THE TROPICAL MONITORING AVIAN PRODUCTIVITY AND SURVIVORSHIP (TMAPS) PROGRAM IN AMERICAN SAMOA: 2016 REPORT

Peter Pyle, Kim Kayano, Kaitlin Murphy, Alexander J. Pate, Marie Soderbergh, Chris Taft, Nathan Weyandt, Bobby Wilcox, Danielle Kaschube, and Lauren Helton

30 September 2016

THE INSTITUTE FOR BIRD POPULATIONS
PO Box 1346
Point Reyes Station, CA 94956

AMERICAN SAMOA GOVERNMENT DEPARTMENT OF MARINE AND WILDLIFE RESOURCES
PO Box 3730
Pago Pago, American Samoa 96799

Tongan Ground Dove captured as part of the American Samoa TMAPS Project on Ofu Island

Suggested citation:

Pyle, P., K. Kayano, K. Murphy, A. J. Pate, M. Soderbergh, C. Taft, N. Weyandt, B. Wilcox, D. Kaschube, and L. Helton. 2016. The Tropical Monitoring Avian Productivity and Survivorship (TMAPS) Program in American Samoa: 2016 Report. The Institute for Bird Populations, Point Reyes Station, CA.

Cover photograph by Kaitlin Murphy/Booby Wilcox

EXECUTIVE SUMMARY

Few data exist on the ecology, population status, and conservation needs of landbirds in American Samoa. We thus initiated a Tropical Monitoring Avian Productivity and Survivorship (TMAPS) program on Tutuila Island in 2012, expanded it to Ta'u Island in 2013, continued operation on both islands in 2014-2016, and expanded it to Ofu and Olosega islands in 2015-2016. Long-term goals of this project are to: (1) provide annual indices of adult population size and post-fledging productivity; (2) provide annual estimates of adult population densities, adult survival rates, proportions of residents, and recruitment into the adult population (from capture-recapture data); (3) relate avian demographic data to weather and habitat; (4) identify proximate and ultimate causes of population change; (5) use monitoring data to inform management; and (6) assess the success of management actions in an adaptive management framework. An additional goal of the expansion to Ofu-Olosega for the 2016 season was to collect data on the Tongan (also know as Shy or Friendly) Ground Dove, from a little-known population that was listed as an Endangered Species under the USFWS Endangered Species Act in September 2016.

In August 2012 through August 2013 we established and operated eight TMAPS stations in typical habitats utilized by landbirds on Tutuila, American Samoa. Each station consisted of a sampling area of about 20 ha, and within the central 8 ha of this area, 10 12-m long, 30-mm mesh, 4-tier nylon mist nets were erected at fixed net sites and operated for three consecutive days, once per month (a "pulse"), weather permitting. Daily operation of stations followed standardized protocols established by The Institute for Bird Populations for use in the MAPS Program. During these first 13 months we identified the best seasonal period for a TMAPS program in Samoa as November-March. Therefore, in November 2013, four stations were re-established and two new stations were established on Tutuila, and six new stations were established on Ta'u Island. Each of these 12 stations were operated for 1-5 pulses during each of the 2014 (December 2013-March 2014), 2015 (November 2014-March 2015), and 2016 (November 2015 - March 2016) seasons, and in November-December 2015, we also established six new stations on Ofu and Olosega for the 2016 season.

During the 2016 season, we recorded 98 captures on Tutuila, 243 captures on Ta'u, and 489 captures on Ofu-Olosega, totaling 830 captures overall, of 16 bird species. This represents more than twice the number of captures from the 2015 season (400) due primarily to the addition of high-capture stations on Ofu-Olosega. The most commonly captured species, on all three island groups combined, were Polynesian Wattled Honeyeater, Samoan Starling, Pacific Kingfisher, Samoan Shrikebill, Tongan Ground Dove, Polynesian Starling, Crimson-crowned Fruit Dove, and Blue-crowned Lorikeet. The breeding population-size index for all species combined was similar on Ta'u (54.0 adults captured per 600 net-hours) and Ofu-Olosega (52.6) but much lower on Tutuila (17.4), whereas the reproductive index was higher on Ofu-Olosega (0.32 yong/adults captured) and similarly lower on Tutuila (0.21) and Ta/u (0.20). Lower adult breeding population and reproductive indices on Tutuila could easily reflect higher human population densities and agricultural development on this island than is found on Ta'u and Ofu-Olosega. Lower reproductive success on Ta'u than on Ofu-Olosega in 2016 (and on Ta'u than Tutuila during 2014-2016 combined) could represent a saturated adult population on Ta'u, resulting in lower productivity due to competition among higher density breeding populations, and/or it could represent other possible stressors on Ta'u such as habitat degradation, micro-climatic events,

food resource limitations, or disease. More years of data, especially regarding comparisons with population dynamics on Ofu-Olosega, should shed more light on this question.

Using data from the four stations operated on Tutuila during all four seasons (2013-2016) combined, estimates of annual adult survival rates using a transient model were 0.625 for Pacific Kingfisher and 0.655 for Polynesian Wattled Honeyeater. Using data from three seasons (2014-2016) from all 12 stations on Tutuila and Ta'u, survival rates using a non-transient model were 0.522 for Pacific Kingfisher, 0.681 for Polynesian Wattled Honeyeater, 0.542 for Samoan Shrikebill, and 0.586 for Samoan Starling. These are generally very high rates; by comparison, survivorship estimates among MAPS stations in North America vary between 0.40 and 0.55 for most species. Higher survival rates are to be expected among resident tropical species that do not have to migrate and generally are subject to stable climate and food resources. Standard errors and coefficients of variance for these estimates were generally high, indicating low precision. However, precision should improve once additional years of data have been collected; for example, with the addition of a fourth year of data, the mean CVs for Pacific Kingfisher and Polynesian Wattled Honeyeater on Tutuila improved from 53% for survival and 130% for recapture probability to 38% and 63%, respectively. Lower CVs for these two species in the three-year analysis (mean 21% for survival and 30% for recapture probability) also indicate increased precision with the addition of more captures and stations. We expect to see the precision of these estimates improve further and we will also be able to directly compare adult survival on Tutuila and Ta'u with another year of data from these 12 stations.

A corollary goal of the establishment of the new stations on Ofu-Olosega was to gather information on the small population of Tongan Ground Doves residing on these islands. Our capture of 17 individuals and one additional recapture has enabled us to confirm age and sex criteria for this species in American Samoa, and has provided critical information on breeding condition, biometrics, and weights, which will allow us to undertake further studies on this population during future seasons. Our current goal is to collect feather, blood, and swab samples from Tongan Ground Doves during the 2017 season to investigate genetic differentiation, pathogens, and diet, to use playback experimentation to help monitor populations, and to apply tracking devices in order to better understand home-range sizes, movement patterns, population size, and nesting behavior. This information will be applied to the management of this population.

Continuation of the current sampling protocol at these 12 TMAPS stations will yield critical data on the survival, recruitment, and population growth rates for up to seven target native landbird species on Tutuila, Ta'u, and Ofu-Olosega, will allow us to better understand year-to-year dynamics, including trends in population sizes, and will enable us to estimate survival rates for these species on each island. We can then assess how much reproductive success and survivorship are driving population size dynamics, we can use our habitat data to assess how habitat quality affects each of these parameters, reproductive success in particular, and we will be able to apply results of these analyses to inform land-management recommendations for habitat conservation or restoration. We look forward to continuing this important work in coming years.

INTRODUCTION

Birds are sensitive indicators of environmental quality and ecosystem health (Morrison 1986, Hutto 1998), and they are the focus of many regional and continental scale monitoring efforts (Gregory et al. 2005, Sauer et al. 2008). Most broad-scale bird monitoring has involved counts of birds to index abundance and estimate trends (Bart 2005), but monitoring of demographic rates (including productivity, recruitment, and survival) is needed to infer actual causes of population changes (DeSante et al. 2005). Because demographic rates are directly affected by environmental stressors or management actions, they can more-accurately reflect short-term and local environmental changes (Temple and Wiens 1989, DeSante and George 1994). Demographic data can also be used to identify stages of the life cycle that are most important for limiting bird populations (DeSante et al. 2001, 2014, 2015; Holmes 2007; Saracco et al. 2008, 2009) and can be modeled as functions of predictive population analyses to assess the viability of populations (Noon and Sauer 1992; Saracco et al. 2010a, 2010b).

Application of standardized, constant-effort mist netting and modern capture-recapture analytical techniques is an effective means of monitoring demographic rates of many landbird species (DeSante et al. 2005, 2015). In 1989, a long-term landbird mark-recapture effort was initiated in North America by The Institute for Bird Populations (IBP), with the establishment of the Monitoring Avian Productivity and Survivorship (MAPS) program in 1992 (DeSante 1992). The MAPS program is a cooperative network consisting of hundreds of constant-effort mist-netting stations operated across North America during each summer landbird breeding season (over 1,300 stations overall) that has provided demographic data for over 180 landbird species (DeSante and Kaschube 2007, Saracco et al. 2010b, DeSante et al. 2015). Similar programs exist in Europe, where they are central components of national and international bird-monitoring efforts (e.g., Peach et al. 2004). The MAPS program has been utilized to monitor bird demography by many U.S. federal agencies, including the National Park Service, Department of Defense, USDA Forest Service, and USDI Fish and Wildlife Service.

IBP has also established a "Tropical MAPS" (TMAPS) program to collect similar data on avian vital rates in tropical areas, where breeding may occur year-round. The first TMAPS project was established on Saipan, Commonwealth of the Northern Marianas Islands, in 2008, and has provided important new information on population abundance and trends, breeding and molting seasonality, vital rates, age-determination criteria, morphology, habitat use, and general ecology of the resident landbirds on this island (Radley et al. 2011; Junda et al. 2012; Saracco et al. 2015, 2016).

In August 2012, IBP, in collaboration with the Department of Marine and Wildlife Resources (DMWR), established a five-year TMAPS program in American Samoa. This effort aims to provide baseline data on landbird populations of American Samoa and a foundation for informing conservation strategies for its indigenous insular avifauna. Long-term goals are to: (1) provide annual indices of adult population size and post-fledging productivity (from constant-effort capture data); (2) provide annual estimates and trends of adult population size, adult survival rates, proportions of residents, and recruitment into the adult population using capture-recapture analyses; (3) relate avian demographic data to seasonal weather patterns and habitat;

(4) identify proximate and ultimate causes of population change; (5) use monitoring data to inform management; and (6) assess the success of any management actions in an adaptive management framework. In order to estimate productivity and recruitment, accurate criteria for determining each captured bird's age is needed, which in turn relies on knowledge of molting seasons and strategies.

A pilot program was initiated on Tutuila Island in 2012-2013, in which breeding seasonality and an optimal TMAPS season of November-to-March for American Samoa was established. The project has subsequently continued on Tutuila through the 2015-2016 season, has expanded to include Ta'u Island for each of the 2013-2014 (the "2014 season"), 2014-2015 (the "2015 season"), and 2015-2016 (the "2016 season") seasons, and expanded again to Ofu and Olosega islands during the 2016 season. Molting patterns and age-determination criteria for Samoan landbirds were examined, based on museum specimens and captures during 2012-2014, for a preliminary manual for use in the field (Pyle 2014a), which has been updated and refined based on subsequent capture data by Pyle et al. (2016, in press).

The initial establishment of TMAPS stations and summaries of capture data from 16 TMAPS stations on Tutuila and on Ta'u , operated during August 2012 though March 2015, were described by Pyle et al. (2012, 2013, 2014a, 2015a). Twelve of these 16 stations, six on Tutuila and six on Ta'u, were operated during each of 2014, 2015, and 2016 seasons. In November of 2015 we established six new stations on Ofu and Olosega islands and operated these stations during November-March of the 2016 season. A primary goal of the new stations on Ofu_Olosega was to collect data on the Tongan (also know as Shy or Friendly) Ground Dove (see below and Appendix 1 for scientific names), of a little-known population that was listed as an Endangered Species under the USFWS Endangered Species Act in September 2016 (Rosa 2007, USFWS 2015, 2016). Here we provide a comprehensive summary of captures and indices of population size (capture rates) and productivity for these 18 stations operated on Tutuila, Ta'u, and Ofu-Olosega during the 2016 season. We also compare capture and vital rates between the three islands and from year to year on Tutuila and Ta'u, and we provide a preliminary analysis of survivorship for four species using mark-recapture analysis on a minimum of three seasons of data from the same stations.

STUDY AREAS AND METHODS

In July-August 2012 we established six TMAPS stations in typical habitats utilized by landbirds on Tutuila, American Samoa, to be operated for 13 consecutive months (Pyle et al. 2012, 2013). During this period two stations (Fagatele Bay and Olovalu Crater) were discontinued due to access problems and low capture rates, and two new stations were established in their stead. The six remaining stations were operated for most of the period, including the 2013 season (December 2012-March 2013). In November 2013, four of these six stations (Malaeola, Malota, Mount Alava, and Amalau) were re-established on Tutuila and two additional stations (Tula and Vatia) were newly established to replace other stations (Aoloau and Loto'asi) which could not continue during the 2014 season due to encroaching development and/or access problems (Pyle et al. 2014a). These final six stations (Vatia, Tula, Amalua, Mount Alava, Malota, and Malaeloa) were then operated during each of the 2014, 2015, and 2016 seasons. Locations of all 10 stations on Tutuila are shown in Figure 1, and descriptions and a summary of effort for each of the active six stations during the 2016 season are given in Table 1. On Ta'u, six stations (Aokuso, Saunoa, Usu Nua, Fala'a, NPAS - Laufuti Stream, and NPAS- Luamaa) were established in November 2013 and each station was operated during each of the 2014 and 2015 seasons (Pyle et al. 2014a, 2015) as well as the 2016 season. The locations of these six stations are shown in Figure 2, and descriptions and a summary of effort for each station during the 2016 season are given in Table 2. In November 2016, six new stations were established on Ofu-Olosega islands, four on Ofu (Tumu Lower, NPAS - Southeast, Toaga Beach, and Tumu Upper) and two on Olosega (Sili and Oge Beach), and these six stations were operated during the 2016 season. The locations of these six stations are shown in Figure 3, and descriptions and a summary of effort for each station during the 2016 season are given in Table 3. The three stations marked "NPAS," two on Ta'u and one on Ofu islands, are located in the National Park of American Samoa.

Each of these 18 active stations on the three island groups consisted of a sampling area of about 20 ha, and within the central 8 ha of this area, 10 12-m long, 30-mm mesh, 4-tier nylon mist nets were erected at fixed net sites (DeSante et al. 2014). Each station was operated for three consecutive days, once per month (a "pulse"), weather permitting, following standardized banding data-collection protocols established by The Institute for Bird Populations for use in the MAPS Program (DeSante et al. 2014). Logistical considerations resulted in effort varying among stations on the three islands, from two pulses (three stations on Ta'u) to three pulses (most stations), to four pulses (all stations of Ofu-Olosega) during the 2016 season (Tables 1-3). Mist-netting effort data (i.e., the number and timing of net-hours on each day of operation) were collected in a standardized manner by recording net-opening, net-checking, and net-closing times to the nearest 10 minutes. We aimed to operate nets for six morning hours per day, beginning at local sunrise. Inclement weather (especially heavy rain) sometimes truncated operation on a particular day, resulting in further variable effort among stations, ranging from 238 to 621 net hours per station during the 2016 season (Tables 1-3). Station operation was carried out by IBP volunteer biologist technicians. In 2015 these included Murphy, Pate, Soderbergh, Taft, Weyandt, and Wilcox (see also Acknowledgements). All banders were trained in TMAPS protocols and supervised locally by Kayano, and data collection was further supervised remotely by Helton and Pyle.

For this report we follow updated taxonomy and species order of Gill and Donsker (2016), which has resulted in changes to some common and scientific species names of landbirds from previous reports. The following updated taxonomy and names (along with previously used names) are included for landbirds in this report:

Tongan Ground Dove, *Alopecoenas stairi* (formerly Shy Ground-Dove or Friendly Ground-Dove, *Gallicolumba stairi*)
Many-colored Fruit Dove, *Ptilinopus perousii*
Crimson-crowned Fruit Dove, *Ptilinopus porphyraceus* (formerly Purple-crowned Fruit Dove)
Pacific Imperial Pigeon, *Ducula pacifica* (formerly Pacific Pigeon)
Pacific Long-tailed Cuckoo, *Urodynamis taitensis* (formerly Long-tailed Cuckoo, *Eudynamys taitensis*)
White-rumped Swiftlet, *Aerodramus spodiopygius*
Pacific Kingfisher, *Todiramphus sacer* (formerly Collared Kingfisher, *T. chloris*)

Blue-crowned Lorikeet, *Vini australis* (formerly Blue-crowned Lori)
Cardinal Myzomela, *Myzomela cardinalis* (formerly Cardinal Honeyeater)
Polynesian Wattled Honeyeater, *Foulehaio carunculata* (formerly Wattled Honeyeater)
Red-vented Bulbul, *Pyconotus cafer*
Samoan Shrikebill, *Clytorhynchus powelli* (following Pratt 2010, who split this from Fiji Shrikebill, *C. vitiensis*)
Polynesian Starling, *Aplonis tabuensis*
Samoan Starling, *Aplonis atrifusca*
Common Myna. *Acridotheres tristis*
Jungle Myna, *Acridotheres fuscus*

With few exceptions, all birds captured were identified to species, age, and sex based on criteria outlined by Pyle (2014a) and Pyle et al. (2016, in press). Unbanded birds were banded with USGS/BRD numbered aluminum leg bands and recaptured birds (those that had been banded previously) were fully processed. Birds were released immediately upon capture and before being banded or processed if situations arose where bird safety would be compromised. The following data were taken on all birds captured, including recaptures, according to MAPS guidelines (DeSante et al. 2014):

- capture code (newly banded, recaptured, band changed, unbanded)
- band number
- species
- age, how aged, and molt-plumage code (see below)
- sex (if possible to determine) and how sexed (if applicable)
- extent of skull pneumaticization
- breeding condition of adults (i.e., extent of cloacal protuberance or brood patch)
- extent of juvenal plumage in young birds
- extent of body and flight-feather molt
- extent of primary-feather wear
- presence of molt limits and plumage characteristics
- wing chord
- fat class and body mass
- date and time of capture (net-run time)
- station and net site where captured
- any pertinent notes.

Detailed molt data and images were obtained for most captures, to continue documenting molt strategies and ageing and sexing criteria for American Samoan landbirds (Pyle et al. 2016, in press). These data and images were examined by Pyle to assess accuracy of age determinations and to maintain seasonal criteria for acceptable age coding (Pyle et al., in press). Because breeding can occur year-round in American Samoa and the peak breeding season spans the end of the calendar year (December/January), the calendar-year-based ageing system used for MAPS (DeSante et al. 2014) could not be used for this program. Instead, we aged birds according to the molt-plumage (WRP) system following Wolfe et al. (2010) and Johnson et al. (2011); see also Pyle et al. (2015b, in press) for details. Our system was modified to reflect the molt and plumage strategies found for our captured species in American Samoa. In addition, first-cycle birds were scored as either greater than or less than six months of age, based on skull and feather wear data. A final determination of age for productivity analyses, young or adult, was determined through a combination of the WRP designation and whether or not young birds were at least six months of age (Pyle et al. in press).

Breeding status of each species seen, heard, or captured at each TMAPS station on each day of operation was recorded, using techniques similar to those employed for breeding bird atlas projects, as confirmed breeder, likely breeder, or non-breeder (DeSante et al. 2014). Habitat data were collected for each station following Nott et al. (2003), and using the vegetation classification system of Viereck et al. (1992). We verified banding data by running all records through a series of specialized computer programs to (1) check the validity of all codes entered and the ranges of all numerical data, (2) compare station, date, and net fields from the banding data with those from the effort and breeding status data, (3) cross-check species, age, and sex determinations against data such as skull pneumatization and breeding characters indicative of age and sex, and (4) detect unusual or duplicate band numbers, unusual band sizes, or recaptures indicating inconsistent species, age, or sex determinations. Discrepancies or suspicious data identified by these programs were corrected by hand, if necessary. We used wing chord, body mass, fat content, date and station of capture, and pertinent plumage criteria as supplementary information for the correct determination of species, age, and sex (Pyle et al. 2016, in press). As mentioned above, photographs of most captures were examined to provide additional verification of age and sex determinations.

For each species and for all species pooled, we calculated (1) numbers of newly banded birds, recaptured birds, and birds released unbanded; (2) numbers and capture rates of individual birds at each station (birds per 600 net-hours, a standard unit for between-station or regional comparisons; DeSante et al. 2014); and (3) the ratio of young to adult birds representing a reproductive index (Peach et al. 1996). We used these standardized indices to make comparisons of bird dynamics between stations and among the three islands. We conducted modified Cormack-Jolly-Seber mark-recapture analyses (Pollock e al. 1990, Lebreton et al. 1992) using the computer program TMSURVIV on four seasons of banding data from Tutuila and three season of banding data from Ta'u, for species in which, on average, at least 2.5 adults per year were captured, at least two between-season recaptures were recorded, and calculated recapture probabilities were realistic (neither 0.0 or 1.0). Both four-year and three-year survivorship analyses were performed, the former using data from four stations on Tutuila operated during all four of the 2013-2016 seasons, and the latter using data from 12 stations on Tutuila and Ta'u operated during all three of the 2014-2016 seasons. For each of the target species in the four-year analysis, we calculated maximum-likelihood estimates and standard errors (*SE*) for adult survival probability (φ). adult recapture probability (p), and proportion of residents obtained by the use of transient models. Recapture probability is defined as the conditional probability of recapturing a bird in a subsequent year that was banded in a previous year, given that it survived and remained at the station, and proportion of residents is defined as the estimated proportion of residents among those newly-banded adults. For the three-year analysis only adult survival and recapture probabilities were obtained using a non-transient model, as four years of data are required to calculate proportion of residents using a transient model.

RESULTS

A summary of captures of each species during the TMAPS 2016 season (November 2015 through March 2016) is provided for all 6 stations of each of the three island groups combined (Table 4) and for each station separately on Tutuila (Table 5), Ta'u (Table 6), and Ofu-Olosega (Table 7). Number of net-hours, a measure of effort, totaled 2520.50 on Tutuila, 1998.83 on Ta'u, and 3341.00 on Ofu-Olosega (Tables 1-3). Overall, we banded 78 birds on Tutuila, 171 birds on Ta'u, and 392 birds on Ofu-Olosega; we recaptured 19 birds on Tutuila, 64 birds on Ta'u, and 90 birds on Ofu-Olosega; and 1 bird on Tutuila. 8 birds on Ta'u, and 7 birds on Ofu-Olosega were released unbanded (Table 4). We therefore recorded a total of 98 captures on Tutuila, 243 captures on Ta'u, 489 captures on Ofu-Olosega, and 830 captures overall (Table 4). This is well over twice the number of captures recorded on Tutuila and Ta'u during the 2015 season (400), due to the addition of the large number of captures on Ofu-Olosega. Sixteen species were captured during the 2016 season (see Appendix for scientific names), 10 on Tutuila, 9 on Ta'u, and 8 on Ofu-Olosega. These captures include two waterbird species, Buff-banded Rail and Pacific Golden-Plover, which are non-target species in our TMAPS Program and won't be considered further.

The most commonly captured species on all thee islands combined were Polynesian Wattled Honeyeater (396 captures), followed by Samoan Starling (174), Pacific Kingfisher (147), Samoan Shrikebill (56), Tongan Ground Dove (18), Polynesian Starling (14), Crimson-crowned Fruit Dove (8), and Blue-crowned Lorikeet (7); fewer than 3 captures were recorded for the remaining six species. Species captured in previous years but not during the 2016 season have included White-tailed Tropicbird (*Phaethon lepturus*), White Tern (*Gygis alba*), Purple Swamphen (*Porphyrio porphyrio*), and Pacific Long-tailed Cuckoo.

On Tutuila (Table 5), when all species were pooled, the highest numbers of captures were recorded at the Mount Alava station (24 captures), followed by Tula (21), Vatia (18), Malota (15), Amalau (14), and Malaeloa (6). Species richness was highest at Mount Alava and Malota (6 species each), followed by Vatia (5), Amalau (4), Malaeloa (3), and Tula (2). On Ta'u (Table 6), the highest numbers of captures were recorded at Aokuso (63), followed by Usu Nua (51), NPAS - Luamaa (44), Saunoa (43), NPAS - Laufuti Stream (26), and Fala'a (16), and species richness was highest at Saunoa (8), followed by Aokuso (6), Usu Nua (5), NPAS - Laufuti Stream (4), and Fala'a and NPAS - Luamaa (3 each). On Ofu-Olosega (Table 7), the highest numbers of captures were recorded at Sili (110), followed by Toaga Beach (96), Tumu Upper (84), Tumu Lower (78), NPAS - Southeast (75), and Oge Beach (46), and species richness was highest at Tumu Lower and Toaga Beach (6 each), followed by Sili and Tumu Upper (5 each), NPAS - Southeast (4), and Oge Beach (3).

Because of variation in the number of net-hours among islands and stations (Tables 1-3), it is best to compare overall population densities in terms of individual adults captured per 600 net-hours (Tables 4, 8-10). Among the three islands (Table 4), capture rates for all stations combined were low on Tutuila (17.4 adults per 600 net-hours) and substantially higher on Ta'u (54.0) and Ofu-Olosega (52.6), the last two showing comparable capture rates. Captures of young birds were lowest on Tutuila (3.3) followed by Ta'u (10.8), and Ofu-Olosega (16.9). Reproductive success was comparable on Tutuila (0.21 young per adult) and Ta'u (0.20) and higher on Ofu-Olosega (0.32).

Among stations on each island, adult capture rates followed somewhat similar but not identical orders to those for number of captures (above). On Tutuila (Table 8), when all species were pooled, adult capture rates were highest at Mount Alava (26.4 adults per 600 net-hours), followed by Vatia (22.9), Tula (20.9), Malota (16.6), Amalau (15.7), and Malaeloa (4.0). Captures of young on Tutuila showed a different order among stations, being highest at Vatia (11.4 young per 600 net-hours) followed by Tula (4.5 young per 600 net-hours), Malota (2.8), Mount Alava and Amalau (2.6 each), and Malaeloa, which captured no young birds (0.0). Reproductive index showed more variation among stations, being highest at Vatia (0.50 young/adult), followed by Tula (0.21), Malota and Amalau (0.17 each), Mount Alava (0.10) and Malaeloa (0.00).

On Ta'u (Table 9), adult capture rates were highest at Usu Nua (77.0 adults per 600 net-hours), followed by Aokuso (66.9), NPAS - Luamaa (52.2), Saunoa (48.7), NPAS - Laufuti Stream (47.9), and Fala'a (23.3). Capture rates of young again followed a different order than those of adults, being highest at Aokuso (20.2 young per 600 net-hours), followed by NPAS - Laufuti Stream (17.6), Usu Nua (9.6), Fa'ala (9.3), NPAS - Luamaa (5.5), and Saunoa (4.9). As such, reproductive index showed a different variation, being highest at Fa'ala (0.40 young per adult), followed by NPAS - Laufuti Stream (0.37), Aokuso (0.30), Usu Nua (0.13), NPAS- Luamaa (0.11), and Saunoa (0.36).

On Ofu-Olosega (Table 10), adult capture rates were highest at Sili (66.1 adults per 600 net-hours), followed by Toaga Beach (64.6), NPAS - Southeast (51.8), Tumu Lower (51.2), Tumu Upper (43.5), and Oge Beach (31.2). Capture rates of young were highest at Sili (23.4 young per 600 net-hours), followed by Toaga Beach (22.5), Tumu Upper (17.4), Tumu Lower (12.6), Oge Beach (12.5), and NPAS - Southeast (11.0). Reproductive index was highest at Tumu Upper and Oge Beach (0.40 young per adult each), followed by Toaga Beach and Sili (0.35 each), Tumu Lower (0.25), and NPAS - Southeast (0.21).

To assess trends on n Tutuila and Ta'u, and to compare overall capture rates between these two islands, we present estimates of adult population size and reproductive success during each of the 2014-2016 seasons (and for all three seasons pooled) on both islands in Table 11. On Tutuila, both adult population size and productivity appeared to be highest in 2015 among all species pooled, followed by 2014 and 2016, although variation was only slight to moderate. Much of this variation appeared to be driven by that of Polynesian Wattled Honeyeater, the most commonly captured species, although reproductive success in this species showed a decline from 0.24 to 0.15 to 0.11 young/adult during the three seasons. Less-commonly captured species showed different patterns among the three years in both adult population size and reproductive success (Table 11).

On Ta'u, adult population size and reproductive success showed different inter-annual patterns among the three seasons, when all species were pooled (Table 11). Adult population size was highest during the 2014 season (69.40 adults per 600 net-hours), followed by 2016 (54.03) and

2015 (42.37). Reproductive success showed essentially the opposite pattern, being highest in 2015 (0.30), followed by 2016 (0.20) and 2014 (0.12). This variation in both population sizes and reproductive success was again driven primarily be the same patterns in Polynesian Wattled Honeyeater, the most commonly captured species. Most other species, including Crimson-crowned Fruit Dove, Pacific Kingfisher, Blue-crowned Lorikeet, Samoan Shrikebill, and Samoan Starling showed similar variation to Polynesian Wattled Honeyeater and all-species pooled for estimates of adult population size (Table 11), indicating that these population-size patterns appeared to be species-wide. Reproductive success of Samoan Starling also showed similar variation to that of Polynesian Wattled Honeyeater and all-species pooled, whereas Pacific Kingfisher and Samoan Shrikebill showed higher reproductive success in 2016 than in the other two seasons (Table 11).

As noted above, adult capture rates for all species pooled during the three seasons combined (2014-2016) were much lower on Tutuila (18.70 adults per 600 net-hours) than they were on Ta'u (55.30) (Table 11). Inter-annual patterns differed between the two islands, as noted above, population sizes being highest in 2015 and lowest in 2016 on Tutuila, but highest in 2014 and lowest in 2015 on Ta'u. Interestingly, reproductive index during these three years combined was higher on Tutuila (0.26 young/adult) than on Tutuila (0.21). In this case, inter-annual differences were more similar on both islands, being highest in 2015 but lower during the other two seasons.

Among landbird species captured on both islands, Pacific Kingfisher, Polynesian Wattled Honeyeater, and Samoan Starling had higher capture rates on Ta'u during the 2014-2016 seasons than on Tutuila, whereas Crimson-crowned Fruit Dove and Polynesian Starling had higher capture rates on Tutuila (Table 11). Higher adult population sizes on Ta'u than on Tutuila for Pacific Kingfisher, Polynesian Wattled Honeyeater, and Samoan Starling, the three most commonly captured species, explains the large overall difference in capture rates between the two islands. Reproductive index was higher on Tutuila the non Ta'u for Crimson-crowned Fruit Dove, Pacific Kingfisher, Polynesian Wattled Honeyeater, and Samoan Starling and it was higher on Ta'u than on Tutuila for Polynesian Starling, nearly the opposite species-specific patterns to those recorded for adult population size.

Estimates of annual adult survival rate (φ), recapture probability (p), and proportion of residents (τ), using four seasons of data (2013-2016) from the four stations operated on Tutuila during all four seasons (Malaeola, Malota, Mount Alava, and Amalau), are provided in Table 12, and estimates of annual adult survival rate (φ) and recapture probability (p), using three seasons of data (2014-2016) from all 12 stations on Tutuila and Ta'u combined, are shown in Table 13. Two other species, Crimson-crowned Fruit Dove and Polynesian Starling, had sufficient capture and recapture data for both analyses but these resulted in survivorship or recapture values of either 0.0 or 1.0, which are unrealistic and indicate that more data would be needed to produce valid estimates. Survivorship estimates, using transient models on four seasons of data from four stations on Tutuila, were 0.625 for Pacific Kingfisher and 0.655 for Polynesian Wattled Honeyeater, recapture probabilities were 0.423 for Pacific Kingfisher and 0.143 for Polynesian Wattled Honeyeater, and proportion of residents were 0.453 for Pacific Kingfisher and 0.909 for Polynesian Wattled Honeyeater (Table 12). The standard errors (*SE*s) for these four values were high, resulting in high coefficients of variance (CVs > 30%), generally indicating low precision to these estimates.

Using a non-transient model on three years of data collected during three seasons from all 12 stations operated during these years on Tutuila and Ta'u, survivorship estimates ranged from 0.522 for Pacific Kingfisher to 0.681 for Polynesian Wattled Honeyeater, and recapture probabilities ranged from 0.107 for Samoan Starling to 0.411 for Pacific Kingfisher (Table 13). The standard errors (*SE*s) for these four values were relatively low for Pacific Kingfisher and Polynesian Wattled Honeyeater, resulting in lower coefficients of variance for survival (CVs < 25%) than found in the four-season analysis, which indicates moderately good precision to these estimates. Standard errors were higher and coefficients of variance lower (CVs > 50%) for Samoan Shrikebill and Samoan Starling, indicating lower precision to these estimates.

DISCUSSION

During the first 13 months of the Tropical Monitoring Avian Productivity and Survivorship (TMAPS) program in American Samoa, from August 2012 to August 2013 on Tutuila Island, we established seasonality for resident breeding birds and that the best five-month period for the program, based on peak breeding for most indigenous landbird species, would be November-March. During November 2013, we therefore re-established four stations on Tutuila, established two new stations on Tutuila and six new stations on Ta'u Island, and operated these 12 stations for 1-5 pulses each during the 2014 (December 2013-March 2014), 2015 (November- 2014-March 2015), and 2016 (December 2013-March 2014) seasons. We also established six new stations on Ofu and Olosega islands for the 2016 season.

During the 2016 season, we recorded 98 captures on Tutuila, 243 captures on Ta'u, 489 captures on Ofu-Olosega, totaling 830 captures overall, of 16 bird species. This represents more than twice the number of captures from the 2015 season (400) due primarily to the addition of high-capture stations on Ofu-Olosega. The most commonly captured species, on all three island groups combined, were Polynesian Wattled Honeyeater, Samoan Starling, Pacific Kingfisher, Samoan Shrikebill, Tongan Ground Dove, Polynesian Starling, Crimson-crowned Fruit Dove, and Blue-crowned Lorikeet. These are all native indigenous species. The remaining eight species were captured < 3 times each.

In 2016, the breeding population index for all species combined was similar on Ta'u (54.0 adults captured per 600 net-hours) and Ofu-Olosega (52.6) but much lower on Tutuila (17.4), whereas the reproductive index was higher on Ofu-Olosega (0.32 yong/adults captured) and similarly lower on Tutuila (0.21) and Ta/u (0.20). Lower adult breeding population and reproductive indices on Tutuila could easily reflect higher human population densities and agricultural development on this island than is found on Ta'u and Ofu-Olosega. The lower reproductive success on Ta'u than on Ofu-Olosega in 2016, and on Ta'u than Tutuila during 2014-2016 combined, is interesting. This could represent either a saturated adult population on Ta'u, resulting in lower productivity due to competition among higher density breeding populations, or it could represent other possible stressors on Ta'u such as habitat degradation, micro-climatic events, food resource limitations, or disease. More years of data, especially regarding comparisons with population dynamics on Ofu-Olosega, should shed more light on this question.

Apparent density-dependent patterns have been observed at other TMAPS and MAPS stations. Higher reproductive success one year might lead to higher population size but lower success the next year, resulting from an increased number of younger birds in the population that are not as successful due to lower experience within a denser breeding population. Lower reproductive success one year might lead to lower populations the following year but higher success due to more-experienced birds in a lower-density population. Such effects were present to some extent in our data set within 2016. For example, higher population sizes with relatively lower reproductive success were observed on Ta'u overall and at several individual stations such as Mount Alava on Tutuila, Saunoa and NPAS - Luamaa on Ta'u, and Tumu Lower and NPAS - Southeast on Ofu, whereas lower population sizes with higher success were observed at other individual stations such as Fa'ala on Ta'u and Oge Beach on Olosega. An alternative explanation for this within-year pattern could be that adults and young utilize different micro-habitats in these locations, as influenced by habitat variation among stations. The continuation of these density-dependent patterns between years suggests that it is operating, and this could be the case with all species pooled along with Polynesian Wattled Honeyeater and Samoan Starling on Ta'u during the 2014-2016 seasons. However, such inter-annual, density-dependence patterns were not observed on Tutuila.

Using data from the four stations operated on Tutuila during all four seasons (2013-2016), estimates of annual adult survival rates using a transient model were 0.625 for Pacific Kingfisher and 0.655 for Polynesian Wattled Honeyeater. Using data from three seasons (2014-2016) from all 12 stations on Tutuila and Ta'u, survival rates using a non-transient model were 0.522 for Pacific Kingfisher, 0.681 for Polynesian Wattled Honeyeater, 0.542 for Samoan Shrikebill, and 0.586 for Samoan Starling. These are generally very high rates; by comparison, survivorship estimates among MAPS stations in North America vary between 0.40 and 0.55 for most species (DeSante et al. 2015). Higher survival rates are to be expected among resident tropical species that do not have to migrate and generally are subject to stable climate and food resources. Recapture probabilities were higher for Pacific Kingfisher than the other species in both the transient and non-transient models, indicating that this species may be more prone to recapture between seasons, perhaps due to behavior or movement patterns relative to mist-net arrays. On Tutuila, proportion of residents was much higher for Polynesian Wattled Honeyeater than for Pacific Kingfisher, which could indicate smaller home-range sizes or less seasonal movements for the honeyeater.

Standard errors and coefficients of variance for these estimates were generally high, especially for the four-year analysis, indicating low precision. Low precision is expected based on three or four years of mark-recapture data; however, it should improve once additional years of data have been collected. For example, the mean CVs for the two species from the four stations on Tutuila, based on only three seasons of data, 53% for survival and 130% for recapture probability (Pyle et al. 2015a), had improved to 38% and 63%, respectively, with the addition of a fourth year of data. It is also encouraging to see lower CVs for Pacific Kingfisher and Polynesian Wattled Honeyeater in the three-year analysis based on all 12 stations from Tutuila and Ta'u (mean 21% for survival and 30% for recapture probability), indicating much-increased precision with the addition of more captures and stations. We expect to see the precision of these estimates improve further with continued years of data, and we will also be able to compare adult survival on Tutuila and Ta'u with another year of data from these 12 stations.

The establishment of six new stations on Ofu-Olosega has greatly increased our data set on landbird captures in American Samoa. A corollary goal of the establishment of these stations was to gather information on the small population of Tongan Ground Doves residing on these islands. Our capture of 17 individuals and one recapture has enabled us to confirm age and sex criteria for this species in American Samoa, and has provided critical information on breeding condition, biometrics, and weights, which will allow us to undertake further studies on this population during future seasons. Our current goal is to collect feather, blood, and swab samples from Tongan Ground Doves during the 2017 season to investigate genetic differentiation, pathogens, and diet, to use playback experimentation to help monitor populations, and to apply tracking devices in order to better understand home-range sizes, movement patterns, population size, and nesting behavior. This information will be applied to the management of this population, which was listed under the USFWS Endangered Species Act in September 2016 (Rosa 2007; USFWS 2015, 2016). The data on molt, plumage, breeding condition, and morphometrics of Tongan Ground Doves and other American Samoan landbirds will be published in the scientific literature (Pyle et al. in press).

Continuation of the current sampling protocol will yield critical data on the survival, recruitment, and population growth rates for up to seven target native landbird species on Tutuila, Ta'u, and Ofu-Olosega. Our goal is to continue to operate six stations on each of the three island groups during November-March of each season through at least 2017. Five seasons worth of data will allow us to better understand year-to-year dynamics, including trends in population sizes, and will enable us to estimate survival rates for up to seven target species on each island. We can then assess how much reproductive success and survivorship are driving population size dynamics, we can use our habitat data to assess how habitat quality affects each of these parameters, reproductive success in particular, and we will be able to apply results of these analyses to inform land-management recommendations for habitat conservation or restoration. The need for such approaches is pressing given the many potential threats to the persistence of Pacific insular populations such as habitat loss, avian disease, and exotic predators such as brown treesnake (*Boiga irregularis*), which has reduced or eliminated many landbirds on Guam in the Marianas Islands (Frits and Rhodda 1998). We look forward to continuing this important work in the coming years.

ACKNOWLEDGMENTS

We are extremely grateful to Samoan landowners for granting us permission to establish TMAPS stations on their lands. On Tutuila these were Alo Pete Steffany, Utu Ron, Wesley Tulefano, Easter Tom Bruce and the Asi family, Fuimaono Asuemu, the Lauti family, the Gurr family, and the Tula family. On Ta'u these were Sau and Usu Nua, the Saunoa family, the Fala'a family, Aokuso, Tei, and the National Park of American Samoa. On Ofu-Olosega these were the Lata family, Peter Ili and family, Misaalefua family, and the National Park of American Samoa. We thank the U.S. Fish and Wildlife Service (USFWS) for providing funding through Wildlife Restoration (WSFR) Grants to American Samoa; Ruth Utzurrum of USFWS, Honolulu, assisted us by reviewing and making suggestions for improvements to grant proposals for both initial and continuing field work. Shelly Kremer was instrumental in instigating funding for TMAPS in the Pacific, including American Samoa, and Lainie Zarones and Nicole Arcilla, formerly of DWMR in American Samoa, helped us secure funding for data collection in 2012-2014. We thank former DMWR Director Ray Tulafono for approving and facilitating the work during 2012-2013 and current DMWR Director Ruth Matagi-Tofiga and Deputy Director Selaina Vaitautolu-Tuimavave for approving the work for the 2014-2016 seasons. We are indebted to local biologists and guides, Siaifoi Faaumu and Matthew Toilolo of DWMR, Panini Seafa and Meli on Ta'u, and John Utuga and Ricky Miasaalefua on Ofu-Olosega, for help with field work and land access. We thank other DWMR staff members, including Adam Miles, Ailao Tualaulelei, and Mark MacDonald, for help with logistics, and Carlo Caruso, Tavita Togia, Sean Eagan, James Bacon, Kiolona Atanoa, and Loia Tagoni, of the National Park of American Samoa, for assistance and permission to conduct research on lands they manage. IBP field biologists who took part during the first three years of the TMAPS Program, in addition to Kayano, were Alfredo Arcilla Jr., Rudy Badia, Adrienne Doyle, Emily Jeffreys, Sam Jones, Daniel Lipp, Vicki Morgan, Robinson Seumanutafa Mulitalo, Colleen Nell, Jessie Reese, Zachary Robinson, Joshua Tigilau, Keegan Tranquillo, and Salefu Tuvalu. We thank Rodney Siegel of IBP for administrative and technical support. This is Contribution No. 547 of The Institute for Bird Populations.

LITERATURE CITED

Bart, J. 2005. Monitoring the abundance of bird populations. Auk 122:15-25.

DeSante, D.F. 1992. Monitoring Avian Productivity and Survivorship (MAPS): a sharp, rather than blunt, tool for monitoring and assessing landbird populations. Pages 511-521 *in* D. R. McCullough and R. H. Barrett, editors. Wildlife 2001: Populations. Elsevier Applied Science, London, UK. PDF

DeSante, D.F. and T.L. George. 1994. Population trends in the landbirds of western North America. Pages 173-190 *in* J. R. Jehl, Jr. and N. K. Johnson (eds.), A century of avifaunal change in North America, Studies in Avian Biology No 15, Cooper Ornithological Society. PDF

DeSante, D.F., and D.R. Kaschube. 2007. The Monitoring Avian Productivity and Survivorship (MAPS) Program 2002 and 2003 Report. Bird Populations 8:46-115. PDF

DeSante, D.F., M.P. Nott, and D.R. O'Grady. 2001. Identifying the proximate demographic cause(s) of population change by modeling spatial variation in productivity, survivorship, and population trends. Ardea 89:185-207. PDF

DeSante, D.F., M.P. Nott, and D.R. Kaschube. 2005. Monitoring, modeling, and management: Why base avian monitoring on vital rates and how should it be done? Pages 795-804 *in* C. J. Ralph and T. D. Rich, editors. Bird Conservation Implementation and Integration in the Americas. U.S. Forest Service General Technical Report PSW-GTR-191. PDF

DeSante, D.F., K.M. Burton, P. Velez, and D. Froehlich. 2014. MAPS Manual. The Institute for Bird Populations, Point Reyes Station, CA. PDF

DeSante, D. F., D. R. Kaschube, and J. F. Saracco. 2015. Vital rates of North American landbirds. www.VitalRatesOfNorthAmericanLandbirds.org: The Institute for Bird Populations, Point Reyes Station, CA.

Fritts, T.H, and G.H. Rodda. 1998. The role of introduced species in the degradation of island ecosystems: A case history of Guam. Annual Review of Ecology and Systematics 29:113-140.

Gregory R.D., A.J. van Strien, P. Vorisek, A.W. Gmelig Meyling, D.G. Noble, R.P.B. Foppen, and D.W. Gibbons. 2005. Developing indicators for European birds. Philosophical Transactions of the Royal Society London B 360: 269-288.

Gill, F., and D. Donsker (eds). 2016. IOC World Bird List (v 6.3). doi : 10.14344/IOC.ML.6.3. [Accessed 1 September 2016].

Hines, J.E., W.L. Kendall, and J.D. Nichols. 2003. On the use of the robust design with transient capture-recapture models. Auk 120:1151-1158.

Holmes, R.T. 2007. Understanding population change in migratory songbirds: long-term and experimental studies of Neotropical migrants in breeding and wintering areas. Ibis 149:2-13.

Hutto, R.L. 1998. Using landbirds as an indicator species group. Pages 75-92 *in* J. M. Marzluff and R. Sallabanks, editors. Avian Conservation: Research and Management. Island Press, Washington, D.C., USA.

Johnson, E.I., J.D. Wolfe, T.B. Ryder, and P. Pyle. 2011. Modifications to a molt-based ageing system proposed by Wolfe et al. (2010). Journal of Field Ornithology 82:421-423. PDF

Junda, J., A.L. Crary, and P. Pyle. 2012. Two modes of primary replacement during prebasic molt of Rufous Fantails *Rhipidura rufifrons*. Wilson Journal of Ornithology 124:680-685. PDF

Lebreton, J.-D., K.P. Burnham, J. Clobert, and D.R. Anderson. 1992. Modeling survival and testing biological hypotheses using marked animals: a unified approach with case studies, Ecological Monographs, 62:67-118.

Morrison, M.J. 1986. Bird populations as indicators of environmental change. Current Ornithology 3:429-451.

Noon, B.R. and J.R. Sauer. 1992. Population models for passerine birds: structure parameterization, and analysis. Pages 441-464 in D. C. McCullough and R. H. Barrett (eds.), Wildlife 2001: Populations. Elsevier Applied Science, London.

Nott, M.P., and D.F. DeSante. 2002. Demographic monitoring and the identification of transient in mark-recapture models. Pp. 727-736 *in:* J.M. Scott, P. Heglund, et al. (eds.), Predicting Species Occurrences: Issues of Scale and Accuracy, Island Press, New York. PDF

Nott, P., D.F. DeSante, and N. Michel. 2003. Monitoring Avian Productivity and Survivorship (MAPS) Habitat Structure Assessment (HSA) Protocol: describing vertical and horizontal spatial habitat patterns at MAPS stations. The Institute for Bird Populations, Point Reyes Staion, California. PDF

Peach, W.J., S.R. Baillie, and S.T. Buckland. 2004. Current practices in the British Trust for Ornithology Constant Effort Sites scheme and comparisons with temporal changes in mist-net captures with changes in spot-mapping counts a the extensive scale. Studies in Avian Biology 29:46-56.

Peach, W.J., S.T. Buckland, and S.R. Baillie. 1996. The use of constant effort mist-netting to measure between-year changes in the abundance and productivity of common passerines. Bird Study 43:142-156.

Pollock, K.H., J.D. Nichols, C. Brownie, and J.E. Hines. 1990. Statistical inference for capture-recapture experiments, Wildlife Monographs, No. 107.

Pradel, R., J. Hines, J.-D. Lebreton, and J.D. Nichols. 1997. Estimating survival probabilities and proportions of 'transients' using capture-recapture data. Biometrics 53:60-72.

Pratt, H. D. 2010. Revisiting species and subspecies of island birds for a better assessment of biodiversity. Ornithological Monographs 67:79–89.

Pyle, P. 2014a. Updated manual for ageing and sexing landbirds of American Samoa. The Institute for Bird Populations, Point Reyes Station, CA. PDF

Pyle, P. 2014b. Applying "WRP" molt and age codes at TMAPS stations: a case study based on American Samoan landbirds. MAPS Chat 14:1-6. PDF

Pyle, P., N. S. Dauphine, D. Lipp, R. Badia, R. Taylor, and E. Rowan. 2012. The Tropical Monitoring Avian Productivity and Survivorship (TMAPS) Program in American Samoa: 2012 Report. The Institute for Bird Populations, Point Reyes Station, CA. PDF

Pyle, P., N. S. Dauphine, K. Tranquillo, C. Nell, E Jeffreys, D. Kaschube, R. Taylor, and E. Rowan. 2013. The Tropical Monitoring Avian Productivity and Survivorship (TMAPS) Program in American Samoa: 2013 Report. The Institute for Bird Populations, Point Reyes Station, CA. PDF

Pyle, P., N.S. Arcillo, K. Tranquillo, K. Kayano, A. Doyle, S. Jones, D. Kaschube, R. Taylor, and E. Rowan. 2014. The Tropical Monitoring Avian Productivity and Survivorship (TMAPS) Program in American Samoa: 2014 report. The Institute for Bird Populations, Point Reyes Station, CA. PDF

Pyle, P., K. Kayano, J. Reese, V. Morgan, R. S. Mulitalo, J. Tigilau, S. Tuvalu, D. Kaschube, R. Taylor, and L. Helton. 2015a. The Tropical Monitoring Avian Productivity and Survivorship (TMAPS) Program in American Samoa: 2015 Report. The Institute for Bird Populations, Point Reyes Station, CA. PDF

Pyle, P., A. Engilis Jr., and D.A. Kelt. 2015b. Manual for ageing and sexing landbirds of Bosque Fray Jorge National Park and North-central Chile, with notes on occurrence and breeding seasonality. Special Publications of the Louisiana State University. PDF

Pyle, P, K. Tranquillo, K. Kayano, and N. Arcilla. 2016. Molt patterns, age criteria, and molt-breeding overlap in Ameican Samoan landbirds. Wilson Journal of Ornithology 128:59-69. PDF

Pyle, P, K. Tranquillo, K. Kayano, K. Murphy, B. Wilcox, and N. Arcilla. In press. Manual for ageing and sexing landbirds of American Samoa, with notes on molt and breeding seasonality. Special Publications of the Louisiana State University, Baton Rouge, LA.

Radley, P., A.L. Crary, J. Bradley, C. Carter, and P. Pyle. 2011. Molt patterns, biometrics, and age and gender classification of landbirds on Saipan, Northern Mariana Islands. Wilson Journal of Ornithology 123:588-594. PDF

Rosa, K. 2007. U.S. Fish and Wildlife Service Species Assessment and Listing Priority Assignment Form: *Gallicolumba stairi*, Friendly (shy) ground-dove (American Samoa Distinct Population Segment). U.S. Fish and Wildlife Service: Pacific Islands Fish and Wildlife Office.

Saracco, J.F., D.F. DeSante, and D.R. Kaschube. 2008. Assessing landbird monitoring programs and demographic causes of population trends. Journal of Wildlife Management 72:1665-1673. PDF

Saracco, J. F., D. F. DeSante, M. P. Nott, and D. R. Kaschube. 2009. Using the MAPS and MoSI programs to monitor landbirds and inform conservation. Pp. 651-658 in: T. D. Rich, C. D. Thompson, D. Demarest, and C. Arizmendi, editors, Proceedings of the Fourth International Partners in Flight Conference: Tundra to Tropics. University of Texas-Pan American Press. PDF

Saracco, J. F., J. A. Royle, D. F. DeSante, and B. A. Gardner. 2010a. Spatial modeling of survival and residency and application to the Monitoring Avian Productivity and

Survivorship Program. Journal of Ornithology. On-line: doi: 10.1007/s10336-010-0565-1. PDF

Saracco, J. F., J. A. Royle, D. F. DeSante, and B. A. Gardner. 2010b. Modeling spatial variation in avian survival and residency probabilities. Ecology 91:1885-1891. PDF

Saracco, J.F., L. Helton, and P. Pyle. 2015. Seasonal demographics of landbirds on Saipan: report on the 2013-14 TMAPS program. The Institute for Bird Populations, Point Reyes Station, CA. PDF

Saracco, J.F., P. Radley, P. Pyle, E. Rowan, R. Taylor, and L. Helton. 2016. Linking vital rates of landbirds on a tropical island to rainfall and vegetation greenness. PLOS ONE 11(2):e0148570. DOI: 10.1371/journal.pone.0148570. PDF

Sauer, J. R., J. E. Hines, and J. Fallon. 2008. The North American Breeding Bird Survey, Results and Analysis 1966 - 2007. Version 5.15.2008. USGS Patuxent Wildlife Research Center, Laurel, MD.

Temple, S.A., and J.A. Wiens. 1989. Bird populations and environmental changes: can birds be bio-indicators? American Birds 43:260-270.

U.S. Fish and Wildlife Service. 2015. Endangered and threatened wildlife and plants; proposed endangered species status for five species from American Samoa. Federal Register Document 80 FR 61567, pages 61567-61607, Docket No. FWS-R1-ES-2015-0128 4500030113.

U.S. Fish and Wildlife Service. 2016.Endangered and threatened wildlife and plants; endangered status for five species from American Samoa; final rule. Federal Register 81 (184) pages 65466-65508, Docket No. FWS–R1–ES–2015–0128; 4500030113 (22 September 2016).

Viereck, L.A., C.T. Dyrness, A.R. Batten, and K.J. Wenzlick, 1992. The Alaska Vegetation Classification. Gen. Tech. Rep. PNW-GTR-286. Portland, OR. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 278 p

Wolfe, J.D., T.B. Ryder, and P. Pyle. 2010. Using molt cycles to categorize age in tropical birds: An integrative system. Journal of Field Ornithology 81:186-194. PDF

Table 1. Summary of the TMAPS program on the island of Tutuila, American Samoa (AMSA) during the 2016 season, January through March 2016.

Station					November 2015 – March 2016 operation		
Name	Code	Major Habitat Type	Latitude-longitude	Avg Elev. (m)	Total number of net-hours	No. of pulses	Inclusive dates
Vatia	VATI	Mixed, old-growth and secondary lowland tropical forest on a hillside with banana and coconut plantation at base.	14°14'41"S, 170°40'35"W	135	314.67	3	01/25/16 - 3/23/16
Tula	TULA	Primary forest on steep ridge with mature *Callophylum* and *Dysoxylum* trees.	14°14'58"S, 170°34'35"W	380	401.67	3	01/28/16 - 03/28/16
Amalau	AMAL	Mixed, old-growth and secondary lowland tropical forest; some plantation	14°15'19"S, 170°39'32"W	35	459.83	3	01/15/16 - 03/17/16
Mount Alava	MTAL	Old-growth steep-slope, tropical forest; some secondary forest and plantation	14°17'05"S, 170°42'46"W	215	455.00	3	01/05/16 – 03/09/16
Malota	MALO	Ridge-spine, natural tropical forest	14°18'17"S, 170°49'11"W	144	435.00	3	01/19/16 – 03/19/16
Malaeloa	MALA	Old-growth moderate-slope, lowland tropical evergreen forest; ephemeral wetlands	14°19'50"S, 170°46'26"W	43	454.33	3	01/11/16 – 03/12/16
ALL STATIONS					2520.50	3	01/05/16 – 03/28/16

Table 2. Summary of the TMAPS program on the island of Tau, American Samoa (AMSA) during the 2016 season, January through March 2016.

Station Name	Station Code	Major Habitat Type	Latitude-longitude	Avg Elev. (m)	November 2015 – March 2016 operation: Total number of net-hours	No. of pulses	Inclusive dates
Aokuso	AOKU	Agriculturally managed secondary forest bordering herbaceous sand strand	14°12'49"S, 169°27'13"W	43	385.67	3	01/19/16 – 03/21/16
Saunoa	SNOA	Agriculturally managed land with some moderate-slope secondary forest alongside clearcut plantation	14°13'11"S, 169°30'14"W	435	369.50	3	01/07/16 – 03/10/16
Usu Nua	USUN	Agriculturally managed secondary forest	14°13'59"S, 169°30'39"W	210	311.67	2	01/12/16 – 03/15/16
Fala'a	FALA	Gentle-slope mature lowland secondary forest	14°14'49"S, 169°29'59"W	424	257.00	2	01/22/16 – 02/29/16
NPAS - Laufuti Stream	LAUF	Gentle-slope mature lowland secondary forest	14°14'54"S, 169°26'31"W	835	238.00	2	01/27/16 – 03/05/16
NPAS- Luamaa	LUAM	Coral rubble lowland littoral forest	14°15'24"S, 169°25'28"W	8	437.00	3	01/02/16 – 03/12/16
ALL STATIONS					1998.83	3	01/02/16 – 03/21/16

Table 3. Summary of the TMAPS program on the island of Ofu-Olosega, American Samoa (AMSA) during the 2016 season, November 2015 through March 2016.

Station		Major Habitat Type	Latitude-longitude	Avg Elev. (m)	November 2015 – March 2016 operation: Total number of net-hours	No. of pulses	Inclusive dates
Ofu Island							
Tumu Lower	TUML	Agriculturally managed lowland forest	14°10'05"S, 169°40'32"W	94	620.67	4	12/14/15 – 03/09/16
National Park Southeast	NPSE	Coastal lowland forest bordering sand strand	14°10'15"S, 169°38'42"W	5	544.33	4	12/22/15 – 03/05/16
Toaga Beach	TOAG	Coastal lowland forest, bordering sand strand and talus slope; frequently disturbed by rock falls and landslides	14°10'34"S, 169°39'14"W	13	538.67	4	12/09/15 – 03/03/16
Tumu Upper	TUMU	Disturbed montane forest; microwave station at summit	14°10'34"S, 169°39'36"W	477	566.17	4	12/04/15 – 03/21/16
Olosega Island							
Sili	SILI	Reclaimed old village site; coral rubble lowland littoral forest with no stratification	14°09'43"S, 169°37'05"W	12	590.00	4	11/30/15 – 03/01/16
Oge Beach	OGEB	Montane rain forest with low canopy, few saplings, and moderate to heavy ground cover	14°11'15"S, 169°36'50"W	144	481.17	4	01/01/16 – 03/15/16
ALL STATIONS					3341.00	4	11/30/15 – 03/21/16

Table 4. Summary of combined results for all 18 American Samoan TMAPS stations (six from each island group) operated during the 2016 season, November 2015 through March 2016.

	Island of Tutuila						Island of Tau						Island of Ofu-Olosega					
	Birds captured			Birds/600 net-hours			Birds captured			Birds/600 net-hours			Birds captured			Birds/600 net-hours		
Species[1]	Newly banded	Un-band	Recap-tured	Adult	Young	Repr. Index	Newly banded	Un-band	Recap-tured	Adult	Young	Repr. Index	Newly banded	Un-band	Recap-tured	Adult	Young	Repr. Index
Buff-banded Rail								2										
Pacific Golden-Plover								1										
Tongan Ground Dove													17	0	1			
Crimson-crowned Fruit Dove	2	1		0.5	0.0	0.00	2			0.6	0.0	0.00	3					
Pacific Imperial Pigeon														1		0.5	0.0	0.00
White-rumped Swiftlet	1			0.2	0.0	0.00										7.4	4.0	0.54
Pacific Kingfisher	16		6	2.6	1.9	0.73	16		11	4.5	2.1	0.47	63		35	8.1	3.2	0.40
Blue-crowned Lorikeet							6	1		1.5	0.0	0.00				0.5	0.4	0.67
Cardinal Honeyeater	2			0.2	0.2	1.00												
Polynesian Wattled Honeyeater	41		12	10.5	1.2	0.11	80	1	36	29.7	3.0	0.10	192	4	30	28.2	5.9	0.21
Red-vented Bulbul	1			0.0	0.2	und.[2]												
Samoan Shrikebill							20		3	3.9	2.7	0.69	26		7	2.2	0.9	0.42
Polynesian Starling	4		1	1.2	0.0	0.00	2		1	0.6	0.3	0.50	5		1			
Samoan Starling	9			2.1	0.0	0.00	45	3	13	13.2	2.7	0.21	86	2	16			
Common Myna	1			0.0	0.0	0.00												
Jungle Myna	1			0.0	0.0	0.00										2.2	1.8	0.83
ALL SPECIES POOLED	78	1	19	17.4	3.3	0.21	171	8	64	54.0	10.8	0.20	392	7	90	52.6	16.9	0.32
Total Number of Captures		98						243						489				
Number of Species	10	1	3	7	4		7	5	5	7	5		7	3	6	7	6	
Total Number of Species		10			8			9			7			8			7	

[1] Scientific names given in Appendix I.
[2] Reproductive index (young/adult) is undefined because no adults of this species were captured at these stations in this year.

Table 5. Capture summary for the six individual TMAPS stations operated on the island of **Tutuila**, American Samoa (AMSA) during the 2016 season, January through March 2016. N = Newly banded, U = Unbanded, R = Recaptures of banded birds.

	Vatia			Tula			Amalau			Mount Alava			Malota			Malaeloa		
Species[1]	N	U	R	N	U	R	N	U	R	N	U	R	N	U	R	N	U	R
Crimson-crowned Fruit Dove	1												1	1				
White-rumped Swiftlet										1								
Pacific Kingfisher	1			4		4	4			5		2	1			1		
Cardinal Honeyeater	1									1								
Polynes. Wattled Honeyeater	14			9		4	4		1	9		4	2		2	3		1
Red-vented Bulbul													1					
Polynesian Starling							2			1			1		1			
Samoan Starling	1						3						5					
Common Myna										1								
Jungle Myna																1		
ALL SPECIES POOLED	18	0	0	13	0	8	13	0	1	18	0	6	11	1	3	5	0	1
Total Number of Captures		18			21			14			24			15			6	
Number of Species	5	0	0	2	0	2	4	0	1	6	0	2	6	1	2	3	0	1
Total Number of Species		5			2			4			6			6			3	

[1] Scientific names given in Appendix I.

Table 6. Capture summary for the six individual TMAPS stations operated on the island of **Tau**, American Samoa (AMSA) during the 2016 season, January through March 2016. N = Newly banded, U = Unbanded, R = Recaptures of banded birds.

	Aokuso			Saunoa			Usu Nua			Fala'a			Laufuti Stream			Luamaa		
Species[1]	N	U	R	N	U	R	N	U	R	N	U	R	N	U	R	N	U	R
Buff-banded Rail		1			1													
Pacific Golden-Plover					1													
Crimson-crowned Fruit Dove	1			1														
Pacific Kingfisher	7		3	3		2	2						1			3		6
Blue-crowned Lorikeet	3			2			1	1										
Polynes. Wattled Honeyeater	13	1	8	8		7	26		6	5		2	8		3	20		10
Samoan Shrikebill				3						5		2	12		1			
Polynesian Starling							1		1				1					
Samoan Starling	18	2	6	10		5	10	1	2	2						5		
ALL SPECIES POOLED	42	4	17	27	2	14	40	2	9	12	0	4	22	0	4	28	0	16
Total Number of Captures		63			43			51			16			26			44	
Number of Species	5	3	3	6	2	3	5	2	3	3	0	2	4	0	2	3	0	2
Total Number of Species		6			8			5			3			4			3	

[1] Scientific names given in Appendix I.

Table 7. Capture summary for the six individual TMAPS stations operated on the island of **Ofu-Olosega**, American Samoa (AMSA) during the 2016 season, November 2015 through March 2016. N = Newly banded, U = Unbanded, R = Recaptures of banded birds.

	Ofu Island												Olosega Island					
	Tumu Lower			Southeast			Toaga Beach			Tumu Upper			Sili			Oge Beach		
Species[1]	N	U	R	N	U	R	N	U	R	N	U	R	N	U	R	N	U	R
Tongan Ground Dove	3			4			6						4		1			
Crimson-crowned Fruit Dove	1						2											
Pacific Imperial Pigeon														1				
Pacific Kingfisher	5		2	18		13	9		8	1			17		8	13		4
Polynes. Wattled Honeyeater	39	1	5	28		4	36		5	35		11	33	1	1	21	2	4
Samoan Shrikebill	5						1			20		7						
Polynesian Starling										5		1						
Samoan Starling	15	1	1	7		1	23		6	4			35	1	8	2		
ALL SPECIES POOLED	68	2	8	57	0	18	77	0	19	65	0	19	89	3	18	36	2	8
Total Number of Captures		78			75			96			84			110			46	
Number of Species	6	2	3	4	0	3	6	0	3	5	0	3	4	3	4	3	1	2
Total Number of Species		6			4			6			5			5			3	

[1] Scientific names given in Appendix I.

Table 8. Numbers of aged individual birds captured per 600 net-hours and proportion of young in the catch at the six individual MAPS stations operated on the island of **Tutuila**, American Samoa (AMSA) during the 2016 season, January – March 2016.

	Vatia			Tula			Amalau			Mount Alava			Malota			Malaeloa		
Species[1]	Ad.	Yg.	Rep. Ind.	Ad.	Yg.	Rep. Ind.	Ad.	Yg.	Rep. Ind.	Ad.	Yg.	Rep. Ind.	Ad.	Yg.	Rep. Ind.	Ad.	Yg.	Rep. Ind.
Crimson-crowned Fruit Dove	1.9	0.0	0.00										1.4	0.0	0.00			
White-rumped Swiftlet										1.3	0.0	0.00						
Pacific Kingfisher	0.0	1.9	und[2]	6.0	3.0	0.50	2.6	2.6	1.00	5.3	2.6	0.50	0.0	1.4	und[2]	1.3	0.0	0.00
Cardinal Honeyeater	0.0	1.9	und.							1.3	0.0	0.00						
Polynes. Wattled Honeyeater	19.1	7.6	0.40	14.9	1.5	0.10	6.5	0.0	0.00	17.1	0.0	0.00	5.5	0.0	0.00	2.6	0.0	0.00
Red-vented Bulbul													0.0	1.4	und.			
Polynesian Starling							2.6	0.0	0.00	1.3	0.0	0.00	2.8	0.0	0.00			
Samoan Starling	1.9	0.0	0.00				3.9	0.0	0.00				6.9	0.0	0.00			
Common Myna										0.0	0.0	0.00						
Jungle Myna																0.0	0.0	0.00
ALL SPECIES POOLED	22.9	11.4	0.50	20.9	4.5	0.21	15.7	2.6	0.17	26.4	2.6	0.10	16.6	2.8	0.17	4.0	0.0	0.00
Number of Species	3	3		2	2		4	1		5	1		4	2		2	0	
Total Number of Species		5			2			4			5			6			2	

[1] Scientific names given in Appendix I.
[2] Reproductive index (young/adult) is undefined because no adults of this species were captured at this station in this year.

Table 9. Numbers of aged individual birds captured per 600 net-hours and proportion of young in the catch at the six individual MAPS stations operated on the island of **Tau**, American Samoa (AMSA) during the 2016 season, January – March 2016.

	Aokuso			Saunoa			Usu Nua			Fala'a			Laufuti Stream			Luamaa		
Species[1]	Ad.	Yg.	Rep. Ind.	Ad.	Yg.	Rep. Ind.	Ad.	Yg.	Rep. Ind.	Ad.	Yg.	Rep. Ind.	Ad.	Yg.	Rep. Ind.	Ad.	Yg.	Rep. Ind.
Crimson-crowned Fruit Dove	1.6	0.0	0.00	1.6	0.0	0.00												
Pacific Kingfisher	7.8	6.2	0.80	3.2	1.6	0.50	1.9	1.9	1.00				2.5	0.0	0.00	8.2	1.4	0.17
Blue-crowned Lorikeet	4.7	0.0	0.00	3.2	0.0	0.00	0.0	0.0	0.00									
Polynes. Wattled Honeyeater	29.6	3.1	0.11	19.5	0.0	0.00	48.1	7.7	0.16	11.7	2.3	0.20	27.7	0.0	0.00	37.1	4.1	0.11
Samoan Shrikebill				3.2	1.6	0.50				9.3	4.7	0.50	17.6	15.1	0.86			
Polynesian Starling							3.9	0.0	0.00				0.0	2.5	und[2]			
Samoan Starling	23.3	10.9	0.47	17.9	1.6	0.09	23.1	0.0	0.00	2.3	2.3	1.00				6.9	0.0	0.00
ALL SPECIES POOLED	66.9	20.2	0.30	48.7	4.9	0.10	77.0	9.6	0.13	23.3	9.3	0.40	47.9	17.6	0.37	52.2	5.5	0.11
Number of Species	5	3		6	3		4	2		3	3		3	2		3	2	
Total Number of Species		5			6			4			3			4			3	

[1] Scientific names given in Appendix I.
[2] Reproductive index (young/adult) is undefined because no adults of this species were captured at this station in this year.

Table 10. Numbers of aged individual birds captured per 600 net-hours and proportion of young in the catch at the six individual MAPS stations operated on the island of **Ofu-Olosega**, American Samoa (AMSA) during the 2016 season, November 2015 – March 2016.

	Ofu Island												Olosega Island					
	Tumu Lower			Southeast			Toaga Beach			Tumu Upper			Sili			Oge Beach		
Species[1]	Ad.	Yg.	Rep. Ind.	Ad.	Yg.	Rep. Ind.	Ad.	Yg.	Rep. Ind.	Ad.	Yg.	Rep. Ind.	Ad.	Yg.	Rep. Ind.	Ad.	Yg.	Rep. Ind.
Tongan Ground Dove	2.9	0.0	0.00	3.3	1.1	0.33	3.3	3.3	1.00				3.1	1.0	0.33			
Crimson-crowned Fruit Dove	1.0	0.0	0.00				2.2	0.0	0.00									
Pacific Kingfisher	3.9	1.0	0.25	16.5	3.3	0.20	7.8	2.2	0.29	1.0	0.0	0.00	12.2	5.1	0.42	7.5	8.7	1.17
Polynes. Wattled Honeyeater	34.8	2.9	0.08	24.3	6.6	0.27	30.1	10.0	0.33	26.1	7.7	0.30	28.5	4.1	0.14	21.2	3.7	0.18
Samoan Shrikebill	0.0	2.9	und[2]				0.0	1.1	und[2]	11.6	5.8	0.50						
Polynesian Starling										2.9	1.9	0.67						
Samoan Starling	8.7	5.8	0.67	7.7	0.0	0.00	21.2	5.6	0.26	1.9	1.9	1.00	22.4	12.2	0.54	2.5	0.0	0.00
ALL SPECIES POOLED	51.2	12.6	0.25	51.8	11.0	0.21	64.6	22.3	0.35	43.5	17.4	0.40	66.1	23.4	0.35	31.2	12.5	0.40
Number of Species	5	4		4	3		5	5		5	4		4	4		3	2	
Total Number of Species		6			4			6			5			4			3	

[1] Scientific names given in Appendix I.
[2] Reproductive index (young/adult) is undefined because no adults of this species were captured at this station in this year.

Table 11. Mean numbers of aged individual birds captured per 600 net-hours and reproductive index for six MAPS stations pooled on each of the Islands of Tutuila and Ta'u, American Samoa (AMSA), from November - March, during each of the three seasons 2014-2016 and all three seasons combined.

	Island of Tatuila								Island of Ta'u							
	2014		2015		2016		Mean 2014 - 2016		2014		2015		2016		Mean 2014 - 2016	
Species[1]	Adult/ 600nh	RI	Adult/ 600nh	RI	Adult/ 600nh	RI	Adult/ 600nh	RI	Adult/ 600nh	RI	Adult/ 600nh	RI	Adult/ 600nh	RI	Adult/ 600nh	RI
Many-colored Fruit Dove			0.39	0.00			0.10	0.00								
Crimson-crwnd. Fruit Dove	1.35	0.13	0.78	0.50	0.48	0.00	0.90	0.21	0.93	0.00	0.20	0.00	0.60	0.00	0.60	0.00
Pacific Long-tailed Cuckoo	0.00	und.[2]					0.00	und.[2]	0.23	0.00	0.00		0.00		0.10	0.00
White-rumped Swiftlet					0.24	0.00	0.10	0.00								
Pacific Kingfisher	2.53	0.40	2.34	0.50	2.62	0.73	2.50	0.54	5.78	0.20	4.04	0.10	4.50	0.47	4.80	0.26
Blue-crowned Lorikeet									1.85	0.13	0.40	0.00	1.50	0.00	1.30	0.04
Cardinal Honeyeater	0.00	und.[1]			0.24	1.00	0.10	1.00								
Polyn. Wattled Honeyeater	9.79	0.24	15.19	0.15	10.47	0.11	11.80	0.17	41.87	0.06	24.21	0.25	29.72	0.10	31.90	0.14
Red-vented Bulbul					0.00	und.[2]	0.00	und.[2]								
Samoan Shrikebill									4.40	0.37	2.62	0.54	3.90	0.69	3.60	0.53
Polynesian Starling	1.86	0.00	1.17	0.67	1.19	0.00	1.40	0.22	0.93	1.50	1.21	0.00	0.60	0.50	0.90	0.67
Samoan Starling	2.02	0.25	1.17	1.67	2.14	0.00	1.80	0.64	13.42	0.12	9.68	0.50	13.21	0.21	12.10	0.28
ALL SPECIES POOLED	17.55	0.25	21.04	0.32	17.38	0.21	18.70	0.26	69.40	0.12	42.37	0.30	54.03	0.20	55.30	0.21

[1] Scientific names given in Appendix I.
[2] Reproductive index (young/adult) is undefined because no adults of this species were captured at this station in this year.

Table 12. Estimates of adult annual survival and recapture probabilities among newly captured adults using a time-constant, transient model for two species breeding at the four long-term stations on the Island of Tutuila, American Samoa (AMSA), obtained from four years[1] of mark-recapture data.

Species[2]	No. stn.[3]	No. indv.[4]	No. capt.[5]	No. btwn-yr recap.[6]	Survival probability[7] φ	SE(φ)	CV(φ)	Recapture probability[8] p	SE(p)	CV(p)	Proportion of residents[9] τ	SE(τ)	CV(τ)
Pacific Kingfisher*	4	36	47	7	0.625	0.283	45.3%	0.423	0.239	56.4%	0.453	0.334	73.7
Polynesian Wattled Honeyeater*	4	141	169	18	0.655	0.199	30.4%	0.143	0.098	68.8%	0.909	0.627	69.0

Table 13. Estimates of adult annual survival and recapture probabilities among newly captured adults using a time-constant, non-transient model for four species breeding at the 12 stations that operated on the Islands of Tutuila and T'au, American Samoa (AMSA), obtained from three years[1] of mark-recapture data.

Species[2]	No. stn.[3]	No. indv.[4]	No. capt.[5]	No. btwn-yr recap.[6]	Survival probability[7] φ	SE(φ)	CV(φ)	Recapture probability[8] p	SE(p)	CV(p)
Pacific Kingfisher†	12	89	145	23	0.522	0.126	24.1%	0.411	0.142	34.5%
Polynesian Wattled Honeyeater†	12	531	668	72	0.681	0.119	17.5%	0.160	0.042	26.3%
Samoan Shrikebill*†	3	39	56	6	0.542	0.369	68.1%	0.288	0.261	90.6%
Samoan Starling*†	11	173	196	11	0.586	0.318	54.3%	0.107	0.081	75.7%

[1] Only data collected during the core breeding season (November-March) were included for the four (2013-2016) or three (2014-2016) seasons.
[2] Species included are those for which (a) an average of at least 2.5 individual adult birds were captured per year (season) over the three seasons, 2014-2016, (b) at least two between-year recaptures were recorded during the three seasons from all stations pooled, and (c) survival and recapture probabilities were neither 1.000 nor 0.000.
[3] Number of stations at which at least one adult individual of the species was captured.
[4] Number of adult individuals captured at stations where the species was a regular or usual breeder (i.e., number of capture histories).
[5] Total number of captures of adult birds of the species at stations where the species was a regular or usual breeder.

[6] Total number of between-year (between-season) recaptures, a recapture in a given season of a bird originally banded at the same station during a previous season.
[7] Survival probability (φ) presented as the maximum likelihood estimate (standard error of the estimate). Defined as the probability of an adult bird surviving to and returning in a particular year (breeding season) to the area where it was present in the previous season. The estimated probability (φ), standard error of the estimate (SE(φ)), and coefficient of variation (CV(φ)=100*SE(φ)/φ) are presented.
[8] Recapture probability (p) presented as the maximum likelihood estimate (standard error of the estimate). Defined as the conditional probability of recapturing an adult bird at least once in a particular year (breeding season), given that it did survive and return to the area where it was present in the previous season. The estimated probability (p), standard error of the estimate (SE(p)), and coefficient of variation (CV(p)) are presented.
[9] Proportion of residents (τ). The estimated proportion of residents among those newly-banded adults that were not recaptured seven or more days later during their first year (season) of capture. The estimated proportion (τ), standard error of the estimate (SE(τ)), and coefficient of variation (CV(τ)) are presented.
* The estimate for survival probability should be viewed with caution because it is based on fewer than five between-year (between-season) recaptures or the estimate is very imprecise (SE(φ)≥ 0.200 or CV(φ) ≥ 50.0%)
† The estimate for survival probability, recapture probability, or both may be biased low because for τ (proportion of residents) was set at 1.00.

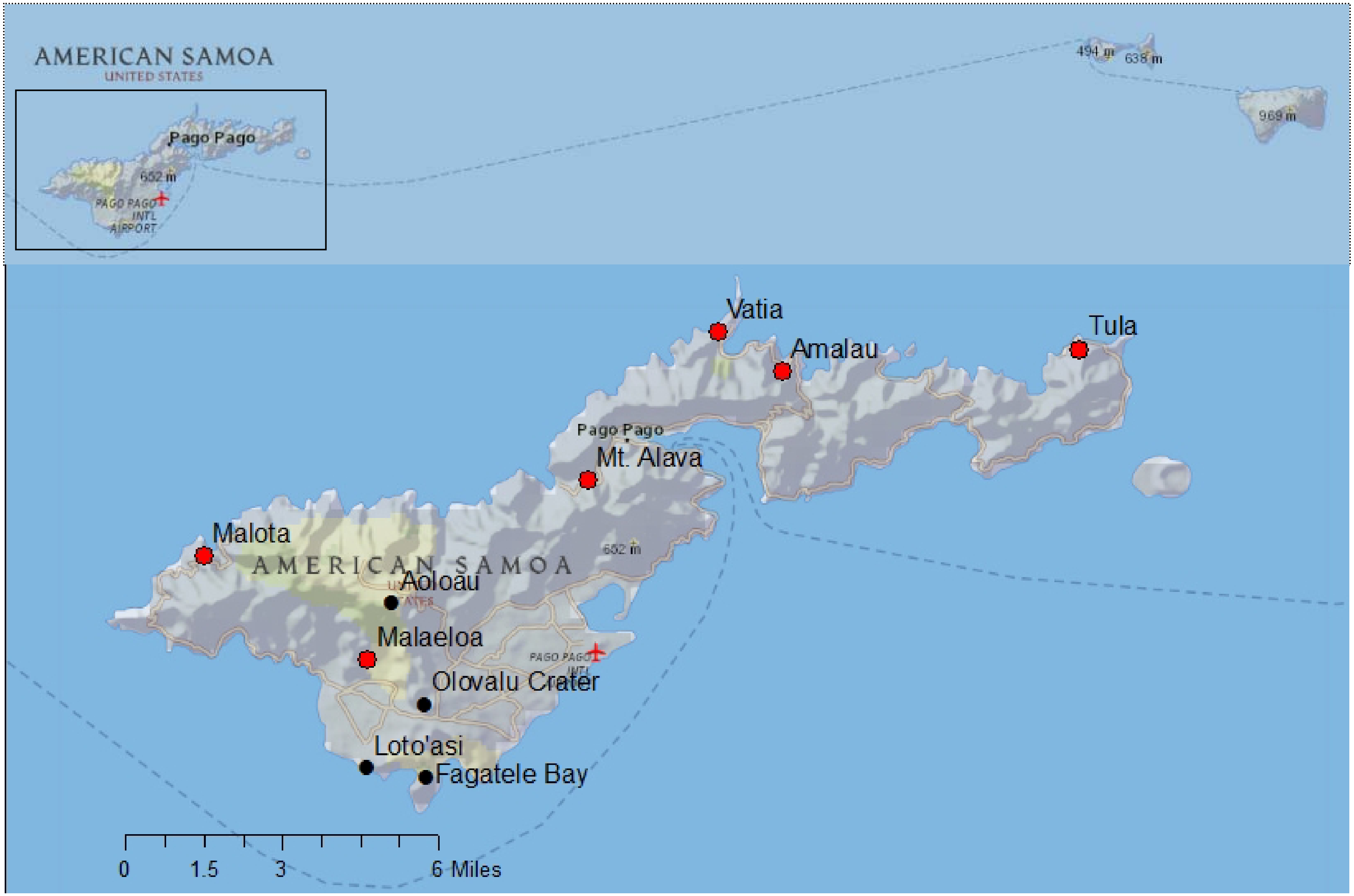

Figure 1. Locations of the ten Tropical Monitoring Avian Productivity and Survivorship (TMAPS) stations operated on Tutuila Island, American Samoa, from 2012 to 2016. Active (2016) stations are shown by red circles, non-active stations by black circles.

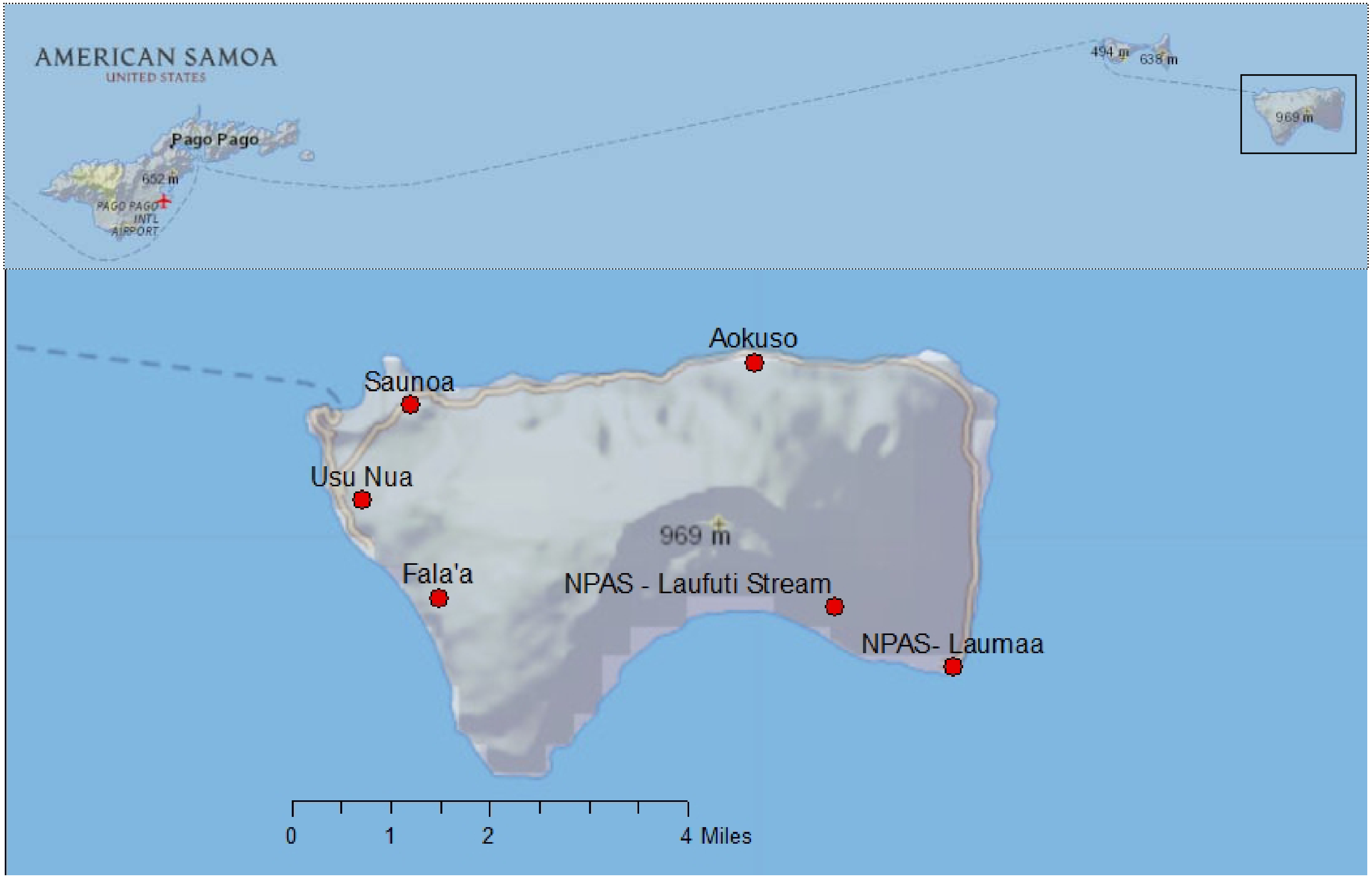

Figure 2. Locations of the six Tropical Monitoring Avian Productivity and Survivorship (TMAPS) stations operated on Tau island, American Samoa, during the 2014-2016 seasons.

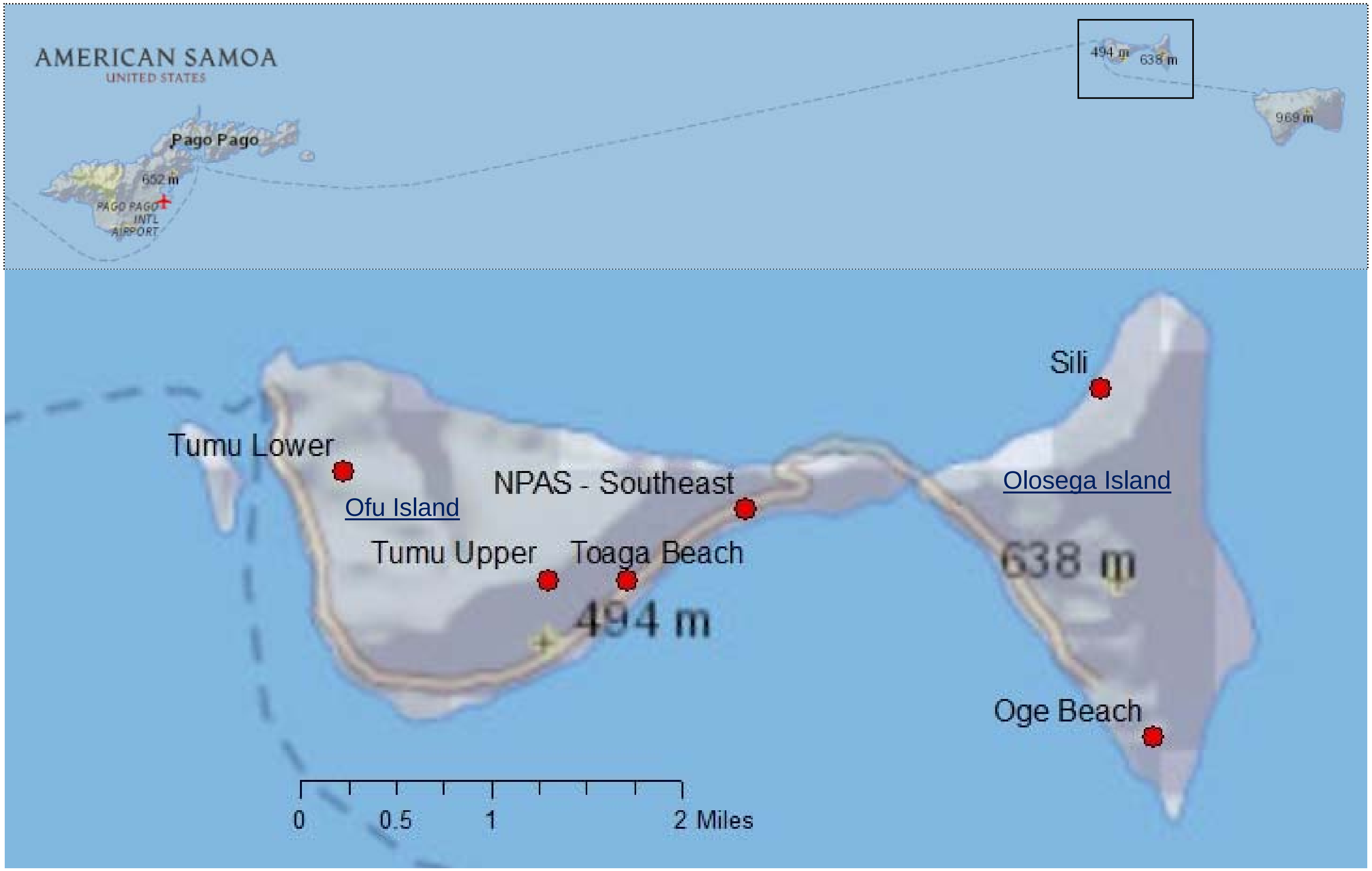

Figure 3. Locations of the six Tropical Monitoring Avian Productivity and Survivorship (TMAPS) stations operated on Ofu (left) and Olosega (right) islands, American Samoa, during the 2016 season.

Appendix I. Stations in which bird species (nomenclature and sequence of Gill and Donsker 2016) were banded during the American Samoa TMAPS Program during August 2012 to March 2016.

Common Name	**Scientific Name**	Vatia	Tula	Amalau	NPAS - Mt. Alava	Malota	Aoloau	Malaeloa	Olovalu Crater	Loto'asi	Fagatele Bay	Aokuso	Saunoa	Usu Nua	Fala'a	NPAS – Laufuti Stream	NPAS- Laumaa	Tumu Lower	NPAS- Southeast	Toaga Beach	Tumu Upper	Sili	Oge Beach
Buff-banded Rail	Gallirallus philippensis			X	X							X	X										
Purple Swamphen	Porphyrio porphyrio			X																			
Pacific Golden-Plover	Pluvialis fulva												X										
White Tern	Gygis alba				X																		
White-tailed Tropicbird	Phaethon lepturus							X															
Tongan Ground Dove	Alopecoenas stairi																	X	X	X		X	
Many-colored Fruit Dove	Ptilinopus perousii				X																		
Crimson-crowned Fruit Dove	Ptilinopus porphyraceus	X		X	X	X	X			X		X	X	X				X		X			
Pacific Imperial Pigeon	Ducula pacifica					X																X	
Long-tailed Cuckoo	Urodynamis taitensis		X			X										X							
White-rumped Swiftlet	Aerodramus spodiopygius				X			X					X	X									
Pacific Kingfisher	Todiramphus sace	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Blue-crowned Lorikeet	Vini australis											X	X	X									
Cardinal Honeyeater	Myzomela cardinalis	X			X	X	X			X													
Polynesian Wattled Honeyeater	Foulehaio carunculata	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Red-vented Bulbul	Pycnonotus cafer					X	X			X	X				X								
Samoan Shrikebill	Clytorhynchus powelli												X	X	X	X		X		X	X		
Polynesian Starling	Aplonis tabuensis	X		X	X	X	X	X					X	X	X	X	X				X		
Samoan Starling	Aplonis atrifusca	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Common Myna	Acridotheres tristis				X					X	X												
Jungle Myna	Acridotheres fuscus					X	X	X		X													