10-minute censuses with 5 minute breaks. The estimated size of the population remained relatively constant in the last three years. Significant variability in numbers was, however, found among survey sites, and within a year. These results suggest that the patterns of occurrences may be related to aspects of the habitat (e.g., food availability and vegetative composition). The lack of interannual variation and the dampening of oscillations in growth rates suggest that the population may be reaching an asymptote, or are near-equilibrium. An examination of the population counts over the last 15 years, and in relation to occurrences of hurricanes and hunting activities suggest that P. samoensis were being severely impacted by hunting. Conversely, the data strongly suggests that the recovery process has been favored by a banting moratorium. P. tonganus populations are still below the pre-hurricane levels, but population growth rate trajectories and trends in numbers since 1991 suggest a slow recovery. Unlike P. samoensis, the hurricanes may have had a more direct impact on P. tonganus. Although improvements in survey methods have increased the reliability and consistency of data, the numbers generated remain, at best, as population size indicators rather than estimators. A true estimate may be achieved by instituting a mark-recapture program. Additionally, such a recapture program will provide the much needed information on reproduction and mortality that are necessary in assessing the dynamics of the population, and in understanding mechanisms of population recovery.

BACKGROUND: Data on the status and distribution of Pteropus samoensis and P. tonganus on American Samoa have been collected for the past seven years. Population estimates prior to 1995 were considered problematic for a number of reasons. First, counts were done by several individuals (up to eight at one time) whose abilities to differentiate between the two species vary. These increased the uncertainty in numbers generated due to misidentifications. Secondly, the counts were done in 20-minute periods. Difficulties in keeping track of individuals as they disappeared and reappeared over the survey areas are heightened over such a period. Additionally, when several people are independently surveying different areas, differences in decision-making over recognition of occurring individual bats within a 20-minute period may have become an artificial source of variance in numbers. Finally, the time when counts were conducted varied significantly. Although it has been shown that the fruit bats (especially P. samoensis) exhibit diurnality, the extent of daytime activities varied...
throughout the day, and were most and consistent pronounced in the early morning and late afternoon hours. Thus, counts conducted around mid-day could have significantly underestimated the numbers of bats present compared to counts at other times of the day.

Despite the differences in the survey methods employed, there was general consensus that the numbers of fruit bats in the territory declined drastically in response to a series of hurricanes between 1987 and 1991. A hunting ban (prohibiting both species of fruit bats, and three species of pigeons and doves) was instituted in 1991 to aid in population recovery. The ban is still in effect but will need to be re-evaluated as it expires in 1998. Regardless of whether this protection is lifted or not, the monitoring of population trajectories in time and space should be continued as a basic management and conservation tool.

OBJECTIVES. To determine the abundance and distribution of the two species of fruit bats, *Pteropus samoensis* and *P. tonganus*, in American Samoa. In relation to this, we conducted a preliminary evaluation of survey methods employed to date for the purpose of developing a standardized approach for long-term monitoring of populations.

APPROACH. Beginning in 1995, *P. samoensis* surveys on Tutuila, consisted of doing eight 10-minute counts (at 5-minute intervals) beginning at first light. The counts were conducted at six sites, largely by the same individual, at monthly intervals. Beginning January 1997, the frequency was reduced to quarterly counts by Dr A.P. Brooke (then wildlife biologist). The rationale for this change in approach is unknown. To arrive at a population estimate, counts over the eight 10-minute periods were averaged (=mean count/10 minutes), standardized to a count per unit area (per km²) to account for differences in the sizes of area surveyed, and the extrapolated to a count over the suitable habitat available on the island (i.e., 69.9 km² of forest, based on Cole et al., 1988). Any *P. tonganus* sighted during these dawn counts were also recorded.

*P. tonganus* were surveyed quarterly through ectic (dusk) counts from vantage points on land of accessible known roosts, and through a round-the-island boat count of visible roosts. These counts were considered minimum estimates of total population on the island given that all existing roosts may not be known or found. The locations of roosts are plotted to track spatial shifts in occurrence and changes in sizes of colonies at the same locations are noted to monitor population change and possible flexes between colonies.

The *Manuas* were surveyed once a year. *P. samoensis* was surveyed as on Tutuila. In FY1997, the visit was aimed at re-evaluating the sites used in previous surveys, and the surveys were conducted following a modified site scheme. The *P. tonganus* colony roosting at a crater slightly SW of Judah's crater on Ta'u was visited.

Data analysis. *P. samoensis* counts from January 1995 to November 1987 on Tutuila were statistically analyzed to determine spatial differences and temporal trends in numbers. Counts per km² per 10 minutes were log$_{10}$ transformed and analyzed using Repeated Measures Analysis of Variance. The model used was: log$_{10}$ count = site year site*year, with months as the repeated measurement variable. Data were log transformed to approximate normality, and results of the within-subject comparisons were interpreted using the Greenhouse-Geisser
Adjusted $F$ to address problems due to heteroscedasticity. A post-hoc comparison (Scheffe Test following analysis of variance) was applied to analysis with significant results. All interpretations were based on a significance level $\leq 0.05$.

The average or minimum population growth rate for both species was calculated using the formula: $\Delta N_j/dt = 1/s \sum 1/t \ln(N_i) - \ln(N_{i+1})$, where $N$ is the average population and $s$ are the number of sites. For $P. samoensis$, mean counts/km$^2$/10 minutes were averaged across all six sites for each survey period from January 1995 to November 1997. These averages were used in the calculation. $P. tonganus$ calculations are based on yearly minimum total observed bats (from exit/dawn counts and roost counts), including yearly recorded estimates from 1987 to 1997.

RESULTS and DISCUSSION:

The status of $P. samoensis$ populations on Tutuila. The population of $P. samoensis$ on Tutuila has remained stable over the last three years (Repeated Measures ANOVA: $F = 0.60$, $P = 0.4394$), with total numbers estimated below 1000 counts (924, 867, and 907 respectively for 1995, 1996, and 1997). Although interannual differences were not significant, intrannual variation was (i.e., variation in numbers among months were significant; Repeated Measures ANOVA: $F_{10} = 8.16$, $P = 0.0001$). Additionally, this monthly variation were significantly different among the six survey sites (i.e., intra-annual patterns were not synchronous; Repeated Measures ANOVA: $F_{10} = 3.36$, $P = 0.0001$; Fig. 1) and among years (i.e., periods of low and high abundance were not coincident among years; Repeated Measures ANOVA: $F_{10} = 7.10$, $P = 0.0001$). $P. samoensis$ were significantly most numerous at Amalau Valley (on the north coast within U.S. National Park of American Samoa boundaries), followed by Melota (northwest tip of island) and Aoa (northeast tip), then by Malaisei and Nuului; it was significantly lowest at the Malaisei valley (Fig. 1; Scheffe Test at $P < 0.05$).

A plot of changes in numbers over time (i.e., growth rate: $dN/dt$) of the average population (across the six survey sites) support in part the lack of interannual variation in numbers that was found. Rates generally hovered around zero growth (Fig. 1). Additionally, the plotted values indicate a trend towards a stable pattern (i.e., amplitudes of oscillations become flatter), with a trend towards a slightly positive growth rate (Fig. 1).

Some of the implications of these observed spatial and temporal patterns in numbers are: 1) estimates extrapolated from surveys and the assumed extent of available habitat may be a poor estimator of the actual population size as the number and types of sites surveyed do not amply represent the variation in numbers associated with habitat differences throughout the island; and 2) the dampening of growth rate oscillations in association with interannual stability in numbers suggest that the population may be reaching asymptotic levels (i.e., the population estimated in the last three years are within the range of the maximum that may be present on the island). It is unknown, however, how the positive trend in population growth is being achieved (i.e., is it increased recruitment through immigration or births, or through decreased mortality?). Although reproduction is indicated by sightings of females carrying young, or recorded presence of volant subadult individuals, the data are not sufficient for a
The estimates of total population size for 1995 to 1997 are higher than the average 1987 estimate (the highest available estimate since 1986, and prior to Hurricanes Ofa and Val) and more than 10X the estimated total in early 1991 following Hurricane Val (Craig et al., 1994). Since the counts are diurnal rather than during nocturnal peaks of activity, and since a large proportion of the counts are generated by individuals in the air, and very few roosting or within-vegetation individuals are accounted for, then it is possible that these figures slightly underestimate the actual size of the population. Despite this weakness, and the problems inherent to the survey methods employed prior to 1995 (for a discussion, see Craig, 1992 and Craig et al., 1994), the numbers generated by the surveys may be used as an index of long-term population trends. With these caveats in mind, a strong argument can be made that the P. samoensis population on Tutuila were declining largely as a result of hunting (i.e., the population decline was evident prior to the devastating effects of Hurricane Ofa), and that any effect the hurricanes may have had on the population were secondary (i.e., the hurricane destroyed habitat and food sources and extensively exposed bats to hunting). It is on record that the harvest of both P. samoensis and P. tonganus were extremely high within the first six months following Hurricane Ofa, with takes declining precipitously thereafter (Craig et al., 1992; Craig et al., 1994). This coincided with the precipitous decline in the post-Ofa P. samoensis population (Fig. 3). Despite Hurricane Val in 1991, there was no further reduction in numbers within a 12-month period; this may be why the numbers were so drastically reduced following the hunting banonaz associated with Ofa: the few bats left were below the threshold of exploitation and impact from the hurricanes. Albeit, the destruction of habitat and food sources by hurricanes may have slowed down the recovery process (see post-1991 phase of Fig. 3), although it is difficult to disentangle this effect from the possible lag time in growth characteristic of populations starting from very low numbers.

Despite the 2-year data gap between 1992 and 1995, a recovery is strongly indicated by the marked increase in estimated numbers of P. samoensis (Fig. 3). The change represents an 8-16 fold increase in numbers (the range depending on whether the pre-1995 counts are reduced to 10-minute counts or kept as 20-minute counts). As noted above, numbers in the last three years are higher than estimates prior to the Hurricanes. This recovery coincides with the implementation of a hunting ban in April 1992. This moratorium is still in effect, and the behavior of the population in the last three years (i.e., stable at slightly less than 1000 bats) under protection reinforces the arguments that hunting was the principal reason for population declines. Conversely, it attests to the utility of a hunting ban as a strategy for recovery.

The status of P. tonganus populations on Tutuila. Surveys of P. tonganus in FY1997 were spotty. The first survey was conducted in October 1996; no other surveys were conducted until September 1997. This was partly due to personnel turnover (C. Solek, a Biological Assistant, left in early 1997, and A. P. Brooke, the bat biologist, left in May 1997), lag time in assumption of responsibilities by the new wildlife biologist due to familiarization

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phase, and unusually prolonged periods of rough weather in the last quarter of FY97 that precluded surveys by boat.

Taking the sum of the averages of counts made during the fiscal year, the minimum estimate of *P. tongoanus* on Tutuila for 1997 was 5483 (Table 1). This is comparable with the 1996 estimate of 5750 bats, and slightly 2x greater than the post-Hurricane Val estimate of 1770 bats (A.P. Brooke, unpub. report). The FY1997 counts were from 16 colonies. A comparison of current roost locations with previous records show that not all roost locations are stable over a long-term. For example, previous colonies at the Olava'ulu Crater and Siliaga Point were confirmed absent. New sites were also recorded, including those at Faiga Ridge, Fagasua Bay, and Nuu'Uo'o Cove (Table 1).

The current estimate is still well below (67% lower) than numbers before Hurricane Ofu (A.P. Brooke, unpub. report; Craig et al., 1994), but the population has exhibited positive growth rates following a hunting moratorium in early 1992 (Fig. 4). If this positive trend continues under conditions of no hunting, then the population could potentially return to late 1980's levels. Because the *P. tongoanus* population was markedly greater than *P. samoaensis* on Tutuila, and, perhaps, as a consequence of their propensity to roost in large aggregations on wind-exposed coastal vegetation, it is possible that the two hurricanes that hit in 1989 and 1991 has a more direct impact on the former population. It is indicated, however, that in the absence of further hurricanes, the hunting ban has had positive effects on the recovery of the species on Tutuila.

The status of fruit bat populations on Manu'a: The Manu'a were visited in early August 1997. The surveys were very incomplete due to inclement weather and the lack of flexibility in the time allotted for the visits. The general impression from the few counts completed was that *P. samoaensis* were very uncommon in Ta'u and Olosega (< 10/0-min). The low numbers could be due in part to the very high winds that buffet the areas used for surveys, especially on Ta'u. The average counts across 3 sites on Ofu was 1.63/10-minutes (range: 1.5-2.7/10-min), or roughly 6.5 bats/km²/10-minutes. This is nearly double the estimate in 1996 (3.6/km²/10-min., from A.P. Brooke, unpub. report). The *P. tongoanus* colony within the crater due NE of Judd's crater (on Mt. Lata) was estimated to number around 200 bats. A.P. Brooke estimated the colony to number ca. 500 bats during an October 1996 visit. The combined numbers of *P. tongoanus* observed in one day (a combination of exit and roost counts) on Ofu or August 1997 was 211. A.P. Brooke counted 244 individuals of the species exiting from a ridge behind the lodge at the Airport (unpub. quarterly report).

Re-assessment of survey sites on Manu'a: The principal purpose of the August 1997 visit to the islands was to evaluate survey sites used in previous years as a preliminary step towards standardizing survey methods on the islands. Given the relative smallness of the three islands compared with Tutuila, the number of sites used for counts were seemingly disproportionate (6 in Ta'u, 4 on Ofu, and 5 in Olosega compared with 6 on Tutuila). When plotted on a map, the sites were considered to be too close, and upon visitation, it was considered that the numbers and configurations of their locations possibly compromises
independence of the counts (i.e., highly likely for a bat seen in one area to be counted at a neighboring site). A reduction and reconfiguration of survey sites without sacrificing adequacy of sampling will also improve the logistics of the survey (i.e., time and number of personnel needed to complete them). Thus, sites on Ta'u were reduced from six to five, on Ofu from four to three, and on Olosega from five to three. These reductions were accompanied by reconfigurations (i.e., not all sites retained were included in the set surveyed previously).

JOB EVALUATION and RECOMMENDATIONS:
The surveys on Tutuila were carried out with better consistency by reducing the numbers of observers basically to one person, with occasional substitution by a second experienced observer. Additionally, the reduction of the count period from 20 minutes to 10 minutes has served to improve tracking of the same individuals (thus, reducing recapture) within the same period. Since the basis for reducing the frequency of surveys from monthly to quarterly is unclear, it is best to return to a monthly census until data are statistically evaluated (perhaps, by bootstrapping) to determine how the reduction affects the extraction of averages, and if warranted, how the reduction may be done without affecting results. More importantly, it is recommended that the surveys be made more meaningful against an ecological backdrop by trying to determine possible relationships between temporal and spatial variability and such ecological factors as food resource availability and vegetative quality. Continuing the monthly surveys, and complementing them with phenological studies at the survey sites should be implemented in the next fiscal year. Additionally, we should obtain basic botanical characterizations of the study areas for comparisons.

The current survey approach will remain inadequate as a true estimator of population sizes, however. Thus, it is highly recommended that attempts be made to initiate and establish a mark-release-recapture program beginning the next fiscal year.

Literature Cited
Department of Marine and Wildlife Resources (American Samoa), unpublished report.
Department of Marine and Wildlife Resources (American Samoa) Biological Report Series, No. 25.
Table 1. Minimum average estimated numbers of *Pteropus tonganus* on Tutuila in FY1997. Estimates represent averages of surveys taken between October 1996 and September 1997. (An asterisk (*) denotes estimates based on exit counts; ** denotes a combination of exit count, dawn return count, and/or boat count; otherwise numbers presented are based on visual counts of roosting colonies from a boat.)

<table>
<thead>
<tr>
<th>Roost Location Based on FY 1996/97 Surveys</th>
<th>Minimum Estimate FY1997</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amalau (Olo Ridge)*</td>
<td>200</td>
</tr>
<tr>
<td>Fagateno Bay*</td>
<td>904</td>
</tr>
<tr>
<td>Faiga Ridge</td>
<td>100</td>
</tr>
<tr>
<td>Fagateno Pt., Maloata**</td>
<td>107</td>
</tr>
<tr>
<td>Fagafou Bay</td>
<td>1500</td>
</tr>
<tr>
<td>Fagatogo bird transect**</td>
<td>0</td>
</tr>
<tr>
<td>Nuooto Cove</td>
<td>700</td>
</tr>
<tr>
<td>Oa’Vainuu Pt.**</td>
<td>409</td>
</tr>
<tr>
<td>Oloomoa Mt.*</td>
<td>293</td>
</tr>
<tr>
<td>Olavala Crater*</td>
<td>0</td>
</tr>
<tr>
<td>Mt. Pica*</td>
<td>100</td>
</tr>
<tr>
<td>Polats Ridge, north</td>
<td>250</td>
</tr>
<tr>
<td>Puaena Pt.</td>
<td>300</td>
</tr>
<tr>
<td>Siliaga Pt.</td>
<td>0</td>
</tr>
<tr>
<td>Tafaga Cove/Cape Larsen</td>
<td>320</td>
</tr>
<tr>
<td>Tolotolotoe Pt.</td>
<td>300</td>
</tr>
</tbody>
</table>

**MINIMUM TOTAL ESTIMATE**

5483
FIG 1. Temporal patterns in numbers of *P. samoensis* per 10 minute at six survey sites on Tutuila, American Samoa: January 1996 to November 1997. (mean ± 1 s.d. in parentheses)
FIG. 2. Growth rate of the average population of *Pteropus samoensis* on Tutuila. (Computed based on counts/10 minutes across 6 sites corrected for differences in size of area surveyed: January 1995 to November 1997. Starting average population estimate [January 1995] = 17.3 bats/km²/10 min.; ending estimate [November 1997] = 14.64 bats/km²/10 min.)
Fig. 3. Ten-year trend in *P. samoensis* population on Tutuila (1987-1997), with respect to hurricanes and hunting. [Data from 1987-1992 were extracted from Craig et al., 1992 and for 1993-1994 from Grant et al., 1997, and converted to 10-min counts. Data from 1995-1997 represent unpublished 10-minute counts. Graph in open boxes and dashed lines represent the original 20-minute counts.]

1990 counts were done 7 months following Hurricane Ofa, while 1991 counts were done prior to Hurricane Val.
Fig. 4. Growth rate of the average population of Pieropus tonganus on Tutuila. (Computed based on minimum population estimated from observed bats through surveys of roosts and exit counts: 1987-1997. Starting population size estimate [1987] = 12,750 bats; ending estimate [1997] = 5483.)

TIME SCALE (in years)
GOVERNMENT OF AMERICAN SAMOA
DEPARTMENT OF MARINE AND WILDLIFE RESOURCES
ANNUAL REPORT: FY1997

PROJECT W-1-R-12: American Samoa Wildlife Investigations
STUDY 1: Fruit Bat Studies
JOB 2: Movements and home range studies

PERIOD COVERED: 1 October 1996 to 30 September 1997
IMPLEMENTED BY: Dr. A. P. Brooke, C. Solek, and R. C. B. Uzurrum
REPORT PREPARED BY: R. C. B. Uzurrum

SUMMARY: The last two-radiotagged *P. samoensis* were tracked between November 1995 and February 1996. Preliminary analysis of data gathered indicate that the species are more active at night despite exhibiting diurnal activity. Additionally, the bats exhibited a tendency to restrict movement within a limited home range. No long-distance movement was recorded. No new attempts to tag individuals in 1997 were achieved. Given the limited numbers (2) of individuals tagged, and the number of hours of tracking achieved (150 hours), it is difficult to make any concluding statements about use of space (for roosting and foraging) and behavior by this species. It is recommended that the best possible effort be exerted to implement the project goals in the next fiscal year. Acquisition of additional radiotags and the hiring of a full wildlife staff will be necessary towards this goal. It is also necessary to set up quantitative goals (e.g., maximum number of animals desired for tagging and tracking) so progress can better be evaluated. Additionally, information on home ranges and inter-habitat movement may be obtained through mark-release recapture. Since this approach is also useful in population estimation, there is ample justification for the initiation of such a program.

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

BACKGROUND: Effective conservation and management of the fruit bats of American Samoa require detailed information on their home range sizes, movement patterns, and activity cycles. These information will allow us to estimate the extent of areas required for foraging, identify the types of habitat preferred for roosting and foraging, and assess the relative degree of interface of the bats' sphere of activity and space use with human spheres of activity (e.g., residences, plantations, etc.).

Visual observations can provide but limited data due to the nocturnal phases of fruit bat activity, our inability to follow individuals within foliage (both while foraging or roosting), and the challenge of visually following bats in the highly dissected topography characteristic of American Samoa islands. Radio tracking will address these problems by allowing one to keep track of individuals both day and night, and within and outside of foliage. It also permits continues monitoring of individuals over a diel cycle or more.
APPROACH: Individuals captured in mist nets will be fitted with radio collars that emit unique signals (thus, permitting individual identification). The initial 48 hours will be used to obtain a fix on a bat's location. The bat will be monitored daily initially to determine flight activity patterns, and less frequently thereafter to document ranging patterns. Efforts will be concentrated on _P. samoensis_ since fewer individuals (compared with _P. tonganus_) of the species have been tracked to date.

RESULTS and DISCUSSION: A. P. Brooke and C. Solek were unable to capture and radiotag additional bats in FY1997 prior to their departure. R. Utsurum has not made an attempt to do radiotracking since assuming the wildlife biologist job due to lack of familiarity with sites, habitat, and topography. Instead, R. Utsurum concentrated her efforts at site familiarization, identification of candidate sites for mist netting, and developing strategies and logistics for capturing bats. Permission has been obtained to set up netting stations at Amalau Valley and on Alava ridge (within U. S. National Park boundaries) and in Maloata (land belonging to the Gurr family). Permission was denied by the owner of a candidate site in Aoa. A prospective site at Massusi has also been surveyed. Site evaluations included monthly visits to determine flight patterns of bats within the area (and how these may change with time), and the identification of gaps in vegetation and the presence of suitable trees for setting up canopy nets relative to the bats movement patterns within the area.

JOB EVALUATION and RECOMMENDATIONS: Radiotelemetry work requires a huge investment in man-hours needed for radiotracking. If radiotagged animals are not tracked adequately, then the whole effort is compromised since the data collected will be sparse. If this project is to gain ground, D.M.W.R. must make the commitment to provide the necessary manpower. This would entail filling up vacant positions in the Wildlife division, or temporarily re-assigning in-house personnel who can be trained to fill-in the need for staff. Since radiotags are expensive, it is recommended that the approach be supplemented with less expensive mark-recapture techniques. Each approach will yield different but complementary information.
GOVERNMENT OF AMERICAN SAMOA
DEPARTMENT OF MARINE AND WILDLIFE RESOURCES
ANNUAL REPORT: FY1997

PROJECT W-1-R-12: American Samoa Wildlife Investigations
STUDY 1: Fruit Bat Studies
JOB 3: Genetic analysis of populations

PERIOD COVERED: 1 October 1996 to 30 September 1997
IMPLEMENTED BY: Dr. A. P. Brooke and R. C. B. Utzurrum
REPORT PREPARED BY: R. C. B. Utzurrum

SUMMARY: Microsatellite DNA techniques are being applied to determine the population structure of fruit bat populations in American Samoa, and the biogeographic structure and degree of inter-island movements across the range of the species distribution. The project extends to Western Samoa and Fiji. In FY1997, additional tissue samples of *P. tonganus* were sent to Dr. Gary McCracken for genetic analysis. To date, 25 specimens have been submitted and analyzed, including 22 *P. tonganus* and 3 *P. samoensis*. The overall heterozygosity of *P. tonganus* from American Samoa is very high but comparable to levels of variation seen in other species of *Pteropus*. Results do not indicate any genetic divergence between *P. tonganus* populations on American Samoa and Fiji, although there are 3 alleles unique to the American Samoa samples. In contrast, heterozygosity in *P. samoensis* was lower than those observed even in inbred captive populations of *Pteropus*. A sample size of three, however, precludes use from making any extensive discussion of this result. Not only are additional samples required, it is also necessary to obtain sample from Manua and Western Samoa (for both species). Attempts to obtain samples from Ta'u and Ofu were stymied by inclement weather during the August 1997 visit. The number of samples desired for adequate analysis and discussion should be set to aid in tracking the progress of this project.

OBJECTIVES: To determine inter-island movements of fruit bats through genetic analysis, and the level of genetic variation within islands as a tool for evaluating population performance in the event of catastrophic events (e.g., hurricanes, epidemic diseases).

BACKGROUND: Of the two species of fruit bats found in American Samoa, *P. samoensis* is characterized by lower numbers. Its geographic range is also more limited than *P. tonganus*. While *P. tonganus* ranges throughout the South Pacific, *P. samoensis* is found only in the Samoan archipelago and Fiji. Populations of both species have been decimated by hunting, with declines exacerbated by recent hurricanes that hit American Samoa between 1987 and 1991. Although population appear to be recovering (see preceding Study 1: Job 1 report), the precipitous declines in numbers that were recorded have raised issues of possible extinctions, and processes of recovery through natural recolonization and/or reintroduction. Extinctions may result from highly reduced genetic variability of populations, especially those at very low numbers. Given a situation that would involve formulating recovery plans for this species, it
is important to have information on how genetically distinct geographically-separated populations are. The management strategy best under conditions of inter-island high genetic similarity may not be the best strategy under conditions of low genetic similarity and low inter-island exchanges.

APPROACH: Samples from Tutuila, Manu'a, Western Samoa, and Fiji are to be obtained by mist netting bats and acquiring tissue biopsies from wing punchers. The samples are preserved in 20% DMSO in saturated salt solution and sent to the laboratory of Dr. Gary McCracken at the University of Tennessee for analysis. Genetic information are derived through microsatellite DNA analysis. The numbers of alleles on selected loci, and the degree of heterozygosity at these loci will provide measurements of genetic variation within and between populations. The degree of inter-island movements may be indirectly determined by examining the genetic distinctiveness of geographically separated populations.

RESULTS and DISCUSSION: Levels of heterozygosity of P. tonganus on Tutuila are extremely high (94%) based on 16 alleles found among three loci. Samples from Fiji showed a 71% heterozygosity. While these values are extremely high, they are not unusual for wild populations of Pteropus as seen from P. pumilus and P. vampyrus. There is no evidence that populations of Tutuila and Fiji differ genetically, although samples from Tutuila have shown 3 alleles not seen in samples from Fiji.

Results of analysis of 2 samples of P. samoensis from Tutuila and 1 from Fiji show very low levels of heterozygosity in the species. The overall heterozygosity was 22%, and 0 for Tutuila. These values are lower than that observed in highly inbred captive populations of Pteropus rodhainensis. However, it is premature to draw any conclusions from these results since the sample size is abysmally low.

The results available to date, at best, provide a very tentative picture of the genetic profile of these two species across the range of distribution targeted. Not only are sample sizes low (especially for P. samoensis), but geographic gaps in sampling exist since no samples have been obtained from Manu'a and Western Samoa.

JOB EVALUATION and RECOMMENDATIONS:

To better track the progress of this project, it is necessary to set up desired sample sizes from each of the geographic locations targeted (i.e., Tutuila, Manu'a, Western Samoa, and Fiji). The priority would be to obtain adequate samples from Tutuila, then Manu'a, followed the Western Samoa, and Fiji. Funds for analysis were last released in 1994. The amount provided cover the basic cost of analysis (chemicals and non-reusable labwears), and since analysis is costly, it is necessary that additional funds be provided to Dr. McCracken for additional analysis. It is recommended that an amount be allocated for this purpose in the FY1998 budget. If additional samples and further analysis are not obtained and conducted, the monies spent to date on this project will essentially be wasted since the level of information gathered so far is inadequate for proper interpretation of results.