THE TROPICAL MONITORING AVIAN PRODUCTIVITY AND SURVIVORSHIP (TMAPS) PROGRAM ON SAIPAN, COMMONWEALTH OF THE NORTHERN MARIANA ISLANDS: 2008 REPORT

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EXECUTIVE SUMMARY

Few data exist on the ecology, population status, and conservation needs of landbirds of Saipan. In an effort to improve our understanding of this insular avifauna and to provide baseline population data for these species, we initiated the Tropical Monitoring Avian Productivity and Survivorship (TMAPS) program on the island in 2008. Long-term goals of this project are to: (1) provide annual indices of adult population size and post-fledging productivity (from constant-effort capture data); (2) provide annual estimates of adult population size, 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 managements actions in an adaptive management framework. Here we provide a summary of captures, indices of population size (capture rates), and productivity for TMAPS stations operated during the 2008 season.

We established six TMAPS stations in habitats typically used by landbirds of Saipan. Five of these stations (Bird Island Conservation Area [BICA], Laderan Tangke [LATA], Kingfisher [KIFI], Mount Tapochau [MTAP], and Obyan [OBYA]) were in forested habitats, which included tangantangan (*Leucaena leucocephala*) forest, tangantangan mixed with other evergreen forest types, and non-tangantangan evergreen forest. The sixth station, Sabana Talofofo (SATA) was in *Casuarina* savannah mixed with swordgrass thicket. Each station consisted of a sampling area of about 20 ha, within the central 8 ha of which we established 10 fixed mist-net sites. Mist nets were operated at these sites for approximately 6 morning hours on 10 days (per station) between 13 April and 17 July 2008. With few exceptions, all birds captured during the operation of stations were identified to species, age, and sex and, if unbanded, were banded with numbered aluminum leg bands. Band numbers of all recaptures were recorded. We also recorded the breeding status of all birds seen, heard, or banded at these monitoring stations.

We banded 977 birds of 11 species and recorded 249 recaptures at the six Saipan TMAPS stations in 2008. The most commonly captured species were Rufous Fantail (*Rhipidura rufifrons saipanensis*; 448 newly banded), Golden White-eye (*Cleptornis marchei*; 204 newly banded), Bridled White-eye (*Zosterops conspicillatus saypani*; 176 newly banded), Micronesian Honeyeater (*Myzomela rubrata*; 65 newly banded) and Collared Kingfisher (*Todiramphus chloris*; 48 newly banded). A large proportion of all birds were aged as adults (no. young/no. adults = 0.38 for all species combined), and most young birds were of a single species, Rufous Fantail. We found high variation among stations in numbers of birds captured, capture rates, and reproductive index values. Capture rates were highest at the two northerly stations, Bird Island Conservation Area (BICA; 282.0 birds/600 net-hours) and Laderan Tangke (LATA; 279.0 birds/600 net-hours) and lowest at Sabana Talofofo (SATA; 75.2 birds/600 net-hours. The reproductive index (no. young/no. adults) was highest at Mount Tapochau (MTAP; 0.59) and lowest at SATA (0.11).

Continuation of the current TMAPS sampling protocol will yield critical data on the survival, recruitment, and population growth rates for these birds. We suggest, however, that additional mist-netting throughout the year (for at least 1-2 pilot years) would better enable us to assess the annual cycle of resident landbirds and the optimal timing and extent of future TMAPS sampling. Continued monitoring and realization of TMAPS goals will aid identification of conservation needs and formulation of management plans for landbirds of Saipan. The need for such plans is pressing, given the many threats to the persistence of these populations.

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 focused on counts of birds with the principal goal of indexing abundance and estimating trends (Bart 2005). Monitoring of demographic rates (productivity, recruitment, survival) can lend additional insight by providing data on causes of population changes (DeSante et al. 2005). Because demographic rates are directly affected by environmental stressors or management actions, they should more accurately (compared to abundance) and sensitively reflect short-term and local environmental changes (Temple and Wiens 1989, DeSante and George 1994). In addition, demographic data can be used to identify stages of the life cycle that are most important for limiting bird populations (Green 1999, Peach et al. 1999, DeSante et al. 2001, Holmes 2007, Saracco et al. 2008). Finally, demographic data can be modeled as functions of environmental variables and incorporated into predictive population models to assess the viability of populations (Noon and Sauer 1992).

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). Such an effort was initiated in North America by The Institute for Bird Populations (IBP) in 1989 with the establishment of the Monitoring Avian Productivity and Survivorship (MAPS) program (DeSante 1992). The MAPS program is a cooperative network of nearly 500 constant-effort mist-netting stations operated across North America each summer; it provides demographic data for > 180 landbird species (DeSante and Kaschube 2007). 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 was endorsed in 1991 by the Monitoring Working Group of Partners in Flight (PIF) and the USDI Bird Banding Laboratory, and has attracted participation from many U.S. federal agencies, including the National Park Service, Department of Defense, Department of the Navy, Department of the Army, Texas Army National Guard, USDA Forest Service, and USDI Fish and Wildlife Service.

IBP, in collaboration with the Division of Fish and Wildlife of the Commonwealth of the Northern Mariana Islands, established and operated the first six “Tropical MAPS” (TMAPS) stations on the island of Saipan in spring/summer 2008. This effort aims to provide baseline data on landbird populations of Saipan and a sound foundation for developing informed conservation strategies for this 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 of adult population size, 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 managements actions in an adaptive management framework. Here we provide a summary of captures, indices of population size (capture rates), and productivity for TMAPS stations operated during the 2008 season.

STUDY AREAS AND METHODS

We established six TMAPS stations in typical habitats utilized by landbirds on Saipan (Table 1; Fig. 1). Each station consisted of a sampling area of about 20 ha. Within the central 8 ha of each station, 10 12-m long, 30-mm mesh, 4-tier nylon mist nets were erected at fixed net sites. Stations were operated according to the standardized protocol established by The Institute for Bird Populations for use in the MAPS Program (DeSante et al. 2008). We operated each station on 10 days (separated by about 10 days) between 13 April and 17 July 2008. Mist-netting effort data (i.e., the number and timing of net-hours on each day of operation) were collected in a standardized manner. Specifically, we recorded the time (to the nearest 10 min.) of opening and closing of the mist net array, as well as the time at which each net check was started. We aimed to operate nets for six morning hours per day (beginning at 05:30 AST). Inclement weather (mostly high sun and wind exposure) and very high capture rates at some sites, however, resulted in slightly less and variable effort among stations (Table 1). Station operation was carried out by JB and CC, who were trained in MAPS protocols by IBP staff biologist Amy Finfera.

With few exceptions, all birds captured were identified to species, age, and sex based on criteria outlined by Pyle et al. (2008) and, if unbanded, were banded with USGS/BRD numbered aluminum leg bands. 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. 2008):

- capture code (newly banded, recaptured, band changed, unbanded)
- band number
- species
- age and how aged
- 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.

Breeding (summer residency) status (confirmed breeder, likely breeder, non-breeder) of each species seen, heard, or captured at each MAPS station on each day of operation was recorded using techniques similar to those employed for breeding bird atlas projects (see Appendix). We used these data to classify each species at each station according to three residency categories: breeder, migrant, or transient (see Appendices I-III). Habitat data were collected following Nott

et al. (2003a), and using the vegetation classification system of Viereck et al. (1992). John W. Shipman of Zoological Data Processing, Socorro, NM, entered banding data. IBP staff biologists entered effort data and proofed and verified digitized banding data. Verification of banding data involved running all records through a series of specialized computer programs. These programs included:

- Clean-up programs to check the validity of all codes entered and the ranges of all numerical data.
- Cross-check programs to compare station, date, and net fields from the banding data with those from the effort and breeding status data.
- Cross-check programs to compare species, age, and sex determinations against degree of skull pneumaticization, breeding condition (extent of cloacal protuberance and brood patch), extent of juvenal plumage, extent of body and flight-feather molt, extent of primary-feather wear, and presence of molt limits and plumage characteristics.
- Screening programs which allow identification of unusual or duplicate band numbers or unusual band sizes for each species.
- Verification programs to screen banding and recapture data for inconsistent species, age, or sex determinations for each band number. Discrepancies or suspicious data identified by these programs were corrected if necessary. We used wing chord, body mass, fat content, date and station of capture, and pertinent notes as supplementary information for the correct determination of species, age, and sex.

For each species and for all species pooled at each location, we calculated (1) numbers of newly banded birds, recaptured birds, and birds released unbanded; (2) numbers and capture rates (per 600 net-hours) of first captures (in each year) for individual adult and young birds; and (3) the ratio of young to adult birds ("reproductive index"; Peach et al. 1996).

RESULTS

We banded 977 birds of 11 species during the 2008 TMAPS season on Saipan (Table 2). Of these, we recorded 249 recaptures. An additional 36 birds were captured and released unbanded. Five species were commonly captured. The most common species was the endemic subspecies of Rufous Fantail (*Rhipidura rufifrons saipanensis*), and both adult and young birds were well-represented in the mist-net sample for this species. The second and third most commonly captured species were the endemic Mariana white-eyes (Zosteropidae) – Golden White-eye (*Cleptornis marchei*) and Bridled White-eye (*Zosterops conspicillatus saypani*) – followed by the less frequently captured Micronesian Honeyeater (*Myzomela rubrata*) and Collared Kingfisher (*Todiramphus chloris*).

We found high variation in numbers of birds captured, capture rates, and reproductive index values among stations (Tables 3 and 4). Capture rates (adults and young combined) were highest at the two northerly stations, Bird Island Conservation Area (BICA; 282.0 birds/600 net-hours) and Laderan Tangke (LATA; 279.0 birds/600 net-hours) and lowest at Sabana Talofofo (SATA; 75.2 birds/600 net-hours. The reproductive index (no. young/no. adults) was highest at Mount Tapochau (MTAP; 0.59) and lowest at SATA (0.11).

DISCUSSION

The first year of the Tropical Monitoring Avian Productivity and Survivorship (TMAPS) program on Saipan was an unqualified success. Six monitoring stations, representing a range of terrestrial habitats typical in the region, were established across the length of the island; goals for mist-netting effort were met; and nearly 1,000 birds were banded. Extensive data on molt, plumage, breeding condition, skull pneumaticization, and morphometrics were also collected, and have provided a foundation for developing criteria for determining age and sex in these birds (Pyle et al. 2008).

The two northern sites, Bird Island Conservation Area (BICA) and Laderan Tangke (LATA), had higher capture rates (adult and young birds of all species combined) than the other four TMAPS stations. Rankings of sites by capture rates, however, differed among species. Sites with the highest capture rates of the four most commonly captured species were: Sabana Talofolo (SATA) for Micronesian Honeyeater, LATA for Rufous Fantail, Obyan (OBYA) for Bridled White-eye, and BICA for Golden White-eye. These differences reflect, in part, ecological differences among species. For example, Micronesian Honeyeaters are known to frequently utilize the exotic plant species, *Lantana camara*, which flowers year-round and is common at SATA (Craig 1996). High abundance of Golden White-eye at BICA could be due to proximity of this site to native limestone forest, where this species may be especially abundant (Craig 1996, Sachtleben 2005), and differences in abundance between the two white-eye species could reflect competitive exclusion (Craig and Beal 2001).

Productivity, as indexed by the ratio of the number of young to adult birds, was highest at the Mount Tapochau station (MTAP), intermediate at the other predominantly forested sites, and lowest at SATA, which was comprised of open *Cassuarina equisetifolia* savannah and swordgrass thicket. High productivity at MTAP could reflect habitat conditions of the larger landscape, which is heavily forested and contains a nearby remnant native limestone forest stand (Fig. 1), conditions that may be favored for nesting by many landbird species (Sachtleben 2005). Despite observed patterns in productivity, however, it must be noted that ratios of young to adult birds during the limited time period sampled by TMAPS may not be the best indicator of annual reproductive success. Many landbird species on Saipan, including all species commonly captured at TMAPS stations, can breed at any time of the year (Marshall 1949, Craig 1996, Pyle et al. 2008), and the potential lack of a single breeding peak suggests that the 'snapshot' provided by TMAPS may not accurately represent productivity.

Given the dearth of data on Micronesian landbirds (Rodda et al. 1998, Mosher and Fancy 2002, Sachtleben et al. 2006), establishment of the TMAPS program on Saipan represents a significant advance in improving our understanding of this insular avifauna. Continuation of the current sampling protocol will yield critical data on the survival, recruitment, and population growth rates of several endemic species or subspecies, such as Golden White-eye, Rufous Fantail, and Bridled White-eye. However, we suggest that regular mist-netting throughout the year (for at least 1-2 pilot years) would better enable us to assess (1) the annual cycle of resident landbirds and (2) the optimal timing and extent of future TMAPS sampling efforts. More extensive sampling would also improve our ability to accurately age and sex birds (Pyle et al. 2008). Accurate age and sex data are critical for identifying demographic structure in populations and

estimating age- and sex-specific demographic rates. Continued monitoring at the TMAPS stations and the realization of TMAPS goals will aid identification of conservation needs and formulation of management plans for Saipanese landbirds. The need for such plans is pressing given the many threats to the persistence of these populations (e.g., habitat loss, exotic predators such as brown treesnake [*Boiga irregularis*]; Rodda et al. 1998). We look forward to continuing this important work in the coming years.

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Table 1. Summary of the 2008 TMAPS program on the island of Saipan, Commonwealth of the Northern Marianas Islands (CNMI), Micronesia.

Station					2008 operation		
Name	Code	Major Habitat Type	Latitude-longitude	Avg Elev. (m)	Total number of net-hours	No. of periods	Inclusive dates
Bird Island Conservation Area	BICA	Lowland tropical evergreen tangantangan forest	15°15'45"N,145°48'50"E	30	572.33	10	04/17 – 07/16
Laderan Tangke	LATA	Lowland tropical evergreen tangantangan forest and lowland tropical rainforest	15°15'10"N,145°47'54"E	207	520.50	10	04/13 – 07/10
Sabana Talofofo	SATA	Tropical *Casuarina* savannah with dense swordgrass thicket	15°13'07"N,145°45'54"E	161	414.67	10	04/14 – 07/11
Kingfisher	KIFI	Lowland tropical broad-leaf evergreen rainforest with riparian zone	15°13'02"N,145°46'37"E	23	406.67	10	04/18 – 07/17
Mount Tapochau	MTAP	Submontane tropical mixed broad-leaf evergreen rainforest	15°11'01"N,145°44'04"E	274	421.67	10	04/16 – 07/15
Obyan	OBYA	Lowland tropical evergreen tangantangan forest	15°06'31"N,145°43'49"E	1	561.17	10	04/15 – 07/14
ALL STATIONS					2897.00	10	04/13 – 07/17

Table 2. Summary of combined results for all six Saipan TMAPS stations operated in 2008.

Species[1]	Birds captured			Birds/600 net-hours		
	Newly banded	Un-banded	Recap-tured	Adults	Young	Prop. Young
Philippine Turtle-Dove	4			0.8	0.0	0.00
White-throated Ground-Dove	16	5	1	2.3	0.8	0.36
Mariana Fruit-Dove	2			0.4	0.0	0.00
Collared Kingfisher	48	1	8	9.5	0.4	0.04
Micronesian Honeyeater	65		7	11.6	1.9	0.16
Rufous Fantail	448	14	187	42.0	42.9	1.02
Nightingale Reed-Warbler	4			0.8	0.0	0.00
Bridled White-eye	176	8	6	28.4	4.6	0.16
Golden White-eye	204	7	40	40.0	1.2	0.03
Micronesian Starling	9	1		1.9	0.0	0.00
Orange-cheeked Waxbill	1			0.2	0.0	0.00
ALL SPECIES POOLED	977	36	249	137.9	51.8	0.38
Total Number of Captures		1262				
Number of Species	11	6	6	11	6	
Total Number of Species		11			11	

[1] Scientific names given in Appendix.

Table 3. Capture summary for the six individual TMAPS stations operated on the island of Saipan, Commonwealth of the Northern Marianas Islands (CNMI), Micronesia, in 2008. N = Newly banded, U = Unbanded, R = Recaptures of banded birds.

	Bird Island Cons. Area			Laderan Tangke			Sabana Talofofo			Kingfisher			Mount Tapochau			Obyan		
Species[1]	N	U	R	N	U	R	N	U	R	N	U	R	N	U	R	N	U	R
Philippine Turtle-Dove	1			2									1					
White-throated Ground-Dove	8	2		1			1			4	3	1				2		
Mariana Fruit-Dove							2											
Collared Kingfisher	16		4	19	1	3				10		1	2			1		
Micronesian Honeyeater	25		2	5		1	26		4	2			3			4		
Rufous Fantail	119	4	54	137	4	62	7		2	32	1	10	45	2	18	108	3	41
Nightingale Reed-Warbler				2			2											
Bridled White-eye	32	2		49		2	10		2	2			27			56	6	2
Golden White-eye	83	6	18	44		10	5			25	1	7	37		3	10		2
Micronesian Starling	2			2			2			2	1					1		
Orange-cheeked Waxbill				1														
ALL SPECIES POOLED	286	14	78	262	5	78	55	0	8	77	6	19	115	2	21	182	9	45
Total Number of Captures		378			345			63			102			138			236	
Number of Species	8	4	4	10	2	5	8	0	3	7	4	4	6	1	2	7	2	3
Total Number of Species		8			10			8			7			6			7	

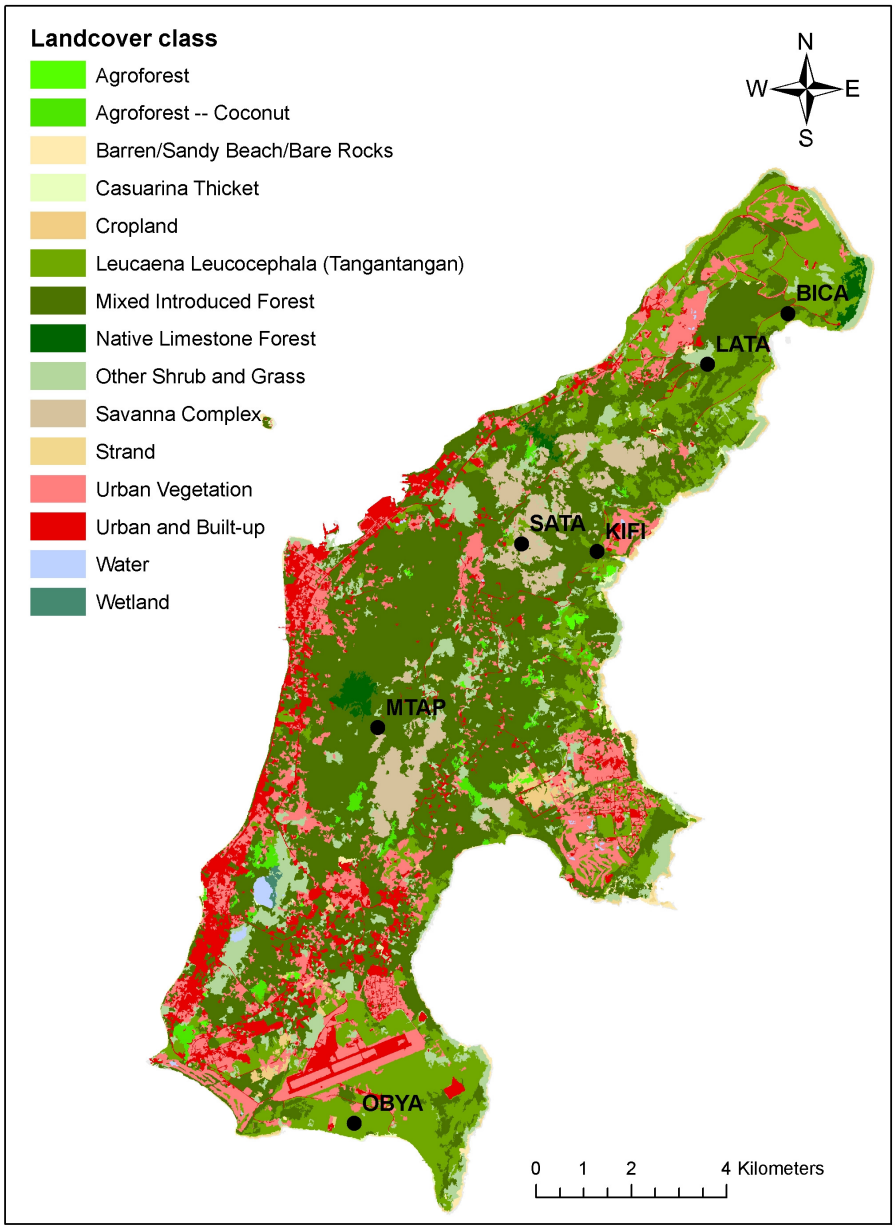
[1] Scientific names given in Appendix.

Table 4. Numbers of aged individual birds captured per 600 net-hours and proportion of young in the catch at the six individual TMAPS stations operated on the island of Saipan, Commonwealth of the Northern Marianas Islands (CNMI), Micronesia, in 2008.

	Bird Island Cons. Area			Laderan Tangke			Sabana Talofofo			Kingfisher			Mount Tapochau			Obyan		
Species[1]	Ad.	Yg.	Prop. Yg.	Ad.	Yg.	Prop. Yg.	Ad.	Yg.	Prop. Yg.	Ad.	Yg.	Prop. Yg.	Ad.	Yg.	Prop. Yg.	Ad.	Yg.	Prop. Yg.
Philippine Turtle-Dove	1.0	0.0	0.00	2.3	0.0	0.00							1.4	0.0	0.00			
White-throated Ground-Dove	5.2	3.1	0.60	1.2	0.0	0.00	0.0	0.0	0.00	5.9	0.0	0.00				1.1	1.1	1.00
Mariana Fruit-Dove							2.9	0.0	0.00									
Collared Kingfisher	16.8	0.0	0.00	19.6	2.3	0.12				14.8	0.0	0.00	2.8	0.0	0.00	1.1	0.0	0.00
Micronesian Honeyeater	24.1	2.1	0.09	6.9	0.0	0.00	31.8	5.8	0.18	3.0	0.0	0.00	2.8	1.4	0.50	2.1	2.1	1.00
Rufous Fantail	39.8	75.5	1.90	76.1	61.1	0.80	8.7	1.4	0.17	16.2	29.5	1.82	21.3	41.3	1.93	71.6	34.2	0.48
Nightingale Reed-Warbler				2.3	0.0	0.00	2.9	0.0	0.00									
Bridled White-eye	26.2	2.1	0.08	51.9	2.3	0.04	13.0	0.0	0.00	1.5	0.0	0.00	21.3	11.4	0.53	44.9	10.7	0.24
Golden White-eye	82.8	1.0	0.01	47.3	2.3	0.05	5.8	0.0	0.00	36.9	0.0	0.00	48.4	4.3	0.09	10.7	0.0	0.00
Micronesian Starling	2.1	0.0	0.00	2.3	0.0	0.00	2.9	0.0	0.00	3.0	0.0	0.00				1.1	0.0	0.00
Orange-cheeked Waxbill				1.2	0.0	0.00												
ALL SPECIES POOLED	198.1	83.9	0.42	211.0	68.0	0.32	68.0	7.2	0.11	81.1	29.5	0.36	98.2	58.3	0.59	132.6	48.1	0.36
Number of Species	8	5		10	4		7	2		7	1		6	4		7	4	
Total Number of Species		8			10			7			7			6			7	

[1] Scientific names given in Appendix.

Figure 1. Locations of the six Tropical Monitoring Avian Productivity and Survivorship (TMAPS) stations operated during 2008 on Saipan, Commonwealth of the Northern Mariana Islands, and distribution of land cover classes on the island. Station codes are listed in Table 1. Land cover data were obtained from the US Forest Service (for detail on methodology, see: http://www.fs.fed.us/r5/spf/fhp/fhm/landcover/islands/CNMI_Report.pdf).



Appendix. Numerical listing (in AOU checklist order) of species sequence numbers, species alpha codes, and species names for birds banded or encountered during the first year, 2008, of the TMAPS Program at the six stations on Saipan, Commonwealth of the Northern Marianas Islands (CNMI), Micronesia. Breeding status in 2008 is indicated by B (breeder) or T (transient).

NUMB	SPEC	SPECIES NAME	Bird Island Cons. Area (BICA)	Laderan Tangke (LATA)	Sabana Talofofo (SATA)	Kingfisher (KIFI)	Mount Tapochau (MTAP)	Obyan (OBYA)
00960	YEBI	Yellow Bittern (*Ixobrychus sinensis*)	T	B	B	T		T
05090	BRNO	Brown Noddy (*Anous stolidus*)			T			T
05120	WHTT	White Tern (*Gygis alba*)	T	T	B	T	T	B
99007	PHTD	Philippine Turtle-Dove (*Streptopelia bitorquata*)	B	B	B	B	B	B
99073	WTGD	White-throated Ground-Dove (*Gallicolumba xanthonura*)	B	B	B	B	B	
99006	MAFD	Mariana Fruit-Dove (*Ptilinopus roseicapilla*)	B	B	B	B	B	B
07490	MASW	Mariana Swiftlet (*Aerodramus bartschi*)	T	T	T	T	T	
99057	COLK	Collared Kingfisher (*Todiramphus chloris*)	B	B	B	B	B	B
99062	MIHO	Micronesian Honeyeater (*Myzomela rubratra*)	B	B	B	B	B	B
99063	RUFA	Rufous Fantail (*Rhipidura rufifrons*)	B	B	B	B	B	B
99053	NIRW	Nightingale Reed-Warbler (*Acrocephalus luscinia*)	B	B	B	B	B	B
99064	BRWE	Bridled White-eye (*Zosterops conspicillatus*)	B	B	B	B	B	B
99065	GOWE	Golden White-eye (*Cleptornis marchei*)	B	B	B	B	B	B
99066	MIST	Micronesian Starling (*Aplonis opaca*)	B	B	B	B	B	B
19990	OCHW	Orange-cheeked Waxbill (*Estrilda melpoda*)		B	B	B	B	B
19930	ETSP	Eurasian Tree Sparrow (*Passer montanus*)			B			