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

PROJECT: W-1-R-12: Wildlife Investigations  
STUDY 2: Bird Studies  
JOB 1. Abundance and Distribution

PERIOD COVERED: 1 October 1996 to 30 September 1997
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REPORT PREPARED BY: Dr. J. O. Seamon

SUMMARY

Censuses of frugivorous columbiforms were conducted each month at six sites on Tutuila, and forest passerines were surveyed quarterly at seven forest transects. These and past data provided us with a three-year time series using a consistent methodology, from which population trends could be reliably inferred. Results suggest that populations of Ducula pacifica, the primary game species present in American Samoa, although relatively stable, are not increasing significantly in spite of low positive growth rates. If current population levels are actually equilibrilal, limited predation (i.e., hunting) might not unduly affect its abundance. However, if the populations are below the carrying capacity, even very limited predation might perpetuate a density trough, preventing a complete recovery of the species. Unfortunately, it is not possible to reliably ascertain that possibility from simple abundance data. Thus, decisions on reinitiating hunting of this species should be deferred until further data on the details of the species population structure are known, presumably through a mark-recapture methodology that allows determination of age structure, space use, and relatedness.

BACKGROUND

Populations of most birds in American Samoa have declined within the past decade. The proximate cause of this decline has been attributed to repeated hurricanes, although an interaction with the forest clearing associated with increases in the human population seems probable. Recovery of populations from such natural catastrophes are expected to depend on both the intrinsic growth rate defined by the life history of each species and on whether the increases predicted by the growth rate are limited by resources or predation.

Since five years have elapsed since the last major hurricane, a population whose recovery is limited primarily through its own reproductive rate would be expected to exhibit an increase in its abundance through time, even if it had not reached the exponential phase of the growth function. If the influence of the disturbance on a limiting resource related to habitat was severe, however, then we might expect the recovery time to lag behind the logistic function, especially in the presence of competing species. A complicating factor is continued predation: while a population is at low density, even quite limited rates of predation are known to extend the length of a density "trough". Since anecdotal evidence exists that
some hunting still occurs in American Samoa, it is possible that recovery will be delayed further. If other frugivores characterized by similar reproductive rates yet not targets for hunters show substantially more rapid recoveries it is plausible to hypothesize that such predatory suppression of population growth rates may be occurring.

OBJECTIVE
To monitor the seasonal and interannual patterns in abundance of the larger forest frugivores among sufficient sites to infer the spatial distribution of the species. Species of particular interest are Ducula pacifica, Protinopus porphyreus and Protinopus peroussii.

PROCEDURES
1. Conduct monthly visual surveys of these species at six sites on Tutuila. An abundance index is created from the mean count of birds observed among four 20-minute counts, with ten minutes separating each count.
2. Conduct quarterly surveys of forest birds using variable circular plots, with stations located at 150-m intervals along seven transects on Tutuila.
3. Document the status and distribution of birds on Manu’a by conducting biannual trips to the three islands in the archipelago.

RESULTS/DISCUSSION
1. Visual surveys at six sites
Despite substantial differences in mean numbers at different sites, the coefficients of variation in D. pacifica counts over time were all well below one (Table 1). The stability of each site was not obviously related to its density, however. Since CVs are negatively correlated with the average lifetime of a population (Leigh 1981), this suggests that stochastic factors are unlikely to influence the survival of this species on Tutuila, at least in the short term.

The prospects of recovery remain less clear. One indicator of population performance is the growth rate of a population. In our case, we have samples from six populations, which taken in toto should provide an indication of the likely performance of D. pacifica populations on Tutuila as a whole. We can view growth rates in two ways, however (Caswell 1989). One, we can estimate the average of the growth rates of the populations (i.e., ln(λ) = 0.0221). Two, we can calculate the growth rate of the average population (i.e., ln(μ) = 0.0221). The former, perhaps, suggests the expected value of any single population, a concern when setting aside particular sites or habitats for conservation (see JOB 2, below). The latter might be more indicative of expected average performance on Tutuila as a whole. Note that both are quite low yet positive, suggesting a very slow increase.

An alternative indicator of population performance is to test whether population trajectories at the various sites are increasing through time. While using the actual numbers observed is appropriate for certain comparisons, for estimating trajectories we wished to
control for any among-site differences in abundance. Therefore, we standardized each population to a mean of zero and a standard deviation of one. There were no obvious trends toward increasing population size over time (Fig. 1). We tested this visual impression using t-tests on each population. If a population is increasing, we would expect successive censuses to show similar density changes (i.e., a positive change from the previous density), but this is not the case (Table 1).

We infer, therefore, that these populations are stable (in the sense of probability of persistence), but the data provide no evidence of a statistically significant increase in numbers during the past three years (i.e., their low population growth rates result in virtual stability as well).

2. Quarterly forest bird transects

The bulk of these data are being analyzed by the previous DMWR ornithologist, although some results have appeared in previous Progress Reports. Since data from FY97 simply add on to the existing data set, we will await completion of those analyses and forward the results as they become available.

3. Status and distribution of birds on Manu'a

The status of Manu'a birds was assessed qualitatively during one trip to the archipelago in 3-9 August 1997. We observed _Vini australis_ on all three islands (Ofa, Olosega, and Tau), as well as the Manu'a forms of species found on Tutuila (_Aplonis tahubensis_ and _Foulkea caniculata_). We did not, however, observe _Clytorhyncus vitiensis_ or _Callicolumba starrii_, two species of particular concern. We recommend two strategies for future trips. First, establish a forest bird transect on each of the three islands, and sample it (but only twice per year) using variable circular plots as is done on Tutuila. This method should provide reliable information on the status of _C. vitiensis_. Second, to visit at least two suitable sites (tulas slopes with mature canopies) on each island. This, while not likely to provide a numerical estimate of population size, should at least serve to document the incidence of _G. starrii_ in Manu'a.
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PROJECT: W-1-R-12: Wildlife Investigations  
STUDY 2: Bird Studies  
JOB 2: Habitat Use

PERIOD COVERED: 1 October 1996 to 30 September 1997  
IMPLEMENTED BY: A. Tualaulei  
REPORT PREPARED BY: Dr. J. O. Seamon

SUMMARY

Determining what constitutes suitable habitat for frugivorous columbiforms provides the foundation on which to base conservation and management decisions. We focus here on demographic patterns among sites, since variability in abundance indices among sites may reflect the influence of habitat or resource variability. We found significant differences among some sites in average abundance, and those sites with greater abundances had higher population growth rates. However, the trajectories among sites with similar abundances were not correlated, suggesting that processes (perhaps temporal patterns of availability of specific resources) unique to each site influence temporal patterns of abundance. In turn, this suggests that different aspects of the demography of *D. pacifica* may respond to different aspects of the environment.

BACKGROUND

Expansion of the human population increases the pressure for accurate knowledge of the relationships between wildlife species and different habitats. It is often easy to determine the preference of a species for particular macrohabitats (e.g., forests or montane scrub) simply by presence/absence data. However, species often respond to less obvious differences within seemingly similar macrohabitats (e.g., among forested sites).

These possibilities can be tested by examining long-term demographic data among various sites. If all forested sites had similar abundances, and since the diversity of tropical forests makes it unlikely that all sites have equal species composition, we might hypothesize that either: 1) the species does not discriminate among differences within such macrohabitat types; or 2) it is responding to a narrow resource dimension irrespective of its abundance (e.g., a keystone tree species that does occur at each site). Conversely, if there are differences in average abundance among sites, we hypothesize that either: 1) the average population level is a function of a variety of resource species, and high diversity within sites promotes greater abundance, perhaps by buffering abundance against changes in availability of any one resource; or 2) sites with greater mean abundance have greater availability of a single keystone resource, with this increased resource frequency buffering the species against...
variability in annual productivity among individual trees.

Likewise, different aspects of demography may provide different information about a species relationship with habitat. For example, if the trajectories of abundance covary positively among all sites, irrespective of habitat composition, we might infer that temporal changes in abundance are a function of either: 1) a large-scale variable such as climate that is similar among all sites; and/or 2) a single resource species with a strong seasonality; and/or 3) the sites are linked by immigration into a metapopulation. If trajectories at different sites are not correlated, it is unlikely the populations at the sites are directly related. (Since, even if individuals moved among sites, say by pursuing ephemeral resources present in different sites at different times, this should generate positive correlations among the remaining sites). Instead, it suggests that populations at each site may be responding to patterns of resource availability largely unique to each location.

**OBJECTIVE**

To assess the possible influence of habitat variation on the demography of frugivorous columbiforms, particularly *D. pacifica*.

**PROCEDURES**

We analyzed the visual census data referred to in JOB 1 by comparing demographic parameters at six sites (Amalaumale, Leone Malasini, Misota, Masausi, and Nuu’uah). We again based these comparisons on three years of data that had been collected using consistent sampling methods (the mean of four twenty-minute counts, taken in the morning once each month).

**RESULTS/DISCUSSION**

Mean abundances varied among sites (Table 1), with Amalaumale having the highest average index, while Masausi had the lowest. Only Amalaumale, however, had mean abundances that differed statistically from the other sites (using T* for multiple comparisons among means [Sokal & Rohlf 1995]. Table 2). Nevertheless, these results suffice to reject the suggestion that *D. pacifica* is not responsive to variation among sites. Indeed, mean abundance was significantly correlated with mean growth rate at a site ($r^2=0.73$), suggesting that the sites with the best population performance are not stabilized at the carrying capacity.

Population trajectories were compared using several measures of correlation, to account for the possible influence of extreme variability or single coincident shifts in numbers. We calculated: 1) Pearson correlation coefficients, a parametric measure of association; 2) Spearman’s rank correlations, which essentially test the ranks of each pair of data points; and 3) Kendall’s $t$, which measures the degree of concordances between the two time series, irrespective of magnitude of the actual values. In addition, we performed these analyses on both the actual data and on the standardized deviates (Fig 1).
One constraint on such analyses, however, is that each data point is assumed to be independent. Clearly, this can be problematic with time series data. To test the notion of independence, we simply referred to the results of the runs tests performed previously on these data (Table 1). The presence of significantly more runs than expected by chance would violate this assumption, and require the use of an explicitly temporal model, such as repeated measures ANOVA. Fortunately, none of the runs tests were remotely significant (Table 1), suggesting that the abundance count in one monthly census did not depend on the value of the preceding count.

Surprisingly, virtually none of the time series were significantly correlated (Table 2). Since many resources are known to have pronounced seasonality in the tropics, including some of the fruiting species used by *D. pacifica* (Trail 1994), we had hypothesized that sites with similar mean abundance would have had similar trajectories. This result may be a function of the relatively generalist habits of *D. pacifica*, since it might be predisposed to switch to the most abundant fruit at any one time. Since the species composition (or at least relative abundance) of fruiting trees is likely to vary among sites, the species to which it responds (i.e., that initiate reproduction, and thus recruitment, which is likely to be the primary synchronizer of numbers among different populations) may vary among sites, causing densities to fluctuate independently among sites. Another complicating factor is the mobility of *D. pacifica*, since short term movements to nearby areas may mask changes in the abundance of individuals actually relying on a given site. If this is the case, however, we would still expect a similar pattern among sites with similar abundances, since ostensibly they would have similar resource distributions. We recommend linking these demographic data with detailed data on the phenology and composition of fruiting species at each site. Such data would permit the testing of hypotheses relating specific resources to columbiaform demography.

LITERATURE CITED


Table 1. Summary statistics for a three-year time series of *Ducula pacifica* numbers. Analyses are based on monthly means of four 20 minute counts at six sites.

<table>
<thead>
<tr>
<th>STATISTIC</th>
<th>Analaup</th>
<th>Leone</th>
<th>Malaeimi</th>
<th>Malua</th>
<th>Masasui</th>
<th>Nu'ulu</th>
</tr>
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<tbody>
<tr>
<td>MEAN</td>
<td>10.25</td>
<td>7.19</td>
<td>4.87</td>
<td>6.96</td>
<td>4.24</td>
<td>4.85</td>
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<td>$\sigma^2$</td>
<td>22.13</td>
<td>23.97</td>
<td>3.36</td>
<td>21.19</td>
<td>6.85</td>
<td>8.12</td>
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<td>CV</td>
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<td>68.08</td>
<td>37.61</td>
<td>66.14</td>
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<td>$t_{(0.01)}$</td>
<td>0.96</td>
<td>-0.15</td>
<td>0.33</td>
<td>-0.66</td>
<td>-0.15</td>
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<tr>
<td>$\lambda^{**}$</td>
<td>0.07</td>
<td>0.02</td>
<td>-0.01</td>
<td>0.02</td>
<td>-0.01</td>
<td>0.03</td>
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</tbody>
</table>

* = t statistic for runs test. ** = average growth rate
Table 2. Comparisons of means and population trajectories among *D. pacifica* populations at six sites, where * indicates significantly different means and a + or - indicates a significant correlation. All comparisons of means were performed on in-transformed numbers. Pearson correlations were conducted on standardized deviates (first result) as well as the actual numbers (second result). Since *p* and *r* are based on ranks and concordances, respectively, such a duplicate analysis was not conducted in these cases.

<table>
<thead>
<tr>
<th>Site Comparison</th>
<th>Mean†</th>
<th>Pearson(r²)</th>
<th>Spearman(r)</th>
<th>Kendall(t)</th>
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<tbody>
<tr>
<td>Amal-Leon</td>
<td>0</td>
<td>0.0</td>
<td>+</td>
<td>+</td>
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<tr>
<td>Amal-Mala</td>
<td>*</td>
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<tr>
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<td>*</td>
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<td>0</td>
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</tr>
<tr>
<td>Amal-Nuul</td>
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<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Leon-Mala</td>
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<td>Leon-Malo</td>
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<td>Masa-Nuul</td>
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</table>

† = based on Tukey multiple comparison.
Fig. 1. Three year population trajectories of *D. pacifica* at six sites

Abundance Index (Standardized Deviation from Mean)

MONTH