



Population Densities and Trends of Landbirds in the National Park of American Samoa



Manutagi or Crimson-crowned Fruit Dove (*Ptilinopus porphyraceus*) perched in a maota (*Didymocheton maota*).
NPS / SIMEONA LEO

Population Densities and Trends of Landbirds in the National Park of American Samoa

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Contents

	Page
Figures.....	v
Tables.....	vii
Appendices.....	ix
Abstract.....	x
Acknowledgments.....	xi
Introduction.....	1
Methods.....	4
Unit Descriptions.....	4
Ta‘ū Unit	5
Tutuila Unit	6
Training and Calibration.....	7
Landbird Sampling	8
Acoustic Sampling and Analysis.....	9
Data Analysis.....	10
Indices	10
Density Estimation	10
Habitat Sampling.....	11
Results.....	12
Population Change Between Surveys.....	14
Landbird Summaries	16
Australasian Swamphen	16
Blue-Crowned Lorikeet	16
Buff-Banded Rail.....	17
Crimson-Crowned Fruit Dove	17
Manu‘a Shrikebill.....	18
Many-Colored Fruit Dove	18
Pacific Imperial Pigeon	18
Pacific Kingfisher.....	19

Contents (continued)

	Page
Pacific Long-Tailed Cuckoo.....	20
Polynesian Starling.....	20
Polynesian Wattled Honeyeater	21
Red Junglefowl.....	22
Samoaan Myzomela	22
Samoaan Starling.....	23
White-Rumped Swiftlet.....	24
Acoustic Sampling Results.....	24
Undetected Landbird Species	24
Eastern Barn Owl	24
Spotless Crake	24
Tongan Ground Dove.....	24
Non-Native Birds.....	25
Seabird Observations.....	25
Ta‘ū Unit	25
Tutuila Unit	25
Habitat Description.....	25
Ta‘ū Unit	26
Tutuila Unit	27
Discussion	28
Landbirds.....	28
Habitat	31
Conclusions	32
Literature Cited	33

Figures

	Page
Figure 1. The Samoan Archipelago and the National Park of American Samoa. Base map from World Geodetic System (1984).....	5
Figure 2. Overview of 2023 landbird monitoring survey stations on Ta‘ū Island.	6
Figure 3. Overview of 2023 landbird monitoring survey stations on Tutuila Island.	7
Figure 4. Blue-crowned Lorikeet detections within the Ta‘ū Unit during the 2023 landbird survey.....	49
Figure 5. Buff-Banded Rail detections within the Ta‘ū Unit during the 2023 landbird survey.....	50
Figure 6. Buff-Banded Rail detections within the Tutuila Unit during the 2023 landbird survey.....	51
Figure 7. Crimson-crowned Fruit Dove detections within the Ta‘ū Unit during the 2023 landbird survey.....	52
Figure 8. Crimson-crowned Fruit Dove detections within the Tutuila Unit during the 2023 landbird survey.....	53
Figure 9. Manu‘a Shrikebill detections within the Ta‘ū Unit during the 2023 landbird survey.....	54
Figure 10. Many-colored Fruit Dove detections within the Ta‘ū Unit during the 2023 landbird survey.....	55
Figure 11. Many-colored Fruit Dove detections within the Tutuila Unit during the 2023 landbird survey.....	56
Figure 12. Pacific Imperial Pigeon detections within the Ta‘ū Unit during the 2023 landbird survey.....	57
Figure 13. Pacific Imperial Pigeon detections within the Tutuila Unit during the 2023 landbird survey.....	58
Figure 14. Pacific Kingfisher detections within the Ta‘ū Unit during the 2023 landbird survey.....	59
Figure 15. Pacific Kingfisher detections within the Tutuila Unit during the 2023 landbird survey.....	60
Figure 16. Polynesian Starling detections within the Ta‘ū Unit during the 2023 landbird survey.....	61
Figure 17. Polynesian Starling detections within the Tutuila Unit during the 2023 landbird survey.....	62

Figures (continued)

	Page
Figure 18. Polynesian Wattled Honeyeater detections within the Ta‘ū Unit during the 2023 landbird survey.....	63
Figure 19. Polynesian Wattled Honeyeater detections within the Tutuila Unit during the 2023 landbird survey.....	64
Figure 20. Red Junglefowl detections within the Ta‘ū Unit during the 2023 landbird survey.....	65
Figure 21. Red Junglefowl detections within the Tutuila Unit during the 2023 landbird survey.....	66
Figure 22. Samoan Myzomela detections within the Tutuila Unit during the 2023 landbird survey.....	67
Figure 23. Samoan Starling detections within the Ta‘ū Unit during the 2023 landbird survey.....	68
Figure 24. Samoan Starling detections within the Tutuila Unit during the 2023 landbird survey.....	69
Figure 25. White-rumped Swiftlet detections within the Ta‘ū Unit during the 2023 landbird survey.....	70
Figure 26. White-rumped Swiftlet detections within the Tutuila Unit during the 2023 landbird survey.....	71
Figure 27. Blue-crowned Lorikeet (Sega; <i>Vini australis</i>) calls (selected in red) recorded near the summit of Lata Mountain between July 22 and 27, 2023.	73
Figure 28. Polynesian Wattled Honeyeater (Iao; <i>Foulehaio carunculatus</i>) calls recorded near the summit of Lata Mountain between July 22 and 27, 2023.	74
Figure 29. Samoan Starling (Fuia; <i>Aplonis atrifusca</i>) calls (selected in blue and red) recorded near the summit of Lata Mountain between July 22 and 27, 2023.	75
Figure 30. A Tahiti Petrel (Ta‘i‘o; <i>Pseudobulweria rostrata</i>) call captured on 22 July, 2023 on Lata Mountain.....	76

Tables

	Page
Table 1. List of bird species detected on-count during the 2023 landbird surveys in the National Park of American Samoa.....	12
Table 2. Number of birds detected on-count, indices of bird occurrence (percent occurrence), and birds per station (BPS) in the Ta‘ū Unit and Tutuila Unit of the National Park of American Samoa in 2023.	13
Table 3. Differences and standard errors (SE) in bird densities in the Ta‘ū Unit and Tutuila Unit between 2018 and 2023.....	15
Table 4. Densities (birds/ha) and abundances (birds/unit) of the Blue-crowned Lorikeet within the Ta‘ū Unit in 2011, 2018, and 2023.	16
Table 5. Densities (birds/ha) and abundances (birds/unit) of the Crimson-crowned Fruit Dove within the Ta‘ū and Tutuila units in 2011, 2018, and 2023.	17
Table 6. Densities (birds/ha) and abundances (birds/unit) of the Pacific Imperial Pigeon within the Ta‘ū and Tutuila units in 2011, 2018, and 2023.	19
Table 7. Densities (birds/ha) and abundances (birds/unit) of the Pacific Kingfisher within the Ta‘ū and Tutuila units in 2011, 2018, and 2023.	19
Table 8. Densities (birds/ha) and abundances (birds/unit) of the Polynesian Starling within the Ta‘ū and Tutuila units in 2011, 2018, and 2023.	20
Table 9. Densities (birds/ha) and abundances (birds/unit) of the Polynesian Wattled Honeyeater within the Ta‘ū and Tutuila units in 2011, 2018, and 2023.....	21
Table 10. Density (birds/ha) and abundance (birds/unit) of the Samoan Myzomela within the Tutuila Unit in 2011, 2018, and 2023.	22
Table 11. Densities (birds/ha) and abundances (birds/unit) of the Samoan Starling within the Ta‘ū and Tutuila units in 2011, 2018, and 2023.	23
Table 12. Blue-crowned Lorikeet density estimate models.	45
Table 13. Crimson-crowned Fruit Dove density estimate models.	45
Table 14. Pacific Imperial Pigeon density estimate models.....	46
Table 15. Pacific Kingfisher density estimate models.	46
Table 16. Polynesian Starling density estimate models.	46
Table 17. Polynesian Wattled Honeyeater density estimate models.....	46
Table 18. Samoan Myzomela density estimate models.	47
Table 19. Samoan Starling density estimate models.....	47

Tables (continued)

	Page
Table 20. Dominant canopy species surveyed within the Ta‘ū Unit during the 2023 landbird survey.....	77
Table 21. Canopy cover classes of the Ta‘ū Unit landbird monitoring stations in 2023.	77
Table 22. Canopy height classes of the Ta‘ū Unit landbird monitoring stations in 2023.	77
Table 23. Dominant understory composition classes documented at landbird monitoring stations in the Ta‘ū Unit (50-m radius plot) in 2023.....	77
Table 24. Number of stations detected with invasive plant species and percent occurrence among landbird monitoring stations in the Ta‘ū Unit (50-m radius plot) in 2023.....	78
Table 25. (Co)dominant canopy species surveyed within the Tutuila Unit during the 2023 landbird survey.....	78
Table 26. Canopy cover classes of the Tutuila Unit landbird monitoring stations in 2023.	78
Table 27. Canopy height classes of the Tutuila Unit landbird monitoring stations in 2023.....	79
Table 28. Dominant understory composition classes documented at landbird monitoring stations in the Tutuila Unit (50-m radius plot) in 2023.....	79
Table 29. Number of stations detected with invasive plant species and percent occurrence among landbird monitoring stations in the Tutuila Unit (50-m radius plot) in 2023.....	79

Appendices

	Page
Appendix A: Akaike’s Information Criterion (AIC) Statistics: Weather, Temporal, and Geographical Covariates	45
Appendix B: Landbird Occurrence Maps	48
Appendix C: Acoustic Monitoring.....	72
Appendix D: Habitat Survey Results	77

Abstract

The National Park of American Samoa (NPSA), which protects some of the most intact tropical rainforest in the South Pacific, is exposed to recurring, intense tropical cyclones, including Tropical Cyclone Gita in 2018. In combination with other anthropogenic pressures, cyclones represent a potential source of disturbance to landbird populations, particularly native frugivorous and seed-dispersing species. Long-term monitoring provides a means to evaluate population trajectories following disturbance events and to identify potential management gaps. Landbird surveys were conducted in the Tutuila and Ta'ū units of NPSA in 2011, 2018, and 2023 using point-transect distance sampling, with vegetation composition and structure quantified at each sampling station. Species-specific detection functions were fitted to count data to estimate densities by unit, with variance estimated using bootstrap procedures. Comparisons of 2018 and 2023 density estimates using two-sample *z*-tests indicated that changes in most landbird populations were inconclusive. Since 2018, increases in density were observed for the Pacific Imperial Pigeon (*Ducula pacifica*) and Crimson-crowned Fruit Dove (*Ptilinopus porphyraceus*) on Tutuila, while decreases were observed for the Pacific Kingfisher (*Todiramphus sacer*) on Tutuila, and for the Polynesian Wattled Honeyeater (*Foulehaio carunculatus*), Polynesian Starling (*Aplonis tabuensis*), and Samoan Starling (*Aplonis atrifusca*) on Ta'ū. The Many-colored Fruit Dove (*Ptilinopus perousii*) remained rare in both units, and the Manu'a Shrikebill (*Clytorhynchus vitiensis powelli*) was narrowly distributed on Ta'ū, with insufficient detections of either species to estimate density. The cryptic Spotless Crake (*Zapornia tabuensis*) was detected only in 2018. Changes in tree canopy cover and height did not exhibit patterns clearly associated with a major disturbance event and likely reflected differences in sampling frames among surveys. Invasive non-native plants, most notably *Miconia crenata*, were widespread in both units. Although many landbird populations in NPSA remain abundant, inference from current monitoring is constrained by limited information on vital rates and species-specific responses to invasive species, disease, habitat change, and extreme weather. As climate change is projected to increase tropical cyclone intensity in the South Pacific, sustained monitoring and targeted management will be important for understanding and conserving landbird populations in American Samoa.

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Introduction

Oceania contains a large percentage of Earth's islands and their endemic biodiversity (Goulding et al. 2016; Kier et al. 2009; Whittaker et al. 2023), particularly birds (Lepage 2024; Steadman 2006). Despite comprising only 6.7% of Earth's land surface, oceanic islands support approximately 2,330—nearly one-fifth—of all bird species (Lepage 2024). Birds are strong indicators of regional endemism and species richness (Long et al. 1996). However, high rates of island endemism have also produced vulnerable flora and fauna and disproportionately high rates of bird extinction (Curnutt and Pimm 2001; Fernández-Palacios et al. 2021; GFANC 1997; Johnson and Stattersfield 1990; Whittaker et al. 2023). These patterns are widely attributed to habitat loss from agricultural expansion, biological resource extraction, invasive species, and climate change (Fernández-Palacios et al. 2021; Matthews et al. 2022; Steadman 2006; Whittaker et al. 2023).

Intrinsic factors further contribute to extinction risk. Geographically isolated species on small islands are especially likely to be threatened or extinct (Long et al. 1996; Pimm et al. 2014) due to restricted ranges and small population sizes (Diamond 1985; Steadman 2006). Habitat fragmentation has the most adverse effect on biodiversity in the smallest and most isolated forest fragments (Haddad et al. 2015). Evolution in the absence of native mammalian predators (Atkinson 1977) and disease (van Riper et al. 1986) has also favored traits such as tameness, low reproductive rates, flightlessness, ground-nesting, and disease susceptibility (Diamond 1985; Pratt 2009; Steadman 2006), increasing vulnerability to invasive species. Over time, these compounding effects have accelerated the rate of extinction relative to prehistoric levels, possibly by two orders of magnitude (Steadman 2006; Steadman et al. 1991).

Interacting synergistically with these threats, climate change is projected to disproportionately affect terrestrial endemic species, which are expected to experience impacts 2.7 times greater than indigenous species and 10 times greater than introduced species in abundance, range size, and taxonomic richness (Manes et al. 2021). More than one-third of studies documenting the conservation implications of climate change-driven extreme weather events revealed that wildlife populations and ecosystems did not recover to pre-disturbance levels, and that birds were especially hard-hit by cyclones (Maxwell et al. 2019). Pacific Islands are highly prone to tropical cyclones (Goulding et al. 2016; Kier et al. 2009; Steadman 2006), including Tropical Cyclone Gita which passed near Tutuila on 9–10 February 2018 (National Centers for Environmental Information 2018). Although Gita passed the islands as a moderate to severe tropical storm, it was particularly destructive on Tutuila, where 43 cm of rainfall and wind gusts up to 70 knots caused more than \$10 million in damage (Shieh 2019). Landbird habitat was affected by flooding, landslides, and wind damage (Pyle et al. 2018). While island biotas are often adapted to such recurring natural disturbance events (Powlesland et al. 2006), cyclones can drive populations to extinction when combined with anthropogenic range contractions and population declines (Goulding et al. 2016; Maxwell et al. 2019; Simberloff 2000). Climate change is increasing the severity of tropical cyclones in the South Pacific (IPCC 2023), posing an escalating threat to island bird populations.

The Samoan Archipelago supports 111 bird species (Lepage 2024) and has experienced frequent high-intensity cyclones, including several Category 4–5 storms over the past century (Chang et al. 2005; Deo et al. 2022). Despite this disturbance history, the National Park of American Samoa (NPSA) hosts some of the most intact tropical rain forests in the South Pacific (Webb et al. 1999) and the only paleotropical rainforests in the United States. As the only southern hemisphere unit of the U.S. National Park system, NPSA spans portions of the islands Tutuila, Ofu, and Ta‘ū. Although geologically young (Tutuila: Pliocene [1.5–1.0 Ma]; Ofu and Ta‘ū: Holocene [<0.012 Ma]; Harris et al. 1997; Neall and Trewick 2008), each island supports a diverse avifauna dominated by indigenous species. Of the 65 documented bird species, only five are introduced (O’Connor and Rauzon 2004; Watling 2001). Seabirds and shorebirds comprise approximately 60% of the avifauna, while 21 landbird species regularly occur in American Samoa, 18 of which are indigenous or endemic breeding species (Watling 2001).

Recent taxonomic revisions indicate that Samoan landbird diversity is greater than previously recognized, with several species and subspecies now understood to be restricted to the Samoan archipelago or individual island groups. The Samoan Myzomela (Segasegamau‘u; *Myzomela nigriventris*) is now recognized as a distinct species by the International Ornithologists’ Union (IOC; Gill et al. 2025), based on vocal and plumage differences from the formerly recognized *M. cardinalis* (Pratt and Mittermeier 2016). Two subspecies of the Pacific Kingfisher (Ti‘otala; *Todiramphus sacer*) are recognized in American Samoa: the Tutuila population (*T. s. pealei*) and the Manu‘a Islands population (*T. s. manuae*), which occurs on Ofu, Olosega, and Ta‘ū (Gill et al. 2025). Similarly, two subspecies of the Polynesian Starling (Miti Vao; *Aplonis tabuensis*) occur in American Samoa: *A. t. tutuilae* on Tutuila and *A. t. manuae* on the Manu‘a Islands (Gill et al. 2025). The Manu‘a Shrikebill (Sega‘olevau; *Clytorhynchus vitiensis powelli*), which is restricted to the Manu‘a Islands, has been proposed as a distinct species from the Fiji Shrikebill (*C. vitiensis*; Pratt 2010; Pratt and Mittermeier 2016), although this split is not currently recognized by the IOC. These revisions refine current understanding of the composition and biogeographic structure of American Samoa’s landbirds and provide important context for interpreting patterns of distribution and abundance.

The forests of NPSA support several range-restricted species and subspecies and contribute to key ecological functions, including pollination and seed dispersal of native rainforest plants (Craig 2009; Freifeld 1996, 1999; Webb et al. 1999). Landbird inventories and monitoring surveys by Amerson et al. (1982a, 1982b), Engbring and Ramsey (1989), the American Samoa Department of Marine and Wildlife Resources (DMWR; Freifeld 1999; Freifeld et al. 2004), and the Pacific Island Inventory and Monitoring Network (PACN; Judge et al. 2013, 2021, 2022) have provided detailed information describing American Samoa’s landbird composition, distribution, and abundance. Following Tropical Cyclones Ofa (1990) and Val (1991), DMWR documented widespread declines in landbird populations (Freifeld et al. 2004). Concurrently, the National Ecological Survey in Samoa reported extensive damage to approximately 80% of forest in conservation areas and declines in bird abundance (Lovegrove et al. 1992; Park 1992). The Pacific Imperial Pigeon (Lupe; *Ducula pacifica*), Crimson-crowned Fruit Dove (Manutagi; *Ptilinopus porphyraceus*), and Many-colored Fruit Dove (Manuma; *Ptilinopus perousii*) were particularly threatened by the cyclones due to forest defoliation increasing their vulnerability to hunting pressures and reducing their food resources. On Tutuila, the

Pacific Imperial Pigeon and Many-colored Fruit Dove were nearly extirpated under these synergistic threats, and in 1992 the American Samoan government enacted a hunting ban on native birds, which may have preserved these populations (Craig et al. 1994). The patchy distribution of the Many-colored Fruit Dove gradually expanded following the hunting restriction (Freifeld et al. 2004), but Cyclones Heta (2004) and Olaf (2005) likely induced further range contractions (Judge et al. 2022). Populations of the Pacific Imperial Pigeon appeared to rebound on Tutuila by 2011 (Judge et al. 2013).

Long-term population monitoring can be used to provide current population estimates and trends which may inform resource managers of the efficacy of ongoing conservation efforts and emergent needs. In 2011, PACN established transects for long-term monitoring of landbird trends in distribution, density, and abundance in the Ta'ū and Tutuila units of NPSA, including several of the transects surveyed by Engbring and Ramsey (1989). To date, these transects have been surveyed using point-transect distance sampling in 2011, 2018, and 2023. The baseline survey conducted seven years before Tropical Cyclone Gita (Judge et al. 2013) yielded sufficient detections to estimate densities (birds/ha) of seven species, which were similar to or higher than previous island-wide surveys on both Tutuila and Ta'ū (Amerson et al. 1982b; Engbring and Ramsey 1989; Freifeld 1999). From the second survey, occurring four to five months after Tropical Cyclone Gita, densities for these seven species were estimated again. Compared with 2011, differences in most bird populations were inconclusive, except for significant decreases in the Blue-crowned Lorikeet (Sega; *Vini australis*) on Ta'ū, and the Samoan Starling (Fuia; *Aplonis atrifusca*) on Tutuila (Judge et al. 2021). Several species, including the Samoan Myzomela, had too few detections to model densities. The shy and cryptic Spotless Crake (Vai; *Zapornia tabuensis*) was previously detected by Engbring and Engilis (1988), Rauzon and Fialua (2003), Adler et al. (2010), and again in 2018 (Judge et al. 2021). In addition to bird counts, surveyors also sampled several habitat variables, including canopy composition, height, and cover, as well as understory species composition and the presence of invasive plants.

The distribution and occurrence of landbirds in NPSA during 2023 are documented. For eight species with sufficient detections, unit-specific density estimates for the Ta'ū and Tutuila units are presented, and differences in densities between the 2018 and 2023 surveys are evaluated using two-sample *z*-tests. Landbird densities estimated in 2023 are qualitatively compared with 2011 estimates to avoid issues associated with multiple testing. Density estimates for the Samoan Myzomela are presented for the Tutuila Unit for the first time. Incidental detections of species infrequently observed during surveys are also reported, and occurrence and encounter rates are summarized for every species, including those with insufficient sample sizes to model densities. Changes in habitat structure and composition across surveys are evaluated, and potential drivers of observed population patterns and implications for landbird conservation in NPSA are described.

Methods

Unit Descriptions

The units of NPSA are separated across three islands in American Samoa: the island of Tutuila, and the islands Ofu and Ta'ū of the Manu'a Islands (115 km east of Tutuila; Figure 1). Landbird surveys were conducted by PACN in 2011, 2018, and 2023 in both the Ta'ū (2,229 ha) and Tutuila (1,021 ha) units. Landbird surveys were not conducted on the small and primarily coastal Ofu Unit because of its limited forest area. Characteristic of paleotropical rainforest, NPSA's forests feature a diversity of tree canopy species and complex vegetation structure. Endemic species comprise 30% of the total floral diversity of the Samoan Archipelago (Whistler 2002), which consists of approximately 225 ferns and 550 flowering plants, of which 250 are estimated to be tree species (Whistler 2004). Orchidaceae is the largest plant family with more than 100 species (Whistler 2004). Approximately 92% of NPSA's terrestrial units are forested, with the remainder largely vine scrub or marsh (Green et al. 2015). The forested area consists of lowland forest (49%), montane rain forest (45%), and coastal forest (6%; Green et al. 2015). Flowering and fruiting stands of *Syzygium inophylloides*, *Diospyros samoensis*, *Myristica inutilis*, *Didymocheton maota*, *Ficus obliqua*, *F. prolixa*, and *F. tinctoria* offer foraging opportunities for frugivorous landbirds, such as the Many-colored Fruit Dove (Amerson et al. 1982a; Freifeld 1996; Whistler 1992, 1994, 1995). The most invasive tree species in American Samoa are *Falcataria falcata*, *Adenanthera pavonina*, and *Syzygium samarangense* (Monello 2004). The most aggressive non-tree invasive species are *Miconia crenata* (formerly *Clidemia hirta*) and *Mikania micrantha*, both of which occur along disturbed areas; however, *M. crenata* has become established throughout NPSA (Judge et al. 2021; Monello 2004).

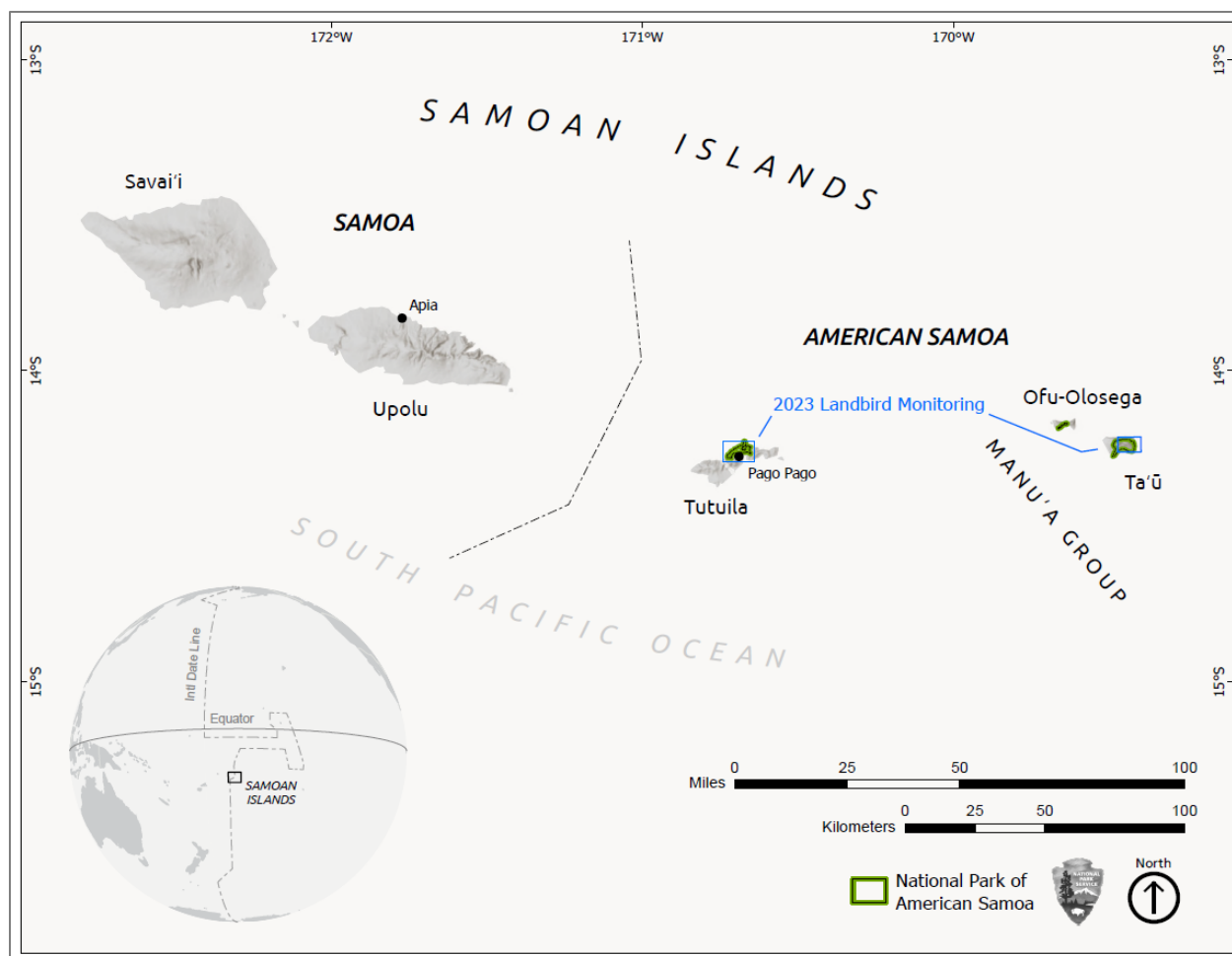


Figure 1. The Samoan Archipelago and the National Park of American Samoa. Base map from World Geodetic System (1984).

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Ta'ū Unit

Ta'ū Island is a small (4,431 ha) shield volcano, formed approximately 300,000 yr B.P. (Nunn 1998) and is the youngest high island in the Samoan Archipelago. It is sparsely populated with 675 residents estimated in 2020 (www.census.gov). Warm and humid, temperatures average 27°C and rainfall averages 2,400 mm/year (Whistler 2002). In NPSA, the Ta'ū Unit (2,229 ha) is roughly half of the entire island (Figure 2). Most of the field effort was based out of Fiti'uta, which is closer to the northeastern boundary. The unit is covered by dense and difficult to access forests that are infrequently traversed by visitors or residents. The slopes of Lata Mountain (966 m) and Mataālaosagamai Ridge descend precipitously to the south to the dramatic Liu Bench area.

Broadly, the predominant vegetation classes at landbird monitoring stations, as described by Green et al. (2015) include, in order of landcover: *Syzygium samoense* – *Pterophylla affinis* Forest, *Didymocheton* spp. – *Melanococca tomentosa* – *Alphitonia zizyphoides* Forest, *Didymocheton*

samoensis and *Didymocheton maota* Forest, *Syzygium inophylloides* – *Calophyllum* spp. Forest, and Cliff Scrub, i.e., cliff faces that were inaccessible and described by Whistler (2009).

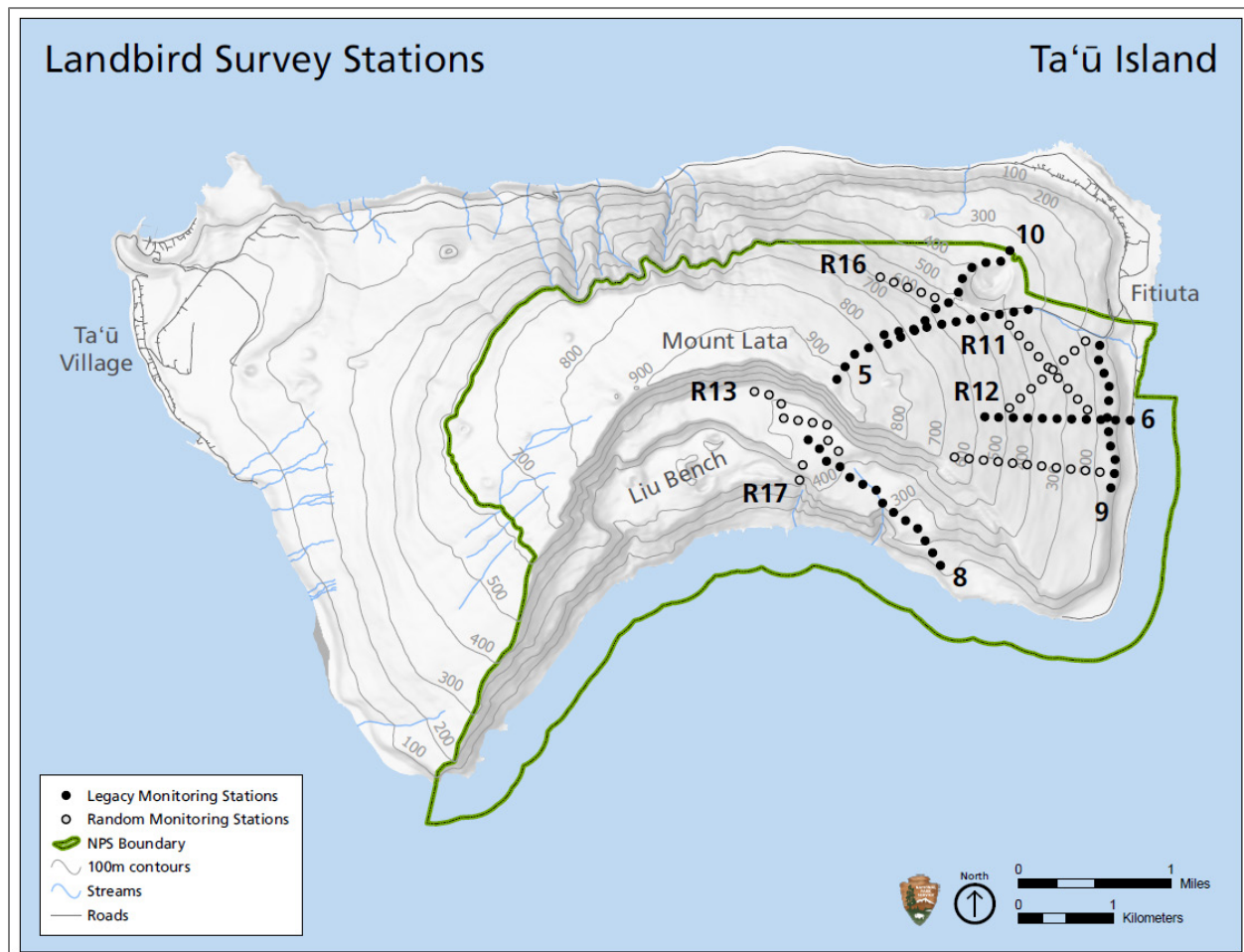


Figure 2. Overview of 2023 landbird monitoring survey stations on Ta'ū Island. Numbers represent transects, with random transects numbers preceded by an 'R'. Legacy transects are shown as filled circles, random as open circles. Base map from World Geodetic System (1984).

NPS

Tutuila Unit

Tutuila Island is the largest (14,500 ha) and most populated island in American Samoa (population estimated at 48,878 in 2020; www.census.gov). The island is dominated by numerous rugged volcanic slopes, the highest point being Matafao Peak (652 m). In NPSA, the Tutuila Unit is approximately 2,000 ha. The terrestrial area is 1,021 ha and comprised of steep north facing slopes and canyons (Figure 3). Dense forested ridges stretch towards the ocean from the summit of Alava Mountain (491 m) and Maugaloa Ridge. The villages of Afono, Vatia, and Fagasa border the eastern and western boundaries of the unit, separated by a steep and rocky coastline. Temperatures are warm, averaging 27°C, and annual rainfall is variable, ranging between 3,810 mm and 6,350 mm/year (<https://www.ncdc.noaa.gov>).

The predominant vegetation found at monitoring stations has been described, in order of landcover, as: *Didymocheton* spp., *Melanococca tomentosa*, and *Alphitonia zizyphoides* Forest, *Syzygium inophylloides* – *Calophyllum* spp. Forest, *Talipariti tiliaceum* Forest, Unvegetated (e.g., beach, bare soil, and large rocks), and *Melanococca tomentosa* Forest (Green et al. 2015).

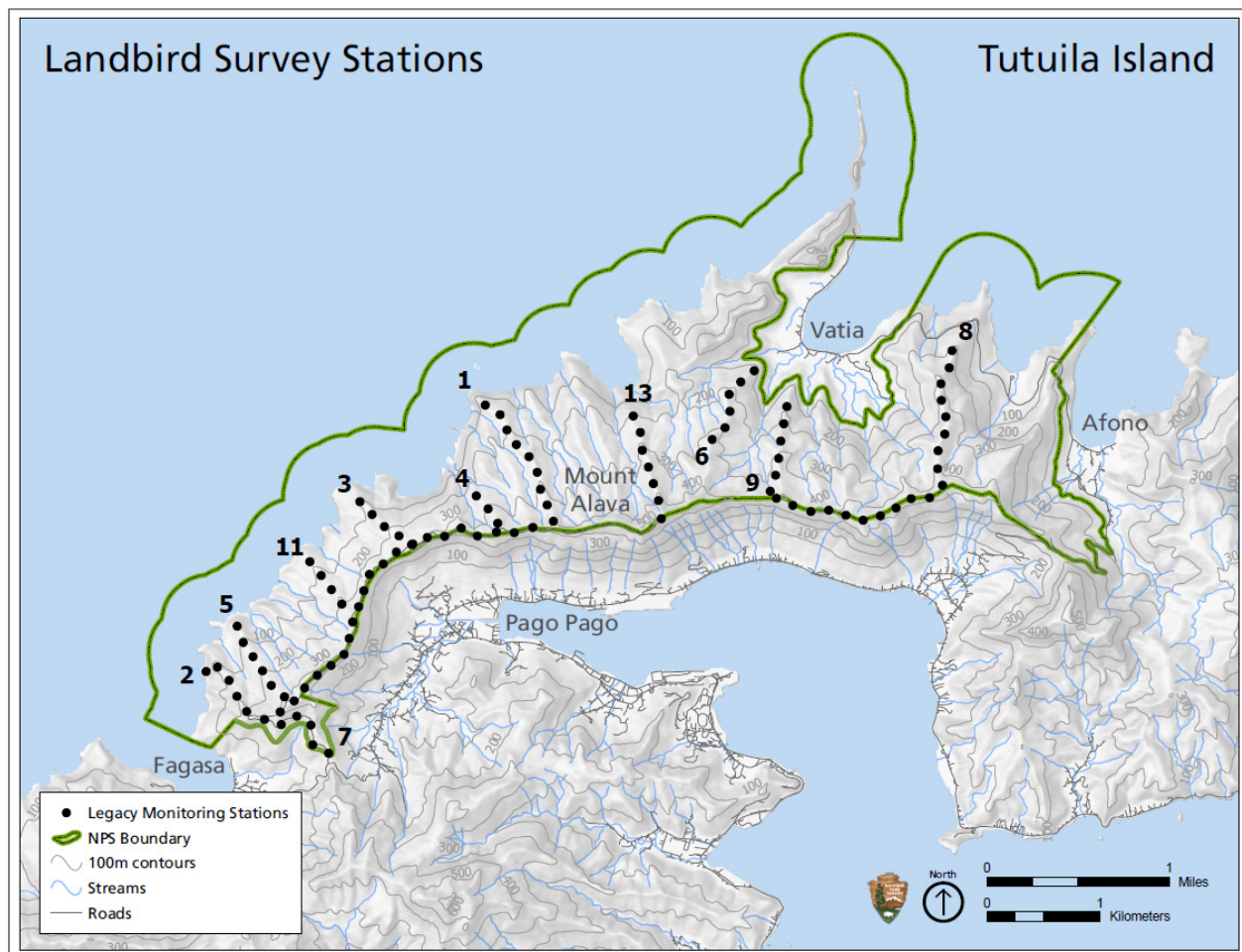


Figure 3. Overview of 2023 landbird monitoring survey stations on Tutuila Island. Numbers along the dotted lines represent legacy transects. Base map from World Geodetic System (1984).

NPS

Training and Calibration

Bird identification and calibration of distance estimation were conducted following the Landbirds Vital Sign Monitoring Protocol (hereafter, Protocol; Camp et al. 2011). Surveyors studied scientific literature to gain expertise in American Samoa's natural history. These included publications such as ecosystem surveys by Amerson et al. (1982a, 1982b), Engbring and Ramsey (1989), Freifeld (1999), and Freifeld et al. (2004), providing recent estimates of the population abundance and distribution of American Samoa's native and introduced landbird species. Books such as Craig's "Natural History Guide to American Samoa" (2009), Watling's "A guide to the birds of Fiji and Western Polynesia" (2001), and "A field guide to the birds of Hawai'i and the tropical Pacific" by Pratt et al. (1987)

provided images, life histories, and distributions of Samoa's avifauna. Audio recordings of birds were accessed on the free websites, <https://www.xeno-canto.org/> and <https://www.macaulaylibrary.org/>, and routinely listened to before arrival in American Samoa. Field identification and practice counts were conducted within and near the Tutuila Unit, consisting of visually confirming aural detections of birds, and comparing observations made during practice counts with those of an experienced primary.

The survey crew repeatedly practiced estimating distances. Before distance calibration, observers practiced estimating distances to flagged objects (trees, ferns, etc.) within a reasonable detection radius (100 m) and verified these by measuring those distances with rangefinders, as described in the Protocol (Camp et al. 2011). Differences between the actual and estimated distance were calculated, and calibration continued until crewmembers obtained an accuracy with less than 10% difference between the actual and estimated distances for more than 80% of their measurements. Distance measurements were practiced in a variety of habitats, such as open shrubland or dense forest, and on both sloped and level ground in the Tutuila Unit. During practice point counts, the new primary compared estimated distances to birds with those of the more experience primary for calibration. Rangefinders were kept on hand during actual surveys to verify distance estimates as needed.

Training for habitat data collection followed the Jacobi (1989) field methods outlined in the Protocol (Camp et al. 2011). Field guides by Amerson et al. (1982a), Whistler (1984, 1992, 1994, 1995, 2002, 2004), Webb (2011), and Webb et al. (1999, 2006), plus a new textbook by Whistler (2022) and the University of Hawai'i website "Higher Plants and Ferns of the National Park of American Samoa" (<http://www.botany.hawaii.edu/basch/uhnpscsu/htms/npsapln2/index.htm>) were studied beforehand to practice identification of American Samoa's flora.

Transects were navigated using GPS Units and magnetic compasses as prescribed in the Protocol (Camp et al. 2011). The Garmin 60CSX Units typically had an accuracy of 3 m to 6 m and stations were established within 1 m to 2 m from the given position preloaded into the GPS. Stations on legacy transects were marked with a metal tag attached by wire, indicating transect and station number as prescribed in the Protocol (Camp et al. 2011). Previous surveyors had marked legacy stations with tagged and anchored 1-m PVC pipes (refer to Judge et al. 2013, 2021), many of which had remained intact and visible.

Landbird Sampling

Landbirds were sampled in the forested portions of the Ta'u and Tutuila units in 2011, with surveys repeated in 2018 and 2023. On Tutuila, landbirds were sampled at 96 stations along 11 transects from June 15 to 29, 2023. On Ta'u, 106 stations along 11 transects were sampled from July 6 to 27, 2023. Landbird counts were initiated soon after dawn and were completed by 11:00 a.m. or earlier, when possible, to coincide with peak bird activity (Camp et al. 2011). Stations were spaced 150 m apart and were surveyed using point-transect sampling methods with eight-minute count durations. At each station, species identity, distance in meters from the observer to each detected bird, and detection type (seen, heard, or both) were recorded.

Point-transect distance sampling methods were used to estimate detection probabilities by modeling species-specific detection functions to derive absolute abundance estimates (Buckland et al. 2001, 2015). This methodology accounts for individuals that go undetected and produces unbiased estimates of absolute abundance when key assumptions are met, including that all birds are detected with certainty at the station center point, detections occur prior to any responsive movement, and distances are measured without error. In addition, weather conditions were recorded at each station and may be incorporated to improve precision in detection functions and abundance estimates. Further details of landbird sampling methods are provided in Camp et al. (2011).

The landbird sampling protocol differed from the 2011 and 2018 surveys in one respect: distances to juvenile birds were not recorded when individuals were visually confirmed or detected aurally based on begging calls. The presence of juvenile birds during counts was recorded, yielding five Polynesian Wattled Honeyeaters and one Samoan Starling, all detected on Tutuila. Given the asynchronous breeding season in Samoa and the small number of juveniles encountered, this deviation from the protocol was not considered to bias population estimates or increase uncertainty.

Acoustic Sampling and Analysis

To improve detection probability for rare species in this remote location, a Song Meter Mini (Wildlife Acoustics, Inc.) was deployed near the summit of Lata Mountain at approximately 1 m above ground level from 22 to 27 July 2023. A recording schedule consisting of two continuous sampling periods was used: from sunrise to 90 minutes after sunrise and from 90 minutes before sunset to three hours after sunset. Recordings were generated in .WAV format with a sampling rate of 44.1 kHz.

Sound recordings were visualized as spectrograms using Raven Pro version 1.5 (K. Lisa Yang Center for Conservation Bioacoustics at the Cornell Lab of Ornithology 2014), and the bird classification model Perch (<https://github.com/google-research/perch>) was used to search for vocalizations of rare species not detected during surveys, including Spotless Crake and Tongan Ground Dove (Tu'aimeo; *Pampusana stairi*), as well as seabird species such as Tahiti Petrel (Ta'i'o; *Pseudobulweria rostrata*).

Perch uses feature embedding, in which high-dimensional acoustic features are transformed into a lower-dimensional space using large-scale birdsong classifiers. This approach enables few-shot learning, allowing classification of bird vocalizations from a limited number of samples while leveraging information from previous classifications to improve performance through transfer learning. Archived vocalizations of Spotless Crake, Tongan Ground Dove, and Tahiti Petrel from the [Xeno-canto website](#) (Xeno-canto Foundation and Naturalis Biodiversity Center) were used as training data for Perch, which was subsequently applied to the acoustic recordings collected during this study. Five-second sliding windows with no overlap were used for automated detections, which were then validated by N. Hunt and A. Navine. Bayesian inference was used to estimate the number of likely true detections within the dataset, accounting for automated detections that were not true positives. All recordings were archived for future surveyor training and model development and are available upon request from the corresponding author (S. Judge).

Data Analysis

Indices

Indices of bird abundance were calculated for each species by island unit. Percent occurrence was calculated as the number of stations occupied divided by the total number of stations sampled within an island unit. Similarly, the encounter rate was calculated as the number of individuals detected divided by the total number of stations sampled (birds per station) within an island unit.

Density Estimation

Species-specific density estimates were calculated for eight species—Blue-crowned Lorikeet, Pacific Kingfisher, Pacific Imperial Pigeon, Crimson-crowned Fruit Dove, Polynesian Starling, Samoan Starling, Polynesian Wattled Honeyeater, and Samoan Myzomela—that had sufficient detections to adequately characterize detectability (Buckland et al. 2015) using the Distance package (version 1.0.8; Miller et al. 2019) in R (version 4.3.1; R Core Team 2024). The candidate detection function models were limited to half normal and hazard-rate detection functions with expansion series of order two (Buckland et al. 2001). Following recommendations by Buckland et al. (2001), the half normal was paired with cosine and Hermite polynomial adjustments, and the hazard-rate was paired with cosine and simple polynomial adjustments. Model precision was improved by incorporating sampling covariates in the multiple covariate distance sampling (MCDS) function of the Distance package. Covariates included cloud cover (estimated to the nearest 10%), rain intensity (measured on a designated scale of 0 to 4), wind intensity (measured on a Beaufort scale), gust intensity (also on a Beaufort scale), survey year, and island unit (Appendix A). All covariates were treated as a factor. Each detectability model in the candidate set was fit to data pooled across units for each species, and the model selected was that with the lowest Akaike's information criterion (AIC; Buckland et al. 2015; Appendix A). Data were truncated at distances used for the 2018 analyses (Judge et al. 2021), except when these negatively affected detection-function fit. In such cases, a truncation distance producing a detection probability of approximately 0.1 (based on a preliminary half-normal model) was applied. Truncation facilitated modeling by removing outliers and reducing the number of parameters required to modify the detection function. Species-specific densities by unit were estimated from the global detection function using post-stratification, and variances and confidence intervals were derived using bootstrap procedures in the *Distance* package with 999 iterations (Thomas et al. 2010). Absolute abundance was calculated as mean density weighted by unit area (2,229 ha for Ta'u; 1,021 ha for Tutuila) for each of the eight focal species. Differences in population density between the 2018 and 2023 surveys were evaluated for each unit using two-sample z-tests within an equivalence-testing framework following Camp et al. (2008). These analyses provided the sole basis for formal statistical inference regarding short-term population change in this study. Density estimates from the 2011 surveys were included for contextual comparison only and were not subjected to formal hypothesis testing against 2023 estimates. Instead, longer-term change was assessed qualitatively based on visual evaluation of overlap among 95% confidence intervals, consistent with the approach used in the Results and species accounts. Formal statistical comparisons between the 2011 and 2018 surveys are reported in Judge et al. (2021).

Habitat Sampling

Landbird habitat data were collected at each survey station following the methods described in Camp et al. (2011) to track changes within each unit in relation to overall bird density. This approach allowed evaluation of whether disturbance associated with Tropical Cyclone Gita was reflected in habitat conditions measured in 2018 and 2023. At each point-count station, a 50-m radius plot was established with the station serving as the plot center. Within each plot, dominant canopy composition, canopy height, and canopy cover were described. Understory composition was also described; because of the high plant diversity in most areas of NPSA, species were often grouped into broader vegetation classes following Jacobi (1989), including native shrubs, native ferns, introduced shrubs, and introduced grasses. Vegetation classes were recorded in order from dominant, co-dominant, to sub-dominant.

Canopy height was classified into three categories: class 1 (2–5 m), class 2 (6–10 m), and class 3 (>10 m). Canopy cover was classified into four categories: very scattered (<5%), scattered (5–25%), open (25–60%), and closed (>60%; Jacobi 1989). Habitat surveys were conducted either before or after completion of station counts or transect counts when returning along the same transect.

In 2011, surveyors collected detailed information of the vegetation prior to disturbance by Tropical Cyclone Gita, including presence or absence of common canopy and understory species (Judge et al. 2013). Prior to this, Liu et al. (2011) had made broad vegetation classifications of NPSA units such as Rain Forest, *Rhus* [*Melanococca*] Secondary Forest, Summit Scrub, and Secondary Scrub, although these were not used in the 2011 landbird analysis. Recordings of canopy composition, however, lumped species into very broad classifications such as Native Tree, Introduced Tree, etc.

In 2015, PACN and partners published a more comprehensive vegetation inventory of NPSA using 2012 satellite imagery, describing 23 vegetated map classes and three unvegetated map classes (Green et al. 2015). On-site collection of habitat data in the 2018 landbird survey occurred four to five months after Tropical Cyclone Gita and again described canopy species as broad classifications, as in 2011. For reporting, however, station locations were later overlaid in ArcMap GIS onto the vegetation classes from Green et al. (2015). The percentage of total stations surveyed within each vegetation map class were calculated to describe landbird habitat and to estimate the representation of vegetation classes that were surveyed (Judge et al. 2021). However, the imagery used by Green et al. (2015) pre-dated Tropical Cyclone Gita and therefore did not account for potential differences in vegetation composition and structure in the survey area pre- versus post-disturbance.

In the 2023 landbird survey, observers collected habitat data following the Jacobi (1989) method specified in the Landbird Monitoring Protocol (Camp et al. 2011), where canopy and understory plants were identified to species on-site, when possible. This may have improved the resolution for characterizing bird habitat and the vegetation community five years post-cyclone and can be used for future comparisons following the same methods. Due to differences in the resolution of habitat data collected in 2023 from 2011 and 2018, a qualitative analysis comparing vegetation composition and structure across survey years was conducted.

Results

During the 2023 survey, a total of 2,781 birds representing 13 landbird species were detected (Table 1). All detected species were indigenous or endemic to the Samoan Archipelago, except for nine detections of Red Junglefowl (*Gallus gallus*). Indices of percent occurrence and encounter rate (birds per station; BPS) were calculated for all detected species (Table 2). Sufficient detections were obtained to estimate densities for eight species and to compare density changes across fourteen populations. Density differences and species-specific density and abundance estimates are summarized by unit and survey year and are described in detail in subsequent sections of this report. A brief narrative summary is also provided for each detected species, describing distribution by unit and measures of occurrence and encounter rate where appropriate. Occurrence maps illustrating the extent and number of detections for each species are presented in Appendix B. Bird detection and habitat data are publicly available at the National Park Service Integrated Resource Management Applications (IRMA) Data Store (<https://irma.nps.gov/DataStore/Reference/Profile/2306625>).

Table 1. List of bird species detected on-count during the 2023 landbird surveys in the National Park of American Samoa. English and scientific names follow International Ornithologists' Union taxonomy (Gill et al. 2025). Origin codes are E = species-level endemic to the Samoan archipelago, I = indigenous (native but more widespread), and NN = non-native. For species with two subspecies listed, the Manu'a Islands subspecies is given first and the Tutuila subspecies second; both forms are treated as indigenous in this table.

English Name	Samoan Name	Scientific Name	Origin
Blue-crowned Lorikeet	Sega	<i>Vini australis goodsoni</i>	I
Buff-banded Rail	Ve'a	<i>Hypotaenidia philippensis</i>	I
Crimson-crowned Fruit Dove	Manutagi	<i>Ptilinopus porphyraceus fasciatus</i>	I
Manu'a Shrikebill	Sega'olevau	<i>Clytorhynchus vitiensis powelli</i>	I
Many-colored Fruit Dove	Manuma	<i>Ptilinopus perousii perousii</i>	I
Pacific Imperial Pigeon	Lupe	<i>Ducula pacifica pacifica</i>	I
Pacific Kingfisher	Ti'otala	<i>Todiramphus sacer manuae</i> <i>Todiramphus sacer pealei</i>	I
Polynesian Starling	Miti Vao	<i>Aplonis tabuensis manuae</i> <i>Aplonis tabuensis tutuilae</i>	I
Polynesian Wattled Honeyeater	Iao	<i>Foulehaio carunculatus</i>	I
Red Junglefowl	Moa	<i>Gallus gallus</i>	NN
Samoan Myzomela	Segasegamau'u	<i>Myzomela nigriventris</i>	E
Samoan Starling	Fuia	<i>Aplonis atrifusca</i>	E
White-rumped Swiftlet	Pe'ape'a	<i>Aerodramus spodiopygius spodiopygius</i>	I

Table 2. Number of birds detected on-count, indices of bird occurrence (percent occurrence), and birds per station (BPS) in the Ta'ū Unit and Tutuila Unit of the National Park of American Samoa in 2023.

Common Name	Total Detections	Ta'ū (106 Stations)				Tutuila (96 Stations)			
		Birds Detected	Stations Occupied	% Occurrence	BPS	Birds Detected	Stations Occupied	% Occurrence	BPS
Blue-crowned Lorikeet	21	21	15	14.2%	0.20	0	0	0	0
Buff-banded Rail	5	1	1	0.9%	0.01	4	4	4.2%	0.04
Crimson-crowned Fruit Dove	461	211	79	74.5%	1.99	250	90	93.8%	2.60
Manu'a Shrikebill	10	10	6	5.7%	0.09	0	0	0	0
Many-colored Fruit Dove	11	8	7	6.6%	0.08	3	3	3.1%	0.03
Pacific Imperial Pigeon	223	63	42	39.6%	0.59	160	73	76%	1.67
Pacific Kingfisher	53	25	20	18.9%	0.24	28	22	22.9%	0.29
Polynesian Starling	124	44	36	34.0%	0.42	80	52	54.2%	0.83
Polynesian Wattled Honeyeater	1,294	704	106	100%	6.64	590	96	100%	6.15
Red Junglefowl	9	6	6	5.7%	0.06	3	3	3.1%	0.03
Samoaan Myzomela	25	0	0	0	0	25	17	17.7%	0.26
Samoaan Starling	477	222	90	84.9%	2.09	255	92	95.8%	2.66
White-rumped Swiftlet	68	43	28	26.4%	0.41	25	18	18.8%	0.26

Population Change Between Surveys

Patterns of population change between the 2018 and 2023 surveys were mixed, and for most species–unit combinations, differences in estimated density were small relative to associated uncertainty (Table 3). High variability, with coefficients of variation approaching or exceeding 100% for several species, limited the ability to draw strong inferences about short-term trends. Significant decreases between 2018 and 2023 were observed for the Polynesian Starling, Polynesian Wattled Honeyeater, and Samoan Starling in the Ta‘ū Unit, and for the Pacific Kingfisher in the Tutuila Unit. In contrast, the Crimson-crowned Fruit Dove and Pacific Imperial Pigeon exhibited increases over this period in the Tutuila Unit.

Density estimates from the 2011 surveys are presented here for longer-term context only. Ninety-five percent confidence intervals for the 2011 and 2018 density estimates generally bracketed the corresponding point estimates reported in the previous analysis, except for the 2011 Tutuila estimate for the Polynesian Starling, which was adjusted upward from 5.36 ± 1.08 birds/ha to 8.73 ± 1.41 birds/ha. This adjustment did not affect interpretation in this report, as statistical comparisons were limited to density estimates from the 2018 and 2023 surveys.

Viewed over the full 12-year interval, several broad patterns emerged from qualitative comparison of 2011 and 2023 density estimates and their associated confidence intervals. Higher densities in 2023 with non-overlapping confidence intervals were observed for the Pacific Imperial Pigeon in both the Ta‘ū and Tutuila units and for the Samoan Myzomela in the Tutuila Unit. Densities of the Crimson-crowned Fruit Dove in both units and of the Pacific Kingfisher in the Ta‘ū Unit were lower in 2023 than in 2011; however, confidence intervals overlapped point estimates, indicating little change. In contrast, densities were lower in 2023 than in 2011 and confidence intervals did not overlap point estimates for the remaining eight species–unit combinations. These included the Blue-crowned Lorikeet in the Ta‘ū Unit; the Pacific Kingfisher in the Tutuila Unit; and the Polynesian Starling, Polynesian Wattled Honeyeater, and Samoan Starling in both units.

Table 3. Differences and standard errors (SE) in bird densities in the Ta'ū Unit and Tutuila Unit between 2018 and 2023. The null hypothesis that density has not changed over time was tested with a z-test. Equivalence tests were used to determine if the difference was within the threshold bounds (-0.0199, 0.0093) of a 25% change in density over 25 years. LCL and UCL = Lower and Upper 90% Confidence Intervals; LEL and UEL = Lower and Upper Equivalence Levels (t-values); LELp and UELp = Lower and Upper Equivalence Level p-values. Differences were interpreted as significant increase, significant decrease, or inconclusive.

Species	Unit	Difference	SE	LCL	UCL	z-test p	LEL	UEL	LELp	UELp	Result
Blue-crowned Lorikeet	Ta'ū	-0.70	0.37	-1.31	-0.09	0.06	1.72	-2.00	0.96	0.02	Inconclusive
Crimson-crowned Fruit Dove	Ta'ū	0.02	0.10	-0.15	0.19	0.84	-0.8	-0.27	0.21	0.40	Inconclusive
	Tutuila	0.45	0.10	0.28	0.62	<0.01	-4.95	3.92	<0.01	>0.99	Increase
Pacific Imperial Pigeon	Ta'ū	0.29	0.16	0.03	0.55	0.06	-2.24	1.56	0.01	0.94	Inconclusive
	Tutuila	1.17	0.30	0.68	1.66	<0.01	-3.88	4.02	<0.01	>0.99	Increase
Pacific Kingfisher	Ta'ū	<0.01	0.06	-0.10	0.10	>0.99	-1.02	-0.80	0.15	0.21	Inconclusive
	Tutuila	-0.12	0.06	-0.22	-0.02	0.04	1.04	-2.86	0.85	<0.01	Decrease
Polynesian Starling	Ta'ū	-4.04	0.93	-5.58	-2.51	<0.01	4.27	-4.38	>0.99	<0.01	Decrease
	Tutuila	-0.81	0.91	-2.31	0.69	0.37	0.82	-0.94	0.80	0.17	Inconclusive
Polynesian Wattled Honeyeater	Ta'ū	-7.48	3.42	-13.11	-1.85	0.03	2.17	-2.20	0.99	0.01	Decrease
	Tutuila	-5.80	3.37	-11.34	-0.26	0.09	1.7	-1.74	0.96	0.04	Inconclusive
Samoa Myzomela	Tutuila	-1.56	2.09	-4.99	1.87	0.46	0.72	-0.77	0.76	0.22	Inconclusive
Samoa Starling	Ta'ū	-1.93	0.80	-3.24	-0.62	0.02	2.35	-2.48	0.99	0.01	Decrease
	Tutuila	-0.18	0.81	-1.51	1.15	0.82	0.15	-0.28	0.56	0.39	Inconclusive

Landbird Summaries

Summaries for each species detected during the 2023 NPSA landbird surveys are presented below, including species incidentally detected off-count. For species with sufficient detections to evaluate recent population change, results from Table 3 are referenced in the summaries. Density (birds/ha) and abundance (birds/unit) estimates for 2011, 2018, and 2023, along with standard errors (SE) and 95% confidence intervals (95% CI), are presented in the accompanying tables. Density estimates from 2011 are included for temporal context; however, these were not statistically compared with 2023 estimates, and inference regarding longer-term change is based on evaluation of confidence interval overlap, as described previously. Formal statistical comparisons between the 2011 and 2018 surveys are reported in Judge et al. (2021). For species with insufficient detections to model density, qualitative comparisons of percent occurrence and encounter rate (birds per station; BPS) are provided relative to results from the 2011 and 2018 surveys reported in Judge et al. (2021). Occurrence maps in Appendix B display the spatial distribution and number of detections for each species in the Ta'ū Unit and Tutuila Unit during the 2023 survey.

Australasian Swamphen

Previously referred to as the Western Swamphen or Purple Swamphen (*Porphyrio porphyrio*), the swamphen found in American Samoa was later identified to be a subspecies of the Australasian Swamphen (*Porphyrio melanotus samoensis*; Gill et al. 2025). One Australasian Swamphen was detected off-count immediately following a survey near the summit of Lata Mountain on Ta'ū. All other detections were incidental in coastal and low elevation rainforests, primarily along roadsides and in agroforestry areas outside park boundaries.

Blue-Crowned Lorikeet

Absent on Tutuila Island, the Blue-crowned Lorikeet occurred at 14.2% of stations surveyed on Ta'ū, with an encounter rate of 0.20 birds per station (BPS; Table 2). Estimated density in the Ta'ū Unit was 0.41 ± 0.13 birds/ha, corresponding to an abundance of 914 ± 285 birds (Table 4). Changes in density between 2018 and 2023 were inconclusive, despite an estimated decrease of -0.70 ± 0.37 birds/ha (Table 3). A significant decrease in density between 2011 and 2018 was previously reported by Judge et al. (2021). Relative to 2011, densities in 2023 were lower, and confidence intervals did not overlap point estimates, suggesting continued decreasing densities over the 12-year interval (Table 4). Detections in 2023 were concentrated primarily along the trail to the summit of Lata Mountain, with additional detections above Saua and near Laufuti Beach (Appendix B). The species was also commonly observed in coastal and residential areas outside park boundaries.

Table 4. Densities (birds/ha) and abundances (birds/unit) of the Blue-crowned Lorikeet within the Ta'ū Unit in 2011, 2018, and 2023. Standard errors (SE) and 95% confidence intervals (95% CI) are presented. Total abundance was calculated as mean density weighted by unit area (2,229 ha).

Unit	Year	Density: Birds/ha ± SE (95%CI)	Abundance: Birds/Unit Area ± SE (95%CI)
Ta'ū	2011	3.82 ± 0.71 (2.46–5.25)	$8,523 \pm 1,575$ (5,486–11,695)

Table 4 (continued). Densities (birds/ha) and abundances (birds/unit) of the Blue-crowned Lorikeet within the Ta'ū Unit in 2011, 2018, and 2023. Standard errors (SE) and 95% confidence intervals (95% CI) are presented. Total abundance was calculated as mean density weighted by unit area (2,229 ha).

Unit	Year	Density: Birds/ha ± SE (95%CI)	Abundance: Birds/Unit Area ± SE (95%CI)
Ta'ū (cont.)	2018	1.11 ± 0.35 (0.47–1.83)	2,475 ± 791 (1,059– 4,068)
	2023	0.41 ± 0.13 (0.20–0.71)	914 ± 285 (439–1,579)

Buff-Banded Rail

The Buff-banded Rail occurred at 0.9% and 4.2% of the Ta'ū and Tutuila Unit stations, with encounter rates of 0.01 and 0.04 BPS, respectively (Table 2). The single on-count detection on Ta'ū was in a thicket of *Freycinetia* spp. near the summit of Lata Mountain (Appendix B). On Tutuila, the four detections were on or near the jeep trail on Maugaloa Ridge, or on sections of Transect 8 comprising the Mount Alava Adventure Trail (Appendix B). Most incidental detections were below 300 m elevation in agricultural areas near the forest edge where the species forages for insects. As in previous surveys, detections were too few to estimate density and abundance.

Crimson-Crowned Fruit Dove

The Crimson-crowned Fruit Dove was widely distributed across both units, occurring at 74.5% of stations on Ta'ū and 93.8% of stations surveyed on Tutuila (Table 2; Appendix B), with encounter rates of 1.99 and 2.60 BPS, respectively. Estimated densities were 0.43 ± 0.06 birds/ha on Ta'ū and 0.87 ± 0.09 birds/ha on Tutuila, corresponding to abundance estimates of 954 ± 138 birds and 889 ± 94 birds, respectively (Table 5). Changes in density since 2018 were inconclusive on Ta'ū, with a minimal increase of $+0.02 \pm 0.10$ birds/ha, but increased significantly on Tutuila, with an increase of $+0.45 \pm 0.10$ birds/ha (Table 3). Although densities in both units were lower in 2023 than in 2011, confidence intervals overlapped point estimates, indicating little change over the 12-year interval (Table 5).

Table 5. Densities (birds/ha) and abundances (birds/unit) of the Crimson-crowned Fruit Dove within the Ta'ū and Tutuila units in 2011, 2018, and 2023. Standard errors (SE) and 95% confidence intervals (95% CI) are presented. Total abundance was calculated as mean density weighted by unit area (Ta'ū: 2,229 ha; Tutuila: 1,021 ha).

Unit	Year	Density: Birds/ha ± SE (95%CI)	Abundance: Birds/Unit Area ± SE (95%CI)
Ta'ū	2011	0.55 ± 0.08 (0.40–0.72)	1,222 ± 173 (903–1,599)
	2018	0.41 ± 0.08 (0.26–0.57)	918 ± 179 (585–1,268)
	2023	0.43 ± 0.06 (0.32–0.56)	954 ± 138 (705–1,246)

Table 5 (continued). Densities (birds/ha) and abundances (birds/unit) of the Crimson-crowned Fruit Dove within the Ta'ū and Tutuila units in 2011, 2018, and 2023. Standard errors (SE) and 95% confidence intervals (95% CI) are presented. Total abundance was calculated as mean density weighted by unit area (Ta'ū: 2,229 ha; Tutuila: 1,021 ha).

Unit	Year	Density: Birds/ha ± SE (95%CI)	Abundance: Birds/Unit Area ± SE (95%CI)
Tutuila	2011	1.00 ± 0.12 (0.77–1.25)	1,023 ± 119 (791–1,276)
	2018	0.42 ± 0.05 (0.32–0.52)	425 ± 54 (323–532)
	2023	0.87 ± 0.09 (0.70–1.06)	889 ± 94 (718–1,079)

Manu'a Shrikebill

The Manu'a Shrikebill was detected only in *Cyathea* spp., *Syzygium* spp., and *Melanococca tomentosa*-dominated canopies within the Liu Bench area of Ta'ū, with 10 individuals detected on-count (Table 2; Appendix B). The species occurred at 5.7% of stations surveyed in the Ta'ū Unit at 0.09 BPS, which was consistent with 2011 and 2018. A fledgling with parents was detected off-count near Station 11 on Transect 8.

Many-Colored Fruit Dove

The Many-colored Fruit Dove occurred at 6.6% and 3.1% of the Ta'ū and Tutuila Unit stations, with encounter rates of 0.08 and 0.03 BPS respectively (Table 2). Encounter rates were slightly higher in 2023 than in previous years (Judge et al. 2021). On Ta'ū, the species exhibited a restricted distribution, limited to a narrow area spanning Transects 11 and 12 (Appendix B). Eight individuals were detected on-count beneath *Didymocheton gaudichaudianus*, *Elattostachys falcata*, *Sterculia fanaiho*, and *Syzygium* spp. canopy between Judds Crater and a coastal rock quarry (Table 2). In the Tutuila Unit, three detections occurred at lower elevations along two ridges comprising Transects 1 and 3 (Appendix B), where higher densities of *Ficus* trees were present.

Pacific Imperial Pigeon

The Pacific Imperial Pigeon was common in forests with canopy heights >10 m, occurring at 39.6% of stations surveyed on the Ta'ū Unit and 76% of stations on the Tutuila Unit, with encounter rates of 0.59 and 1.67 BPS, respectively (Table 2). In both units, occurrence was lower at higher elevations (Appendix B). Estimated densities on Ta'ū were 0.71 ± 0.12 birds/ha, corresponding to an abundance of $1,577 \pm 271$ birds (Table 6). On Tutuila, density was estimated at 2.07 ± 0.27 birds/ha, with an abundance of $2,110 \pm 276$ birds in 2023. Changes in density since 2018 were inconclusive on Ta'ū, with an estimated increase of $+0.29 \pm 0.16$ birds/ha, but showed a significant increase on Tutuila, with an increase of $+1.17 \pm 0.30$ birds/ha (Table 3). Densities in both units were higher in 2023 than in 2011, and confidence intervals did not overlap point estimates, indicating increases over the 12-year interval (Table 6).

Table 6. Densities (birds/ha) and abundances (birds/unit) of the Pacific Imperial Pigeon within the Ta'ū and Tutuila units in 2011, 2018, and 2023. Standard errors (SE) and 95% confidence intervals (95% CI) are presented. Total abundance was calculated as mean density weighted by unit area (Ta'ū: 2,229 ha; Tutuila: 1,021 ha).

Unit	Year	Density: Birds/ha ± SE (95%CI)	Abundance: Birds/Unit Area ± SE (95%CI)
Ta'ū	2011	0.24 ± 0.06 (0.14–0.36)	542 ± 125 (313–795)
	2018	0.42 ± 0.10 (0.24–0.63)	932 ± 224 (535–1,410)
	2023	0.71 ± 0.12 (0.47–0.94)	1,577 ± 271 (1,058–2,104)
Tutuila	2011	1.04 ± 0.14 (0.78–1.33)	1,062 ± 146 (800–1,353)
	2018	0.90 ± 0.12 (0.67–1.14)	915 ± 121 (688–1,164)
	2023	2.07 ± 0.27 (1.58–2.63)	2,110 ± 276 (1,618–2,687)

Pacific Kingfisher

The Pacific Kingfisher occurred at 18.9% of stations surveyed on Ta'ū and 22.9% of stations on Tutuila (Table 2), with encounter rates of 0.24 and 0.29 BPS, respectively. On Ta'ū, most detections occurred between sea level and 300 m elevation (Appendix B), whereas detections on Tutuila were broadly distributed across all elevations (Appendix B). Estimated density on Ta'ū was 0.09 ± 0.03 birds/ha, corresponding to an abundance of 197 ± 67 birds (Table 7). On Tutuila, estimated density was 0.08 ± 0.03 birds/ha, with an abundance of 84 ± 27 birds. Changes in density between 2018 and 2023 were inconclusive on Ta'ū, with an estimated difference of $<0.01 \pm 0.06$ birds/ha, but a significant decrease of -0.12 ± 0.06 birds/ha was observed on Tutuila (Table 3). Relative to 2011, densities in the Ta'ū Unit were lower in 2023, but confidence intervals overlapped point estimates, indicating little change over the 12-year interval. In contrast, densities in the Tutuila Unit were lower in 2023 than in 2011, and confidence intervals did not overlap point estimates, suggesting a sustained decrease in densities.

Table 7. Densities (birds/ha) and abundances (birds/unit) of the Pacific Kingfisher within the Ta'ū and Tutuila units in 2011, 2018, and 2023. Standard errors (SE) and 95% confidence intervals (95% CI) are presented. Total abundance was calculated as mean density weighted by unit area (Ta'ū: 2,229 ha; Tutuila: 1,021 ha).

Unit	Year	Density: Birds/ha ± SE (95%CI)	Abundance: Birds/Unit Area ± SE (95%CI)
Ta'ū	2011	0.13 ± 0.04 (0.06–0.23)	284 ± 100 (125–506)
	2018	0.09 ± 0.05 (0.02–0.20)	201 ± 102 (36–441)

Table 7 (continued). Densities (birds/ha) and abundances (birds/unit) of the Pacific Kingfisher within the Ta'ū and Tutuila units in 2011, 2018, and 2023. Standard errors (SE) and 95% confidence intervals (95% CI) are presented. Total abundance was calculated as mean density weighted by unit area (Ta'ū: 2,229 ha; Tutuila: 1,021 ha).

Unit	Year	Density: Birds/ha ± SE (95%CI)	Abundance: Birds/Unit Area ± SE (95%CI)
Ta'ū (cont.)	2023	0.09 ± 0.03 (0.04–0.16)	197 ± 67 (86–348)
Tutuila	2011	0.36 ± 0.08 (0.22–0.53)	364 ± 81 (225–544)
	2018	0.20 ± 0.05 (0.11–0.3)	200 ± 49 (114–307)
	2023	0.08 ± 0.03 (0.04–0.14)	84 ± 27 (40–145)

Pacific Long-Tailed Cuckoo

In 2023, a single Pacific Long-tailed Cuckoo (*Alewa*; *Urodynamis taitensis*) was incidentally discovered being mobbed by Polynesian Wattled Honeyeaters on Tutuila Legacy Transect 7 (the Jeep Road to Alava Mountain), near station 6. Similarly, in 2011, a single individual was incidentally seen and heard on Ta'ū, just outside the park boundary on the trail near Judds Crater. The species was not detected incidentally or during surveys in 2018 (Judge et al. 2021). This migratory species breeds in New Zealand and migrates north to spend winter months in Polynesia. Shy and secretive, the species was considered an uncommon migrant and population estimates have not been determined in American Samoa (Amerson et al. 1982b; Engbring and Ramsey 1989).

Polynesian Starling

The Polynesian Starling was broadly distributed, occurring at 34% of stations surveyed on Ta'ū and 54.2% of stations on Tutuila (Appendix B), with encounter rates of 0.42 and 0.83 BPS, respectively (Table 2). Density in the Ta'ū Unit was 0.81 ± 0.23 birds/ha for an estimated abundance of $1,795 \pm 519$ birds (Table 8). In the Tutuila Unit, density was 2.83 ± 0.55 birds/ha with an abundance of $2,891 \pm 565$ birds. There was a significant decrease in the Ta'ū Unit with an estimated -4.04 ± 0.93 birds/ha decrease, and differences were inconclusive on Tutuila, despite a -0.81 ± 0.91 bird/ha decrease compared to 2018 estimates (Table 3). Densities were lower in 2023 than in 2011 and the confidence intervals did not overlap the point estimates, indicating a sustained decrease in both units (Table 8).

Table 8. Densities (birds/ha) and abundances (birds/unit) of the Polynesian Starling within the Ta'ū and Tutuila units in 2011, 2018, and 2023. Standard errors (SE) and 95% confidence intervals (95% CI) are presented. Total abundance was calculated as mean density weighted by unit area (Ta'ū: 2,229 ha; Tutuila: 1,021 ha).

Unit	Year	Density: Birds/ha ± SE (95%CI)	Abundance: Birds/Unit Area ± SE (95%CI)
Ta'ū	2011	5.07 ± 1.16 (3.09–7.57)	11,301 ± 2,587 (6,890–16,871)

Table 8 (continued). Densities (birds/ha) and abundances (birds/unit) of the Polynesian Starling within the Ta'ū and Tutuila units in 2011, 2018, and 2023. Standard errors (SE) and 95% confidence intervals (95% CI) are presented. Total abundance was calculated as mean density weighted by unit area (Ta'ū: 2,229 ha; Tutuila: 1,021 ha).

Unit	Year	Density: Birds/ha ± SE (95%CI)	Abundance: Birds/Unit Area ± SE (95%CI)
Ta'ū (cont.)	2018	4.04 ± 0.77 (2.66–5.59)	9,003 ± 1,711 (5,935–12,463)
	2023	0.81 ± 0.23 (0.40–1.32)	1,795 ± 519 (895–2,940)
Tutuila	2011	8.73 ± 1.41 (6.35–11.73)	8,916 ± 1,442 (6,483–11,973)
	2018	3.76 ± 0.73 (2.50–5.27)	3,837 ± 746 (2,556–5,382)
	2023	2.83 ± 0.55 (1.82–3.92)	2,891 ± 565 (1,862–3,997)

Polynesian Wattled Honeyeater

The Polynesian Wattled Honeyeater was the most ubiquitous and abundant species detected during the 2023 survey. The species was detected at every survey station (100%) across both units (Appendix B), with encounter rates of 6.64 and 6.15 BPS in the Ta'ū and Tutuila units, respectively (Table 2). In the Ta'ū Unit, the estimated density was 16.84 ± 1.21 birds/ha, corresponding to an abundance of $37,530 \pm 2,702$ birds (Table 9). On Tutuila, the density was 17.47 ± 1.32 birds/ha, with an abundance of $17,841 \pm 1,347$ birds. On Ta'ū, there was a significant decrease of -7.48 ± 3.42 bird/ha since 2018. Differences were inconclusive for Tutuila, despite a notable -5.80 ± 3.37 bird/ha decrease in density (Table 3). Densities were lower in 2023 than in 2011 in both units and the confidence intervals did not overlap point estimates, indicating a decrease in densities over the 12-year interval (Table 9).

Table 9. Densities (birds/ha) and abundances (birds/unit) of the Polynesian Wattled Honeyeater within the Ta'ū and Tutuila units in 2011, 2018, and 2023. Standard errors (SE) and 95% confidence intervals (95% CI) are presented. Total abundance was calculated as mean density weighted by unit area (Ta'ū: 2,229 ha; Tutuila: 1,021 ha).

Unit	Year	Density: Birds/ha ± SE (95%CI)	Abundance: Birds/Unit Area ± SE (95%CI)
Ta'ū	2011	39.61 ± 6.29 (29.72–54.65)	88,281 ± 14,016 (66,240–121,816)
	2018	24.32 ± 3.20 (18.89–31.24)	54,206 ± 7,136 (42,114–69,622)
	2023	16.84 ± 1.21 (14.63–19.38)	37,530 ± 2,702 (32,608–43,196)

Table 9 (continued). Densities (birds/ha) and abundances (birds/unit) of the Polynesian Wattled Honeyeater within the Ta'ū and Tutuila units in 2011, 2018, and 2023. Standard errors (SE) and 95% confidence intervals (95% CI) are presented. Total abundance was calculated as mean density weighted by unit area (Ta'ū: 2,229 ha; Tutuila: 1,021 ha).

Unit	Year	Density: Birds/ha ± SE (95%CI)	Abundance: Birds/Unit Area ± SE (95%CI)
Tutuila	2011	35.32 ± 5.32 (26.42–48.16)	36,058 ± 5,430 (26,973–49,167)
	2018	23.27 ± 3.10 (17.82–30.01)	23,760 ± 3,162 (18,195–30,640)
	2023	17.47 ± 1.32 (15.11–20.39)	17,841 ± 1,347 (15,423–20,814)

Red Junglefowl

A total of six Red Junglefowl (*Gallus gallus*), or feral chickens, were detected on Ta'ū. The non-native galliform occurred at 5.7% of stations surveyed, with an encounter rate of 0.06 BPS (Table 2). The detections were approximately 2 km south of Fiti'uta, above a rock quarry near the coastal road (Appendix B). These birds were assumed to be of feral and self-sustaining populations. On Tutuila, three were detected on 3.1% of stations surveyed at 0.03 BPS. The detections were outside of the Village of Vatia. There were no detections during survey efforts in 2011 but two were detected in 2018 on Ta'ū.

Samoan Myzomela

The Samoan Myzomela does not occur naturally in the Manu'a Islands. In the Tutuila Unit, the species was detected at 17.7% of stations surveyed, with 25 total detections and an encounter rate of 0.26 BPS (Table 2). Estimated density was 4.81 ± 0.58 birds/ha, corresponding to an abundance of $4,906 \pm 596$ birds (Table 10). Detections were broadly distributed on the eastern and western slopes of Alava Mountain at elevations between 300 m and 450 m (Appendix B). Individuals were also detected incidentally outside park boundaries near Matafao Peak and Pago Pago Harbor. Differences in densities between 2018 and 2023 were inconclusive (Table 3). Densities were higher in 2023 than in 2011, and confidence intervals did not overlap point estimates, indicating an increase over the 12-year interval (Table 10).

Table 10. Density (birds/ha) and abundance (birds/unit) of the Samoan Myzomela within the Tutuila Unit in 2011, 2018, and 2023. Standard errors (SE) and 95% confidence intervals (95% CI) are presented. Total abundance was calculated as mean density weighted by unit area (1,021 ha).

Unit	Year	Density: Birds/ha ± SE (95%CI)	Abundance: Birds/Unit Area ± SE (95%CI)
Tutuila	2011	0.72 ± 0.28 (0.25–1.31)	733 ± 288 (252–1,342)

Table 10 (continued). Density (birds/ha) and abundance (birds/unit) of the Samoan Myzomela within the Tutuila Unit in 2011, 2018, and 2023. Standard errors (SE) and 95% confidence intervals (95% CI) are presented. Total abundance was calculated as mean density weighted by unit area (1,021 ha).

Unit	Year	Density: Birds/ha ± SE (95%CI)	Abundance: Birds/Unit Area ± SE (95%CI)
Tutuila (cont.)	2018	2.93 ± 0.94 (1.41–5.18)	2,994 ± 959 (1,444–5,289)
	2023	1.48 ± 0.43 (0.74–2.40)	1,506 ± 437 (759–2,448)

Samoan Starling

The Samoan Starling was widely distributed across both units (Appendix B), occurring at 84.9% of stations surveyed on Ta'ū and 95% of stations on Tutuila (Table 2). It was the second most frequently detected landbird species, with encounter rates of 2.09 BPS on Ta'ū and 2.66 BPS on Tutuila.

Estimated density in the Ta'ū Unit was 2.92 ± 0.36 birds/ha, corresponding to an abundance of $6,515 \pm 802$ birds (Table 11). On Tutuila, density was 4.81 ± 0.58 birds/ha, with an abundance of $4,906 \pm 596$ birds. Density in the Ta'ū Unit declined by -1.93 ± 0.80 birds/ha between 2018 and 2023 (Table 3). Differences on Tutuila were inconclusive over the same interval, although Judge et al. (2021) reported a decrease between 2011 and 2018. Densities in both units were lower in 2023 than in 2011, and confidence intervals did not overlap point estimates, indicating a decrease in densities over the 12-year interval (Table 11).

Table 11. Densities (birds/ha) and abundances (birds/unit) of the Samoan Starling within the Ta'ū and Tutuila units in 2011, 2018, and 2023. Standard errors and 95% confidence intervals (95% CI) are presented. Total abundance was calculated as mean density weighted by unit area (Ta'ū: 2,229 ha; Tutuila: 1,021 ha).

Unit	Year	Density: Birds/ha ± SE (95%CI)	Abundance: Birds/Unit Area ± SE (95%CI)
Ta'ū	2011	6.31 ± 0.93 (4.61–8.27)	14,074 ± 2,071 (10,283–18,444)
	2018	4.85 ± 0.71 (3.57–6.26)	10,809 ± 1,589 (7,949–13,953)
	2023	2.92 ± 0.36 (2.28–3.68)	6,515 ± 802 (5,083–8,195)
Tutuila	2011	8.74 ± 1.01 (6.91–10.82)	8,920 ± 1,034 (7,055–11,047))
	2018	4.99 ± 0.56 (4.00–6.09)	5,093 ± 570 (4,089–6,220))
	2023	4.81 ± 0.58 (3.78–5.97)	4,906 ± 596 (3,864–6,094)

White-Rumped Swiftlet

The White-rumped Swiftlet (*Aerodramus spodiopygius*) was detected at 26.4% and 18.8% of stations surveyed, with an encounter rate of 0.41 and 0.26 BPS, respectively (Table 2). Its occurrence and distribution were consistent with earlier surveys. On Ta'ū, the species was scattered across a wide range of elevations from sea-level to the summit of Lata Mountain (Appendix B). On Tutuila, the species was usually observed flying along the jeep trail to the summit of Alava Mountain and near high ridges where it forages for insects during flight (Appendix B). Due to the species' biology, the assumption of no movement was violated because they almost invariably move at the moment of detection. Therefore, distance sampling was not a reliable method for calculating density and abundance.

Acoustic Sampling Results

A total of 25 hours of recording data yielded no Spotless Crake detections, however, 737 Tahiti Petrel calls were detected on Lata Mountain on Ta'ū. Commonly detected species included the Polynesian Wattled Honeyeater, Blue-crowned Lorikeet, and Samoan Starling, however, we did not summarize numbers of calls for these species. Appendix C provides spectrogram figures of detected species.

Undetected Landbird Species

Eastern Barn Owl

The Eastern Barn Owl (Lulu; *Tyto javanica*) was only observed incidentally at night in villages outside of NPSA boundaries. The only large, flying predator in American Samoa, the species is known to prey upon flying foxes (Grant and Banack 1995) and rats (Dhondt 1976), as well as on birds and insects in other parts of its range (Watling 2001).

Spotless Crake

The Spotless Crake was not discovered by western scientists in the Samoan Islands until 1923 (Murphy 1924), and their Samoan name, if ever assigned, has likely been lost. Spotless Crakes were not detected on surveys nor incidentally in 2023, despite deploying a Song Meter near the summit of Lata Mountain. In 2018, three individuals were detected incidentally in the Ta'ū Unit on Transect 10 near station 14 in low stature *Didymocheton alliaceus* and *D. maota* canopy, as well as dense montane scrub dominated by *Freycinetia storckii* and *Cyrtandra* spp. This species' cryptic nature, small size, dark plumage, and rarely heard calls have made it difficult to determine its distribution and status on Ta'ū. This species has been detected sporadically by biologists since the 1980s (Adler et al. 2010; Badia 2016; Engbring and Engilis 1988; Rauzon and Fialua 2003).

Tongan Ground Dove

The Tongan Ground Dove (or Shy Ground Dove) was not detected during surveys nor incidentally in 2018 or 2023. In 2011, a single individual was incidentally heard near the middle of Legacy Transect 8 in the Ta'ū Unit (Figure 2; Judge et al. 2013); however, the individual was not visually confirmed. The population of this species in American Samoa was listed as federally endangered in 2016 (USFWS 2016).

Non-Native Birds

Three species of introduced birds were common in non-native lowland habitats outside of NPSA on Tutuila. The Common Myna (Maina Fanua; *Acridotheres tristis*), Jungle Myna (Maina Vao; *A. fuscus*), and Red-vented Bulbul (Manu Palagi; *Pycnonotus cafer*) were readily observed in and close to villages and plantations on Tutuila Island. They were especially common on the Tafuna Plain and Fagasā Pass where they forage in agricultural fields and ornamental vegetation. These species remain absent on Ta'ū Island. In 2023, there were no detections in the predominately native forests surveyed in either NPSA unit. Similar observations were reported in 2011 and 2018.

Seabird Observations

Ta'ū Unit

Several species of seabirds were observed incidentally and during the survey effort. However, we made no attempt to estimate abundances (refer to Raine and Raine 2023 and O'Connor and Rauzon 2004 for current information on seabird status). On Ta'ū, observations of seabirds included the Great Frigatebird (Atafa; *Fregata minor*), White Tern (Manusina; *Gygis alba*), White-tailed Tropicbird (Tava'e; *Phaethon lepturus*), and Brown Noddy (Gogo; *Anous stolidus*). Most notably, there appeared to be several thousand Black Noddies (also named Gogo; *Anous minutus*) foraging, nesting, and resting in coastal forests of NPSA, and many Brown Noddies were observed near Lau Futi Beach. Apparent densities were highest in southern coastal areas, but they were also observed in mid-elevation forest. Large flocks were seen flying eastward at dawn hours or shortly thereafter. No petrels or shearwaters were seen or heard, but a Song Meter deployed near the summit of Lata Mountain detected the Tahiti Petrel (Ta'i'o; *Pseudobulweria rostrata*). An unidentified seabird carcass was found on Random Transect 16 on July 27, 2023, which may have been a Tahiti Petrel. Audubon's Shearwaters (also named Ta'i'o; *Puffinus lherminieri*) could also be detected during breeding season from December through May (O'Connor and Rauzon 2004).

Tutuila Unit

Colonies of Brown Boobies (Fua'o; *Sula leucogaster*) and Red-footed Boobies (also named Fua'o; *S. sula*) were seen nesting in trees on the steep northwestern coastline of the Tutuila Unit, and several late-stage chicks were seen resting in nests during landbird surveys in June, especially on Legacy Transect 1. White Terns and White-tailed Tropicbirds were commonly observed flying over steep ridgelines and coastal areas of NPSA, and surveyors found one active White-tailed Tropicbird nest in a *Didymocheton maota* near the bottom of Transect 1. Brown and Black Noddies were also seen flying offshore and near most coasts. Blue Noddies (Laia; *Anous ceruleus*) were seen flying near the tide pools along the lower Sauma Ridge Trail. Raine and Raine (2023) reported Bridled Terns (Gogo Uli; *Onychoprion anaethetus*) nesting at Pola Island in December 2022. In June, a dead White-tailed Tropicbird was found on the Mount Alava Trail, and a dead Tahiti Petrel was found on the Upper Sauma Trail.

Habitat Description

Characteristic of paleotropical rainforests, the survey areas were distributed among many unique vegetation classes, often with no single species or classification making up a clear majority of the tree canopy or understory. This made vegetation classification of canopy and understory not

particularly hierarchical. Nearly all 2023 survey stations in both the Ta'ū and Tutuila units differed entirely in their combination of dominant, codominant, and subdominant canopy trees; as well as dominant, codominant, and subdominant understory classes, with the greatest frequency of any one canopy or understory combination being <10%. Therefore, the most predominant canopy classes are reported within each island unit. Dominant canopy tree species and understory classifications for the 2023 surveys are provided in Appendix D. A complete list of habitat canopy tree species and understory classifications are available online (Kozar and Judge 2025).

In 2011, seven years prior to disturbance by Tropical Cyclone Gita, surveyors characterized the habitat of 170 stations, reporting a diverse mosaic of native and introduced canopy trees and understory shrubs in both units of NPSA, as described in Judge et al. (2013). In both units, nearly 90% of the canopy cover was closed (>60% cover), while the majority of the canopy trees were of medium height (5–10 m). In 2018, four to five months following Gita, on-site habitat surveys from 121 stations still generally described forest canopy dominated by native trees, with native tree ferns subdominant (Judge et al. 2021). Closed canopy cover in both units decreased from 2011 by roughly 10–20%; however, canopy tree height increased in both units (Judge et al. 2013, 2021). In 2023, five years following Gita, habitat sampling from 203 survey stations continued to reveal primarily native canopy trees. The distribution of closed canopy cover on Ta'ū remained relatively the same, whereas Tutuila's closed canopy cover increased by more than 30%. Most canopy trees in both units were >10 m tall in 2023.

Ta'ū Unit

In 2011, nearly 89% of the 75 stations sampled in the Ta'ū Unit had closed canopy, and over half (52%) had canopy tree heights of 5–10 m (Judge et al. 2013). Trees were generally taller at lower elevations, whereas summit scrub dominated higher elevations. Following Tropical Cyclone Gita in 2018, closed canopy cover decreased to 79% of the 48 stations surveyed (Judge et al. 2021). Canopy height, however, generally increased, with 75% of stations having canopy height >10 m tall. By 2023, the closed canopy cover continued to decrease to 77% of the 107 stations sampled, with fewer stations (58%) having a canopy height >10 m than in 2018 (Appendix D).

Of the 107 stations sampled for canopy and understory composition in 2023, 89 were unique in their canopy composition, with the greatest occurrence of any one combination being 3 stations (Appendix D). *Syzygium samoense* was the most frequently encountered dominant tree species, documented at 19.6% of the survey stations, followed by *Didymocheton maota* (15.0%; Appendix D). There was nearly an equal representation of the next three predominant canopy classes: *Talipariti tiliaceum* and *Cyathea* spp. (both 10.3%) and *Syzygium inophylloides* (9.3%). Generally, native trees formed closed canopies which became more open and replaced with *Cyathea* tree ferns, shrubs, and *Freycinetia* spp. along an elevational gradient towards the summit of Lata Mountain. Understory was variable with 50 unique classifications, where tree ferns, bare ground, *Freycinetia* spp., and native ferns were the most common dominant classes at 29.9%, 21.5%, 20.6%, and 18.7% of stations, respectively (Appendix D).

The most frequently detected invasive species was *Miconia crenata*, found at 88% of stations in 2011, roughly 40% in 2018, and 83.2% in 2023 (Judge et al. 2013, 2021; Appendix D). *Hellenia speciosa* followed with occurrence at 11.2% of stations in 2023. Invasive vines *Decalobanthus peltatus* and *Mikania micrantha* were both detected at only one survey station near sea level where they dominated roughly half of the area extending 25 m from the station point. The most widespread invasive tree species was *Adenanthera pavonina*, occurring at 7.5% of the stations surveyed (Appendix D).

Tutuila Unit

In 2011, 88% of the canopy cover of the 95 Tutuila Unit stations was closed, while the majority (73%) of the canopy trees were of medium height (5–10 m), and most of these species were native (Judge et al. 2013). Following Gita in 2018, native trees continued to dominate the forest canopy at survey stations (Judge et al. 2021). Closed canopy cover was reduced to 62% of stations, although most (67%) of the canopy remained at 5–10 m height. By 2023, closed canopy in Tutuila had increased again to 97.9% of stations, with most (86%) canopy trees >10 m tall, and nearly all species were native (Appendix D).

Of the 96 stations sampled in the Tutuila Unit in 2023, 79 were unique in their canopy composition, with the greatest occurrence of any one combination being just 4 stations (Appendix D).

Melanococca tomentosa and *Syzygium inophylloides* predominated the survey area, accounting for 30.9% and 27.8% of dominant canopy species at the stations surveyed, respectively. These closed canopy forests comprised the highest reaches of Alava Mountain where landbirds were surveyed, between 330 m and 490 m elevation. Understory cover was variable with 70 unique classifications, and bare ground, native ferns, and *Freycinetia* spp. were the most common dominant classes at 36.1%, 20.6%, and 16.5% of stations, respectively. Subdominant classes were variable, making more descriptive classifications non-hierarchical. Stations surveyed at the lower elevations were either native forest with more *Ficus* spp. in proximity of coastal areas, while stations further from the coast consisted of native forest with some agricultural trees such as *Mangifera indica* and invasive herbaceous and shrub plants in the understory. These areas account for less than 8.4% of the survey stations on Tutuila.

Like in the Ta'ū Unit, *M. crenata* was the most frequently detected invasive species in the Tutuila Unit, being found at nearly 90% of stations in 2011, 40% in 2018, and 59% in 2023 (Judge et al. 2013, 2021; Appendix D). *H. speciosa* was the second most prevalent at 43.2% of stations surveyed in 2023. Invasive plants such as *Mimosa* spp., *Stachytarpheta jamaicensis*, and exotic grasses were primarily limited to frequently used trails such as the Mount Alava Trail. The most widespread invasive tree species were *Falcataria falcata* and *A. pavonina* occurring at 17.9% and 16.8% of the stations surveyed, respectively, in 2023 (Appendix D).

Discussion

Landbirds

The 2023 landbird survey effort produced density estimates for eight species across the two units of NPSA, yielding 14 population estimates that were compared with previous surveys. Relative to 2018, which occurred four to five months following Tropical Cyclone Gita, most density estimates from 2023 had decreased, although the differences were inconclusive. Where differences were significant, the changes in populations varied by species and island unit. Specifically, Tutuila populations of the Crimson-crowned Fruit Dove and Pacific Imperial Pigeon had increased, while the Pacific Kingfisher decreased. The Ta'ū populations of the Polynesian Starling, Polynesian Wattled Honeyeater, and Samoan Starling had decreased, following similar but inconclusive decreases between 2011 and 2018 (Judge et al. 2021). The Blue-crowned Lorikeet showed a significant decrease between 2011 and 2018 (Judge et al. 2021) and an inconclusive decrease between 2018 and 2023. The disparity in increasing and decreasing densities between units could indicate differences in how quickly landbird populations are likely recovering from Tropical Cyclone Gita. In the Tutuila Unit, two populations showed evidence of recovering in five years, although only the Pacific Imperial Pigeon has recovered to pre-disturbance numbers or higher. Despite its greater geographical distance from Tropical Cyclone Gita, the Ta'ū Unit showed no significant population increases, and three species had significant decreases.

Recovery of avian populations from tropical cyclones largely depends upon the extent and severity of vegetation damage, how fast it recovers, and how much undisturbed habitat is available for refuge and recruitment (Rittenhouse et al. 2010; Wiley and Wunderle 1993). Initially, tropical storm winds can strip plants of their flowers and fruits, reducing populations of nectarivores and frugivores (Askins and Ewert 2020; Wiley and Wunderle 1993). Defoliation can also increase exposure to invasive mammalian predators and facilitate the spread of invasive non-native plants, at least until the canopy closes in and native species regain their dominance, which may take at least 1–2 decades (Goulding et al. 2016; Lugo 2008; Thompson et al. 2007). Bird community similarity or species evenness may immediately drop post-disturbance and take two or more years to restabilize because bird species respond unequally to vegetation changes (Patten et al. 2024; Rittenhouse et al. 2010). Long-term impacts of tropical cyclones spanning multiple decades include shifts to larger tree diameters and heights and a decline in overall forest species richness (Lugo 2008; Weaver 1986a, 1986b, 1989). These effects are known to interact synergistically with anthropogenic stressors to drive further bird population declines (Conant et al. 1998; Goulding et al. 2016; Maxwell et al. 2019; Raffaele 1977). Provided enough undisturbed forest, however, many tropical species appear to be capable of recovery within a decade of a major storm event (Askins and Ewert 2020; Rittenhouse et al. 2010), which suggests that more landbird populations may recover by the next survey in 2028. Continued post-disturbance landbird monitoring and evaluation of limiting factors that interact with tropical cyclones (Goulding et al. 2016), including habitat loss and invasive species expansion (Matthews et al. 2022), may help inform management within NPSA. Two of the four native columbid species in NPSA showed increasing densities since 2018, likely signaling recovery since Tropical Cyclone Gita. Previously hunted nearly to extirpation on Tutuila following Tropical Cyclones Ofa

and Val in the early 1990s (Craig et al. 1994), the Crimson-crowned Fruit Dove and Pacific Imperial Pigeon were once again widely distributed and abundant by 2011 and significantly increased in density from 2018 to 2023. Protection from harvesting within the park and restoration of native forest on Tutuila (Hughes et al. 2012) may have allowed populations to stabilize enough to be resilient to the damaging effects of Tropical Cyclone Gita. The success of these frugivores supports the rainforest ecosystem, as both disperse native tree seeds (Steadman and Freifeld 1999).

Apart from the Pacific Imperial Pigeon and Samoan Myzomela, no landbird populations in the Tutuila Unit have regained pre-Gita abundances observed in 2011, and one species, the Pacific Kingfisher, had significantly decreased since 2018. Pacific Kingfishers also decreased between 2011 and 2018, although this change was not significant (Judge et al. 2021). These findings corroborate population declines reported by the Institute for Bird Populations based on mark–recapture analysis (Pyle et al. 2018). Preference for coastal habitat may have exposed Pacific Kingfishers more to the impacts of Tropical Cyclone Gita than interior-forest species on Tutuila. Further investigation into the spatial distribution and density of landbirds, and into landbird survival and reproduction in coastal, lowland, and upland habitats could provide information necessary for species conservation. Spatially explicit landbird distribution and density could be determined using density surface modeling (Camp et al. 2020; Wood 2017), while survival and reproduction could be determined from a mark–recapture study such as the Tropical Monitoring Avian Productivity and Survivorship program (Pyle et al. 2018).

Three common species on Ta‘ū likewise showed significant decreases in density: the Polynesian Wattled Honeyeater, Polynesian Starling, and Samoan Starling. There is evidence that landbirds of NPSA maintain population stability through high survivorship and low reproductive output (Pyle et al. 2018). All three species had declined in the early 1990s following Tropical Cyclones Ofa and Val, due to habitat destruction, starvation, and direct mortality (Trail et al. 1992; Trail 1993). The most abundant species, the Polynesian Wattled Honeyeater, had a density more than 7 birds/ha lower in 2023 than in 2018. The once-abundant Polynesian Starling on Ta‘ū declined from more than 5 birds/ha in 2011 to only 0.81 ± 0.23 birds/ha in 2023. Similarly, densities of Samoan Starlings had more than halved from 6.31 ± 0.93 birds/ha in 2011 to 2.92 ± 0.36 birds/ha in 2023. Pyle et al. (2018) documented marked declines in mean numbers of aged Polynesian Starlings and Samoan Starlings in 2017 before Tropical Cyclone Gita and after the cyclone in 2018. Other studies have shown decreases in Polynesian Starling detections following tropical cyclones in Samoa (Lovegrove et al. 1992) and Niue (Powlesland et al. 2008) and suggested fruit availability as a limiting factor. The greater distance of Ta‘ū from Gita and different foraging strategies among species make this cause unlikely and suggest that other threats, such as reduced canopy cover (Appendix D) or increased predation, are at play. Therefore, while the causes of decreases among these species remain unconfirmed, the combined declines in their populations may be due to decreased survival or reproduction and could be further investigated.

Several species had insufficient counts to model their densities and detect trends, limiting inference regarding their populations. Implementing a rare bird search (Camp et al. 2011) may be necessary to confirm the presence of the Tongan Ground Dove, heard but not seen on Lata Mountain in 2011, and

the persistence of the Spotless Crake, only detected in 2018, in the Ta'ū Unit. Even if not confirmed, the Tongan Ground Dove, rare elsewhere in American Samoa, could benefit from a range expansion and establishment of a population on Ta'ū (USFWS 2020). Their nomadic relative, the Many-colored Fruit Dove, has likely been historically rare in American Samoa (Amerson et al. 1982a, 1982b). Feeding almost exclusively on figs (Baptista et al. 2020), Many-colored Fruit Doves follow asynchronous fruiting events, which may make distance sampling an unreliable method for monitoring their populations (Judge et al. 2022). In contrast, the sedentary Manu'a Shrikebill has been consistently detected on Ta'ū, but detections have been restricted to the southern Liu Bench area. The steep walls of the extinct volcanic crater of Lata Mountain may insulate this population and its habitat from violent storms and feral ungulates (Steadman and Freifeld 1998). Mark–recapture data from the Tropical Monitoring Avian Productivity and Survivorship program for American Samoa indicated that Manu'a Shrikebills have high survivorship and demographically stable populations on all three Manu'a Islands (Pyle et al. 2018), further indicating that their limited range is due to specific habitat requirements, such as closed-canopy forest. Assessing abundance and trends in their metapopulation would require a coordinated, increased sampling effort within their preferred vegetation types on Ta'ū, Ofu, and Olosega. For these four species, telemetry tracking (Blakey et al. 2019) may elucidate their spatial ecologies and habitat requirements, whereas further mark–recapture banding studies could monitor differences in productivity and survivorship over time (Pyle et al. 2018).

Like the Spotless Crake, two other uncommonly detected species are in the family Rallidae. The Buff-banded Rail occurred in low numbers in the Ta'ū and Tutuila units throughout the surveys and was regularly observed in agroforest areas outside of the park. Australasian Swampheens were only detected on-count during the 2011 surveys and were likewise incidentally observed in low-elevation agroforest, rainforest, and coastal areas outside of NPSA, and they are known to occupy wetlands throughout their range (Taylor 2020a). The absence of Spotless Crake detections on Ta'ū in 2023, despite the use of passive acoustic monitoring, accentuates the uncertainty of their long-term persistence. However, all three species, which have been observed foraging in the understory in the park, may be seeking cover from predators such as free-roaming cats (*Felis catus*) and dogs (*Canis lupus familiaris*; Diamond 2007; Foin and Brenchley-Jackson 1991; Mack et al. 2000). Adler et al. (2010) suggested that Spotless Crake presence on the summit of Lata Mountain was associated with the low density of Norway Rats (*Rattus norvegicus*). Rats reduced the Norfolk Island and extirpated the Raoul Island populations of the Spotless Crake (Taylor 2020b). In the absence of protective measures outside of NPSA, implementing predator control within the park, especially in areas near wetlands and agroforest, may offer refuge for these populations.

Our diurnal observations of invasive mammals within NPSA suggest that they are abundant on the landscape. However, knowing their distribution and relative abundance could help to understand their impact on landbirds and inform predator control strategies. For canids and felines, motion-triggered cameras can offer an effective means of early detection and range estimation (Arona and Schiavini 2023; Raine et al. 2022). For cats, pairing these cameras with olfactory lures such as cat urine can increase the efficacy of detection (Lohr et al. 2024). If deployed following a randomized and representative sampling framework, camera trap sampling can be used with distance sampling to

estimate mammal densities (Camp and Bak 2023; Howe et al. 2017). However, a tradeoff of cameras is the larger processing time from recordings. In contrast, chew cards or tracking tunnels may be more cost-effective, easily deployed, quick to process, and effective at detecting rodents than cameras (Nance et al. 2024).

Our observation of three seabird carcasses, one a Tahiti Petrel, suggests that there are unmitigated dangers to nesting birds within NPSA. Cameras with direct line of sight to nests, set up in a way to minimize attraction or disturbance, have effectively identified nest predators (Banko et al. 2019; Hess et al. 2004; Wanless et al. 2007). Likewise, dietary analysis techniques, such as scat collection and eDNA metabarcoding, can be used to determine prey species of predators (Caut et al. 2008; Williams et al. 2025; Zarzoso-Lacoste et al. 2016). Active management approaches, such as pre- and post-eradication or control experiments, have also helped quantify the reproductive and survival impacts of invasive mammals on prey species (Banko et al. 2019; Comer et al. 2020; Harris 2009; Raine et al. 2020; Underwood et al. 2014). Whatever the causes of the observed seabird deaths, predators will likely continue to threaten sensitive native wildlife in NPSA if left unidentified and unmitigated.

In addition to predation, other potential threats to NPSA landbirds have received limited empirical evaluation or have not been recently reassessed. These include conversion of land to unsuitable habitat, changes in canopy cover caused by tropical cyclones, disease, and introduced birds (Utzurum et al. 2006). Between 1988 and 2001, the total forest area of American Samoa decreased by at least 1.3% (Utzurum et al. 2006). Comparison with imagery from Green et al. (2015) or more recent remote-sensing datasets is needed to assess the current extent of forest conversion. Atkinson et al. (2006, 2016) found evidence that many mosquito-vectored avian diseases are indigenous to American Samoa. Further surveillance for mosquitoes, climate, and the effect of land use on disease transmission could help to determine impacts to landbird populations. The high endoparasite load found in Samoan Starlings and their recent population decrease on Ta'ū suggest that the impact of hematozoan parasites may need reevaluation. Finally, the impacts of introduced mynas (*Acridotheres* spp.) on native landbirds of American Samoa, including competition, nest predation, and disease transmission, have not been scientifically documented. Having this information may help develop strategic management plans.

Habitat

Changes in habitat can also influence the distribution and abundance of landbirds. Changes in canopy cover and canopy height measured in 2011 (before Gita), 2018 (four to five months following Gita), and 2023 (five years following Gita) differed, however, the changes did not follow expected patterns associated with a major disturbance event. In the Ta'ū Unit the percent of stations with closed canopy decreased from 89% pre-Gita to 79% and 77% following Gita, while in the Tutuila Unit the percent of stations with closed canopy decreased from 88% pre-Gita to 62% immediately following Tropical Cyclone Gita and then increased to 97% in 2023 (Judge et al. 2013, 2021; Appendix D). The decreasing amount of closed canopy in the Tutuila Unit matches the expected stripping and recover of canopy foliage post-Gita, but we expected the percent of closed canopy in the Ta'ū Unit to remain relatively constant instead of declining as the island was further from Tropical Cyclone Gita. Similarly, we expected the percent tall stature trees to decrease in the Tutuila Unit, contrary to what

was observed, and to have remained relatively the same in the Ta‘ū Unit, which instead increased (Judge et al. 2013, 2021; Appendix D). More likely, these changes reflect differences in the sampling frame across the three surveys. This presents an opportunity for future landbird and habitat sampling to be applied consistently to be representative of the diverse vegetation types within each park unit and to include improved training on plant identification to collect species-level information. These practices can help to improve habitat quality monitoring that can then better inform managers of changes associated with bird populations.

Invasive non-native plants, most notably *M. crenata*, were abundant in both island units and may reduce habitat quality by excluding native understory plants. Notably, the Ta‘ū Unit had a wider distribution of *M. crenata* and a lower occurrence of other invasive understory and tree species than in the Tutuila Unit. The difference in invasive plant assemblages between units may reflect the more extensive human-dominated land cover outside the Tutuila Unit, which likely increased the diversity of invasive plant species within the unit. If left unmanaged, invasive plant species will likely continue to spread as climate change increases the intensity of tropical cyclones and their associated mechanisms of dispersal, including wind, flooding, and disturbance of habitat (Goulding et al. 2016; IPCC 2023; Maxwell et al. 2019).

Conclusions

Most of the species within NPSA have relatively large populations (>500 birds), and their distributions extend to other island chains. However, understanding and mitigating threats to native landbirds is relevant as the intensity of tropical cyclones is projected to regionally increase with climate change (IPCC 2023). Population increases of the Crimson-crowned Fruit Dove and Pacific Imperial Pigeon on Tutuila, despite its closer proximity to Tropical Cyclone Gita’s passage in 2018, suggest resilience. Three of four population decreases were in the Ta‘ū Unit, which is not actively managed, and indicates that park protection alone is insufficient to keep these populations stable. The Many-colored Fruit Dove, Spotless Crane, and Tongan Ground Dove remain rare (and, in the latter case, federally endangered) within American Samoa and lack recovery plans. Future landbird surveys can help monitor these species of concern as well as other landbirds in NPSA. The distribution, status and change in landbird populations provided herein can help inform management actions for NPSA and landbird conservation.

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Appendix A: Akaike's Information Criterion (AIC) Statistics: Weather, Temporal, and Geographical Covariates

Model parameters and model-selection results for forest birds of the 2023 National Park of American Samoa landbird survey are presented in this appendix. Within each species analysis, models were sorted by differences in second-order Akaike's information criterion corrected for small sample size (ΔAIC) between each candidate model and the model with the lowest AIC value that is generally the best fitting model. Models examined included half-normal and hazard-rate key detection functions and with cosine (COS), Hermite polynomial (Hpoly), and simple polynomial (Spoly) series expansions. Covariates were incorporated with the most parsimonious model to improve model precision. Covariates included the categorical variables cloud cover (Cloud), amount of rain (Rain), Beaufort wind scale (Wind), Beaufort gust scale (Gust), observer (Obs), time of day (Time), survey month (Month), and survey year (Year [factor]). Detection type (1 = heard, 2 = seen, 4 = heard and seen) was also evaluated as a categorical variable, indicated as "Detection", and based on pooling detection type by combination of types (e.g., "Detect 2, 4" pools all detections that were seen and both heard and seen, while "Detect 1, 4" pools detections that were heard and both heard and seen). Time of day (Time) and survey year (Year [continuous]) were evaluated as a continuous variable. The number of estimated parameters (Num params), and negative log-likelihood (-LogL) are presented. The Akaike model weight (w) is the likelihood that each model is the best of the converged models evaluated for each species.

Model selection criteria for each species are presented below (Tables 12–19).

Table 12. Blue-crowned Lorikeet density estimate models.

Model	Series Adjustment	Covariate	Num Params	(-)LogL	AICc	Delta AICc	Weight
Hazard Rate	Key	None	2	-205.01	920.99	0	0.82
Half-Normal	Key	None	1	-461.03	924.05	3.06	0.18

Table 13. Crimson-crowned Fruit Dove density estimate models.

Model	Series Adjustment	Covariate	Num Params	(-)LogL	AICc	Delta AICc	Weight
Hazard Rate	Key	Gusty vs Calm	3	-3176.68	6359.37	0	1
Hazard Rate	Key	Year	4	-3189.51	6387.01	27.64	0
Hazard Rate	Key	Windy vs Calm	3	-3197.15	6400.3	40.93	0
Hazard Rate	Key	Tract	3	-3201.03	6408.07	48.7	0
Hazard Rate	Key	None	2	-3204.26	6412.51	53.14	0
Hazard Rate	Key	Cloudy vs Clear	3	-3203.43	6412.87	53.5	0
Half-Normal	Key	None	1	-3212.29	6426.59	67.22	0

Table 14. Pacific Imperial Pigeon density estimate models.

Model	Series Adjustment	Covariate	Num Params	(-)LogL	AICc	Delta AICc	Weight
Hazard Rate	Key	Year	4	-2014.07	4036.14	0	1
Hazard Rate	Key	None	2	-2029.41	4062.83	26.69	0
Half-Normal	Key	None	1	-2039.3	4080.61	44.47	0

Table 15. Pacific Kingfisher density estimate models.

Model	Series Adjustment	Covariate	Num Params	(-)LogL	AICc	Delta AICc	Weight
Half-Normal	Key	None	1	-510.5	1023.01	0	0.57
Hazard Rate	Key	None	2	-510.7	1025.4	2.4	0.17
Half-Normal	Cosine	None	3	-510.14	1026.27	3.26	0.11
Half-Normal	Hermitian	None	3	-510.16	1026.32	3.31	0.11
Hazard Rate	Cosine	None	4	-510.1	1028.2	5.19	0.04

Table 16. Polynesian Starling density estimate models.

Model	Series Adjustment	Covariate	Num Params	(-)LogL	AICc	Delta AICc	Weight
Half-Normal	Key	None	1	-1076.01	2154.02	0	0.49
Hazard Rate	Key	None	2	-1075.98	2155.97	1.95	0.19
Half-Normal	Cosine	None	3	-1075.11	2156.21	2.19	0.16
Half-Normal	Hermitian	None	3	-1075.13	2156.27	2.25	0.16

Table 17. Polynesian Wattled Honeyeater density estimate models.

Model	Series Adjustment	Covariate	Num Params	(-)LogL	AICc	Delta AICc	Weight
Hazard Rate	Key	Year	4	-9850.56	19709.12	0	1
Hazard Rate	Key	Gusty	3	-9864.99	19735.98	26.86	0
Half-Normal	Hermitian	None	3	-9865.81	19737.62	28.5	0
Half-Normal	Cosine	None	3	-9867.83	19741.66	32.54	0
Hazard Rate	Cosine	None	4	-9867.69	19743.38	34.26	0
Hazard Rate	Simple Polynomial	None	4	-9867.8	19743.59	34.48	0
Hazard Rate	Key	Windy	3	-9871.7	19749.41	40.29	0
Hazard Rate	Key	Tract	3	-9871.73	19749.46	40.35	0

Table 17 (continued). Polynesian Wattled Honeyeater density estimate models.

Model	Series Adjustment	Covariate	Num Params	(-)LogL	AICc	Delta AICc	Weight
Hazard Rate	Key	Cloudy	3	-9873.46	19752.92	43.81	0
Hazard Rate	Key	None	2	-9874.99	19753.97	44.86	0
Half-Normal	Key	None	1	-9885.32	19772.64	63.53	0

Table 18. Samoan Myzomela density estimate models.

Model	Series Adjustment	Covariate	Num Params	(-)LogL	AICc	Delta AICc	Weight
Half-Normal	Key	None	1	-256.97	515.95	0	0.66
Hazard Rate	Key	None	2	-257.6	519.2	3.25	0.13
Half-Normal	Cosine	None	3	-256.72	519.44	3.49	0.12
Half-Normal	Hermitian	None	3	-256.97	519.93	3.98	0.09

Table 19. Samoan Starling density estimate models.

Model	Series Adjustment	Covariate	Num Params	(-)LogL	AICc	Delta AICc	Weight
Hazard Rate	Key	Year	4	-3451.57	6911.14	0	1
Hazard Rate	Key	Gusty	3	-3464.16	6934.33	23.19	0
Hazard Rate	Key	Windy	3	-3470.71	6947.41	36.28	0
Hazard Rate	Key	Tract	3	-3475.6	6957.21	46.07	0
Hazard Rate	Key	None	2	-3478.31	6960.62	49.48	0
Hazard Rate	Key	Cloudy	3	-3477.34	6960.67	49.54	0
Half-Normal	Key	None	1	-3485.62	6973.25	62.11	0

Appendix B: Landbird Occurrence Maps

Bird occurrence maps by species and unit are presented in Figures 4–26.

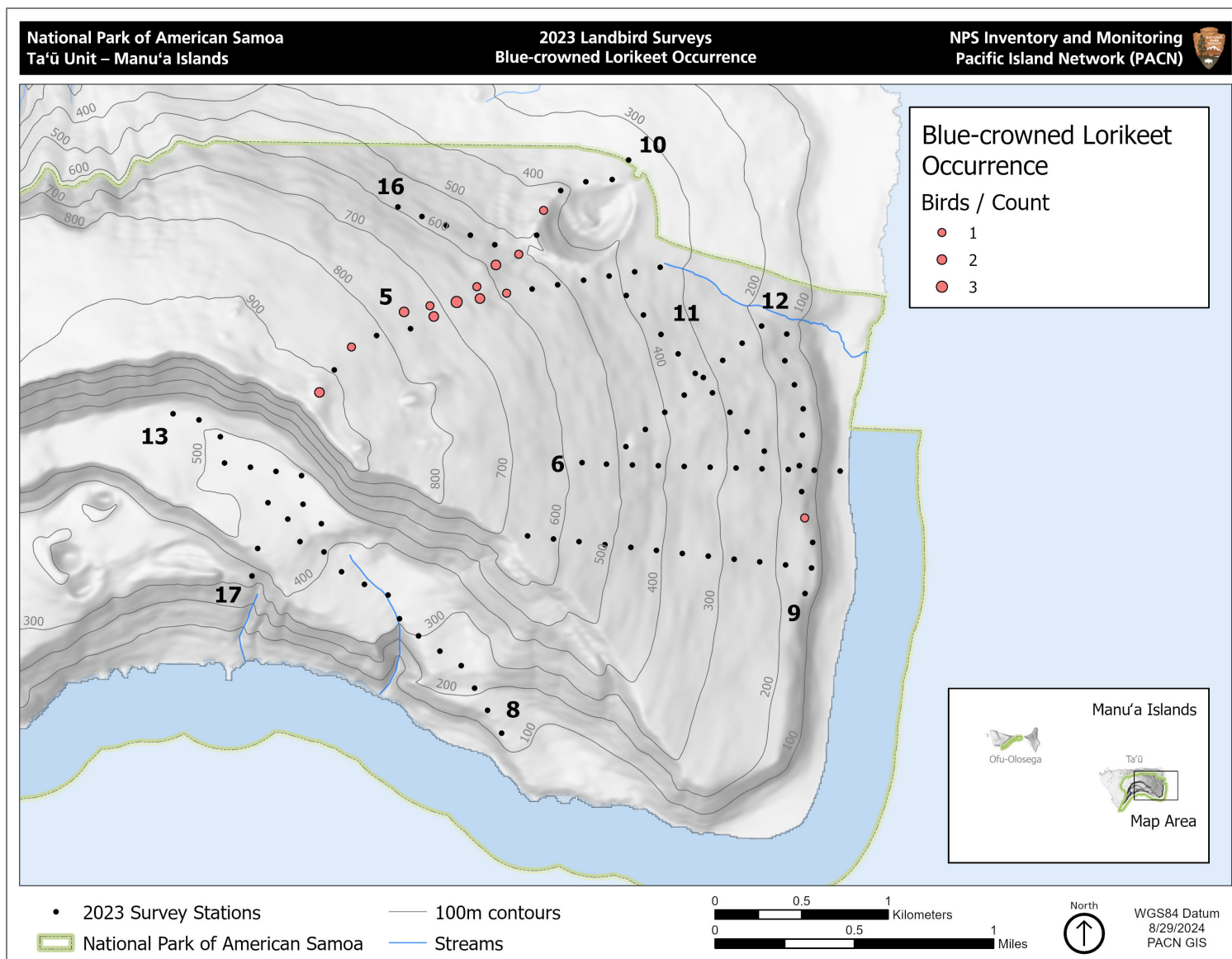


Figure 4. Blue-crowned Lorikeet detections within the Ta'ū Unit during the 2023 landbird survey.

NPS

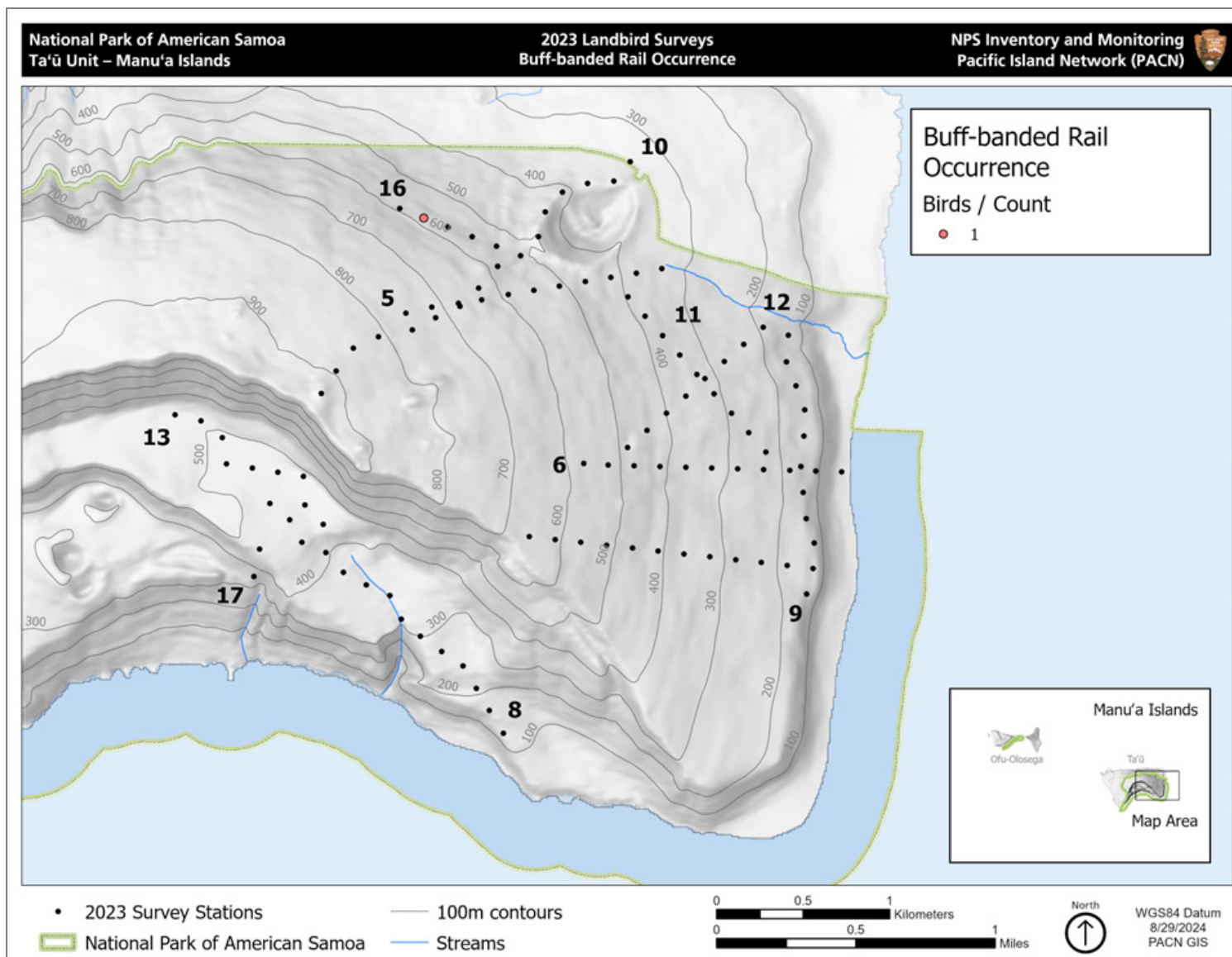


Figure 5. Buff-Banded Rail detections within the Ta'ū Unit during the 2023 landbird survey.

NPS

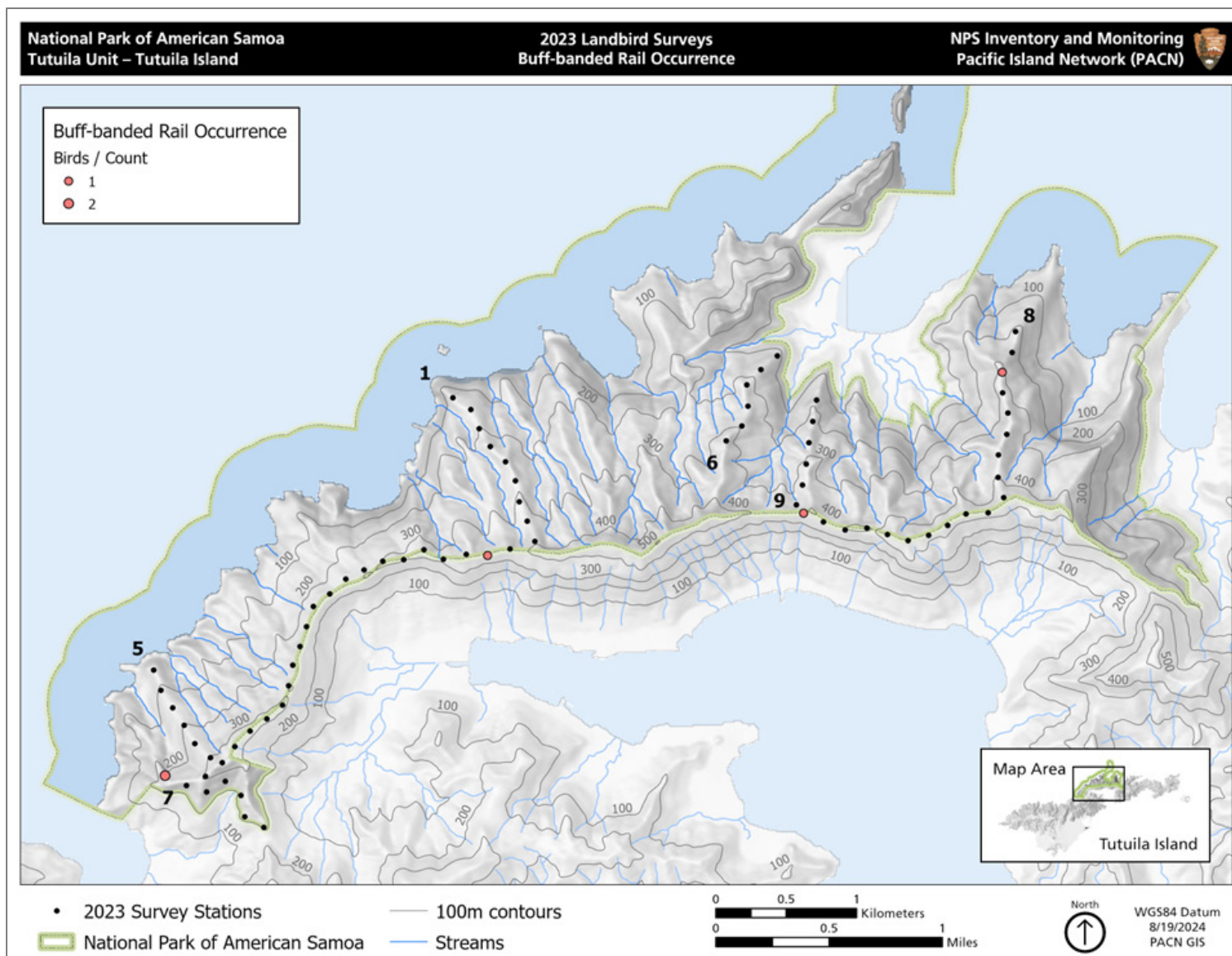


Figure 6. Buff-Banded Rail detections within the Tutuila Unit during the 2023 landbird survey.

NPS

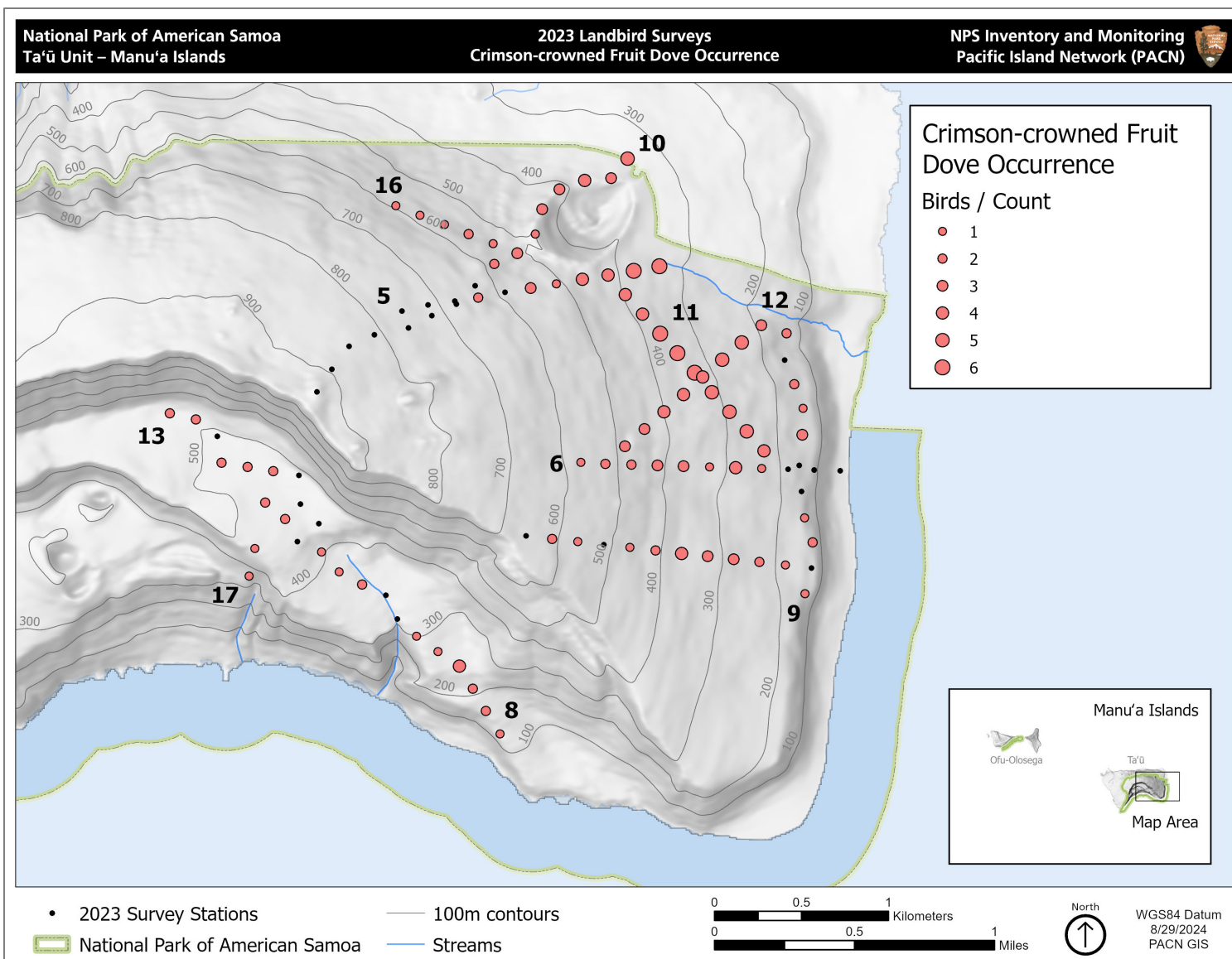


Figure 7. Crimson-crowned Fruit Dove detections within the Ta'ū Unit during the 2023 landbird survey.

NPS

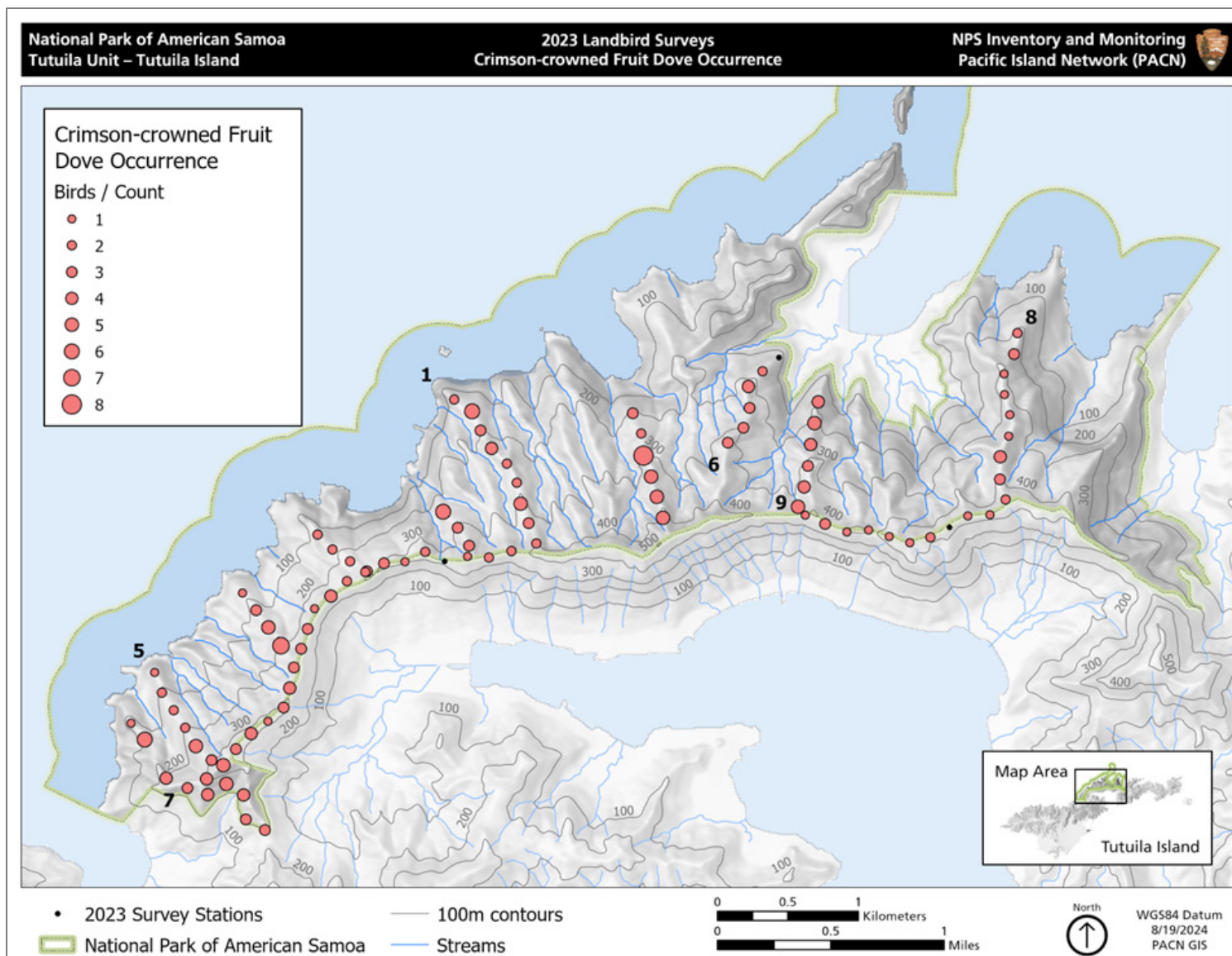


Figure 8. Crimson-crowned Fruit Dove detections within the Tutuila Unit during the 2023 landbird survey.

NPS

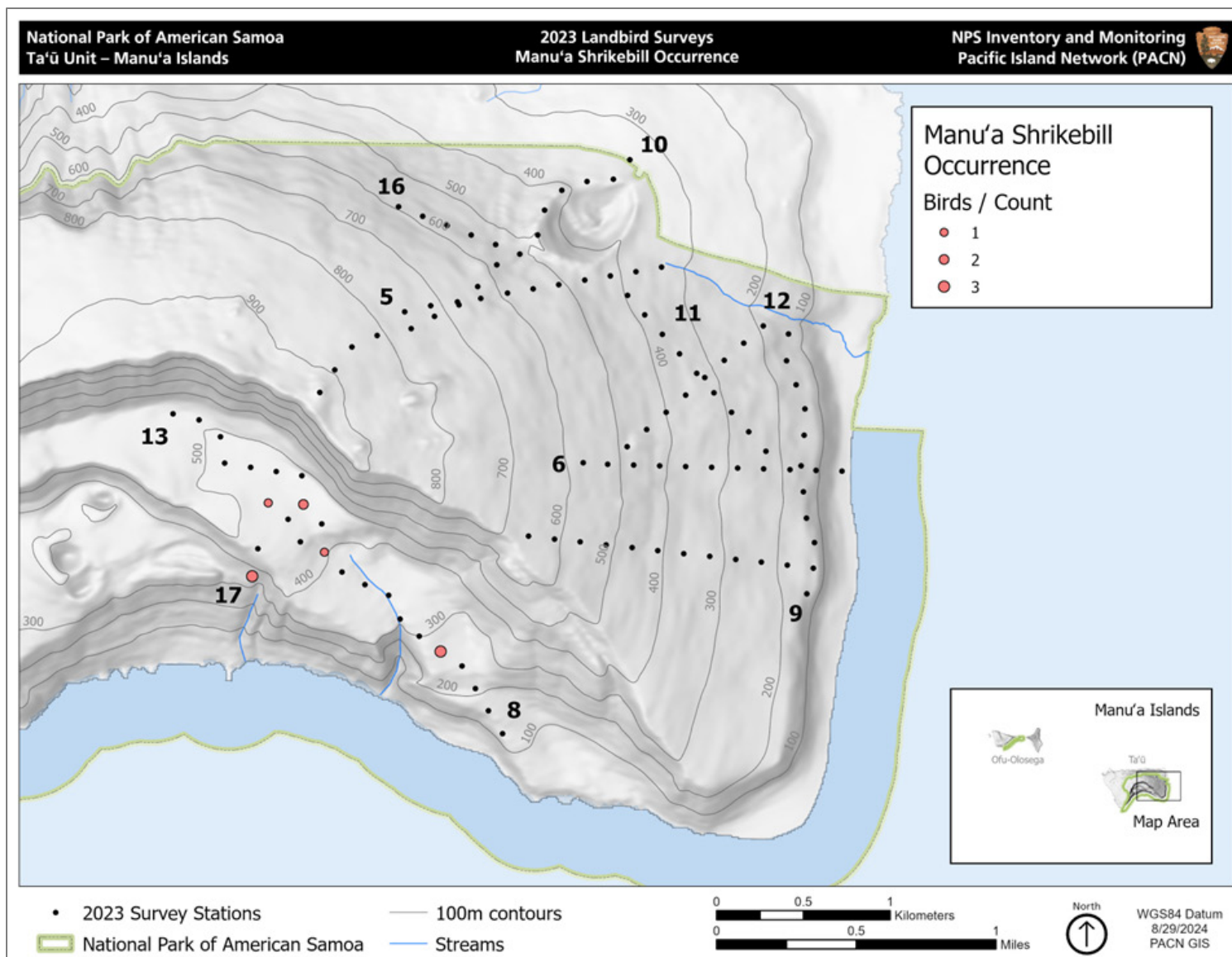


Figure 9. Manu'a Shrikebill detections within the Ta'ū Unit during the 2023 landbird survey.

NPS

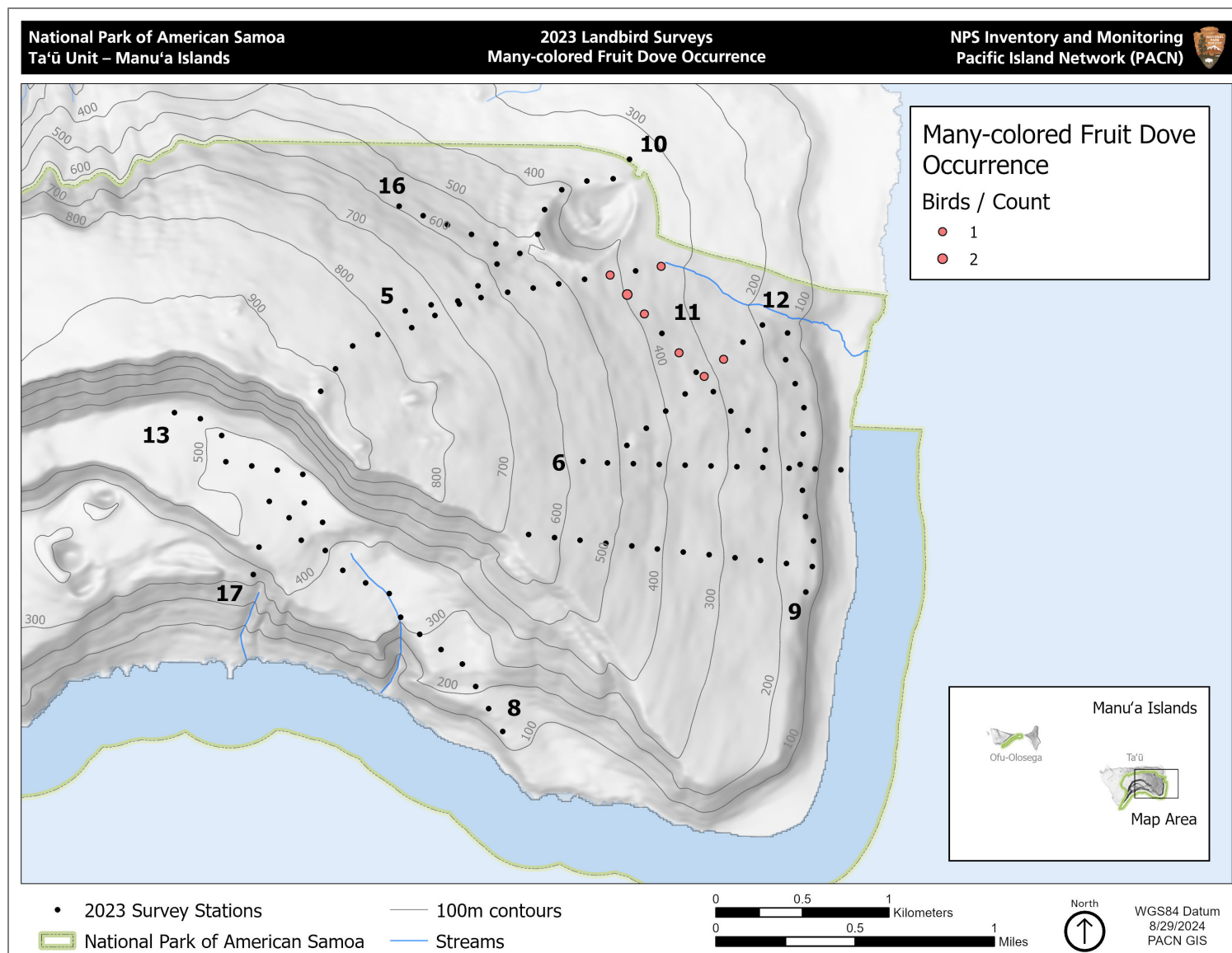


Figure 10. Many-colored Fruit Dove detections within the Ta'ū Unit during the 2023 landbird survey.

NPS

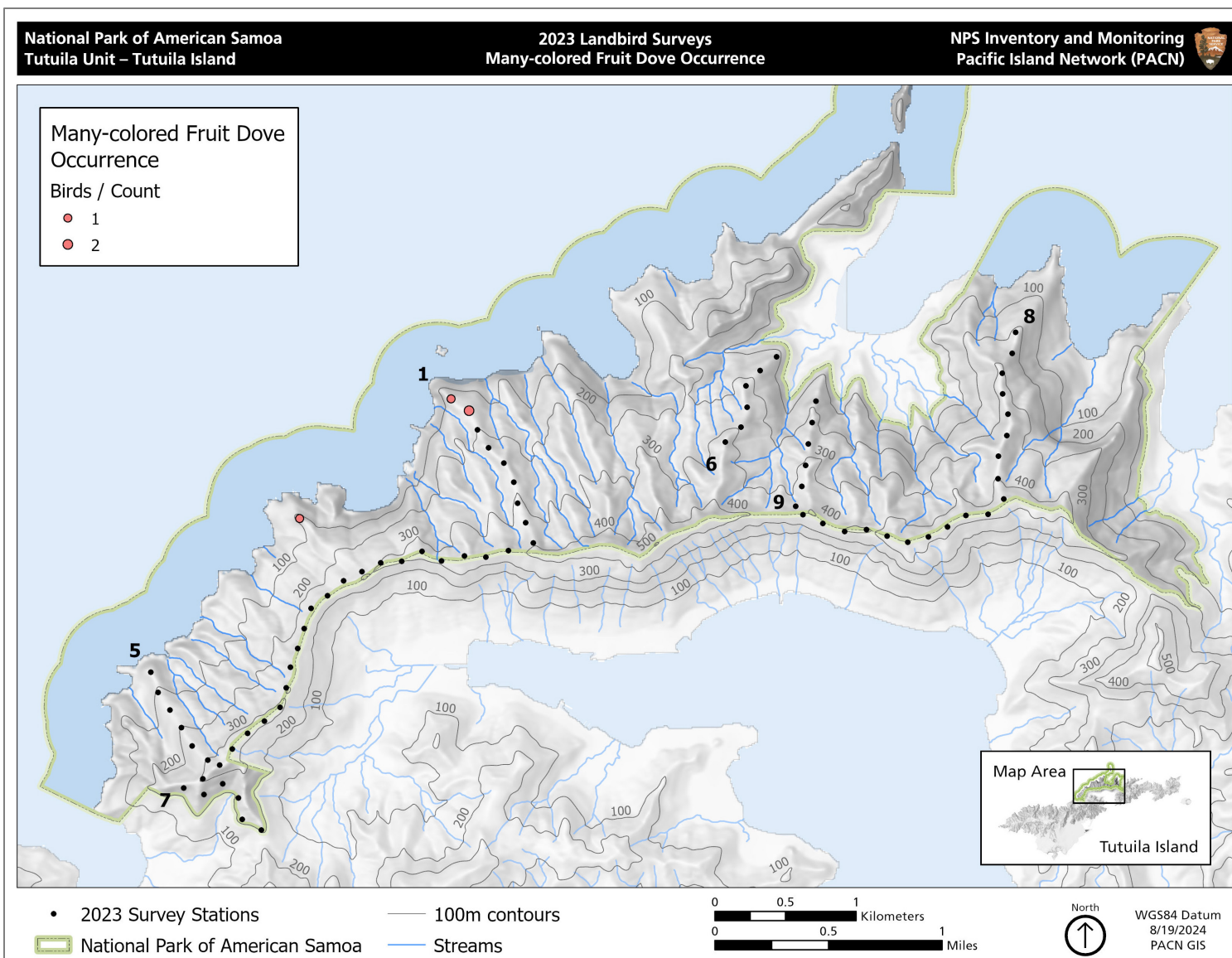


Figure 11. Many-colored Fruit Dove detections within the Tutuila Unit during the 2023 landbird survey.

NPS

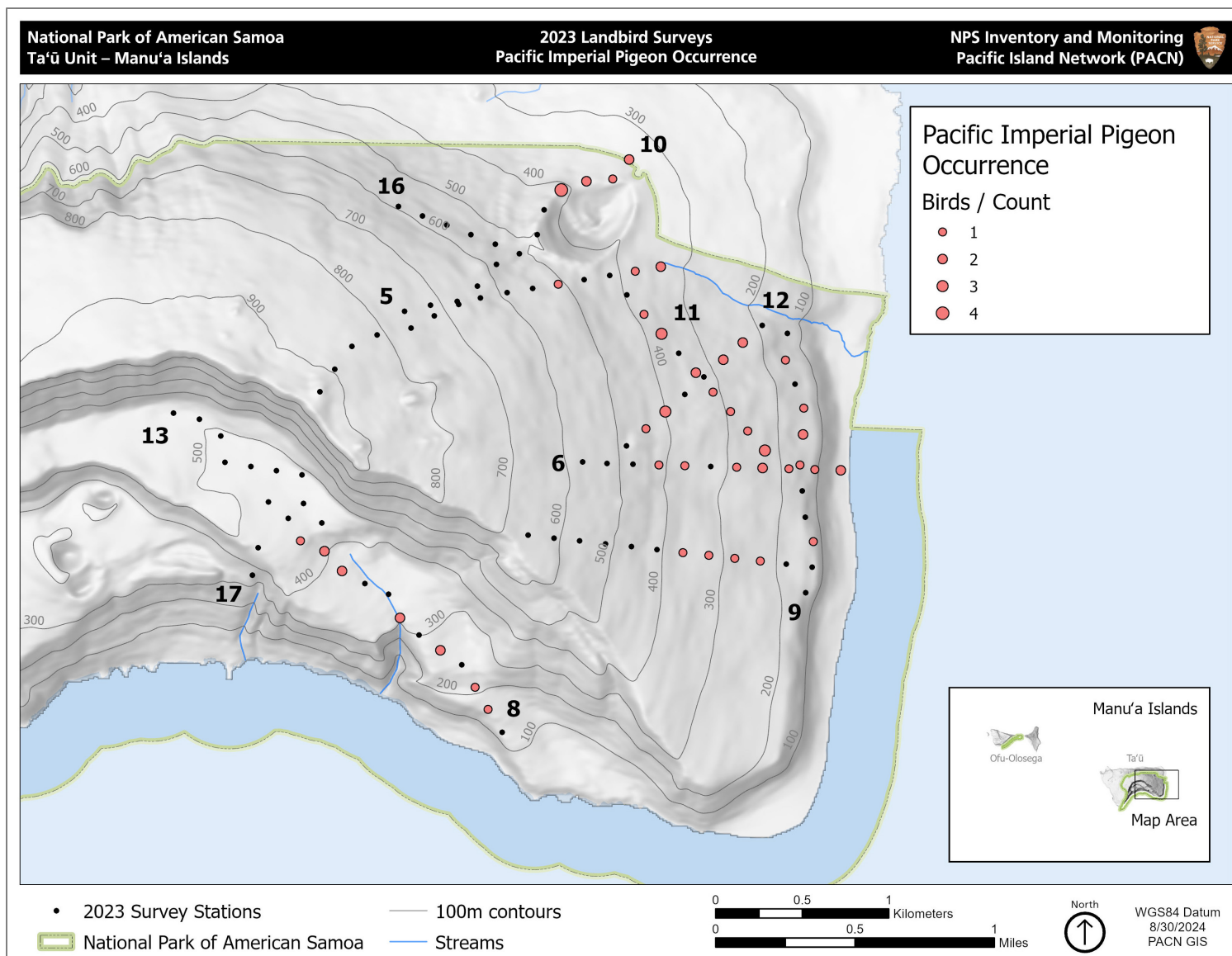


Figure 12. Pacific Imperial Pigeon detections within the Ta'ū Unit during the 2023 landbird survey.

NPS

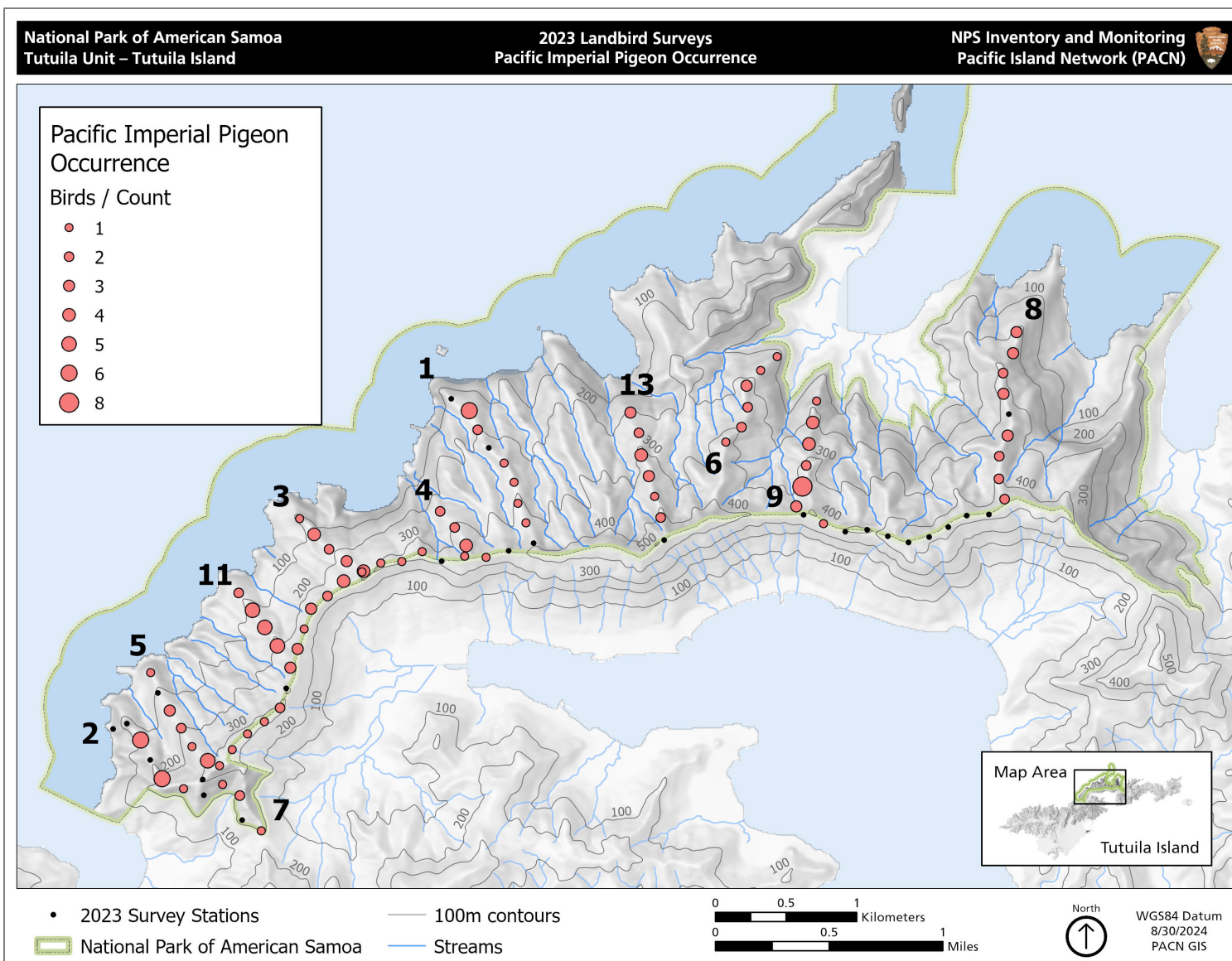


Figure 13. Pacific Imperial Pigeon detections within the Tutuila Unit during the 2023 landbird survey.

NPS

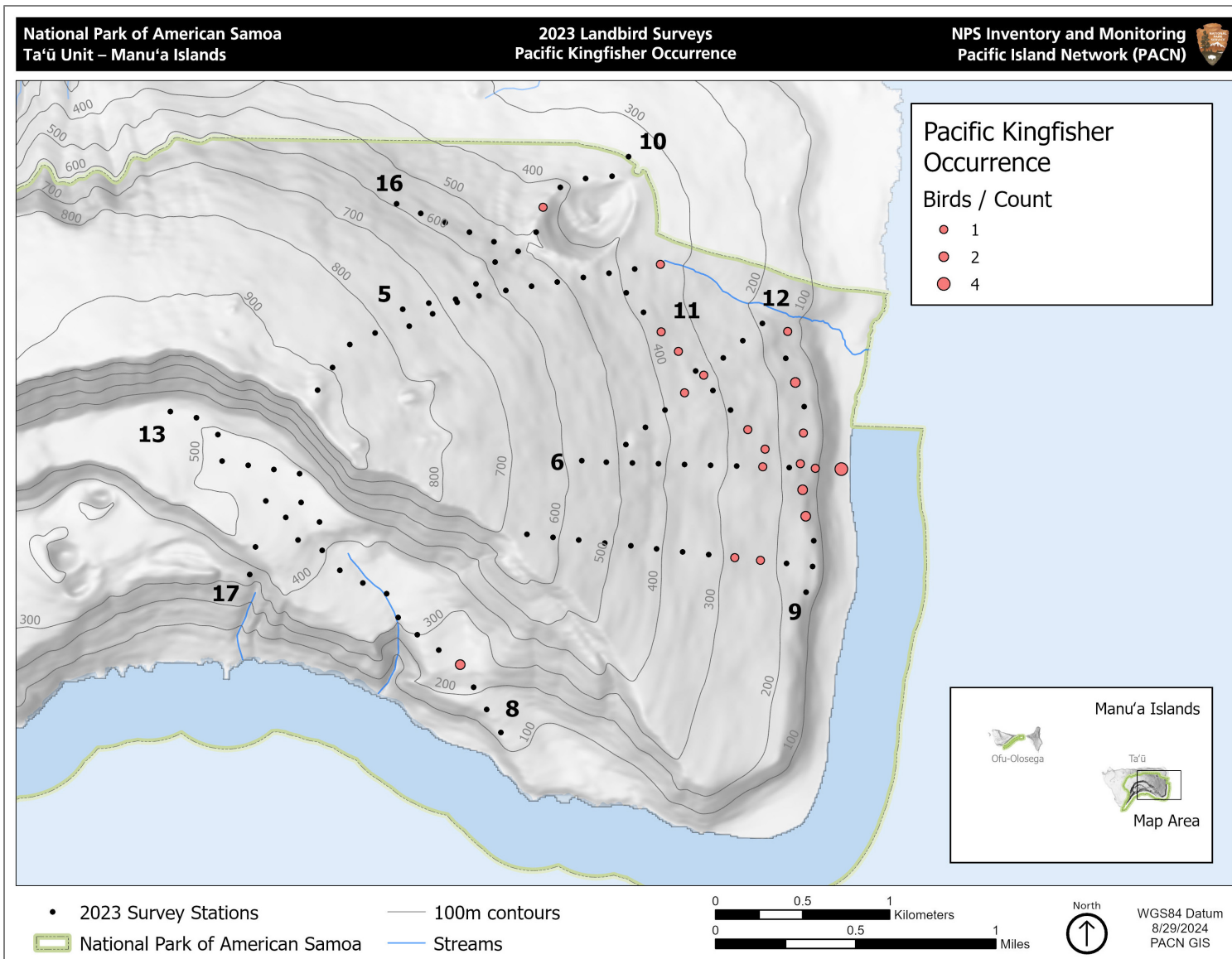


Figure 14. Pacific Kingfisher detections within the Ta'ū Unit during the 2023 landbird survey.

NPS

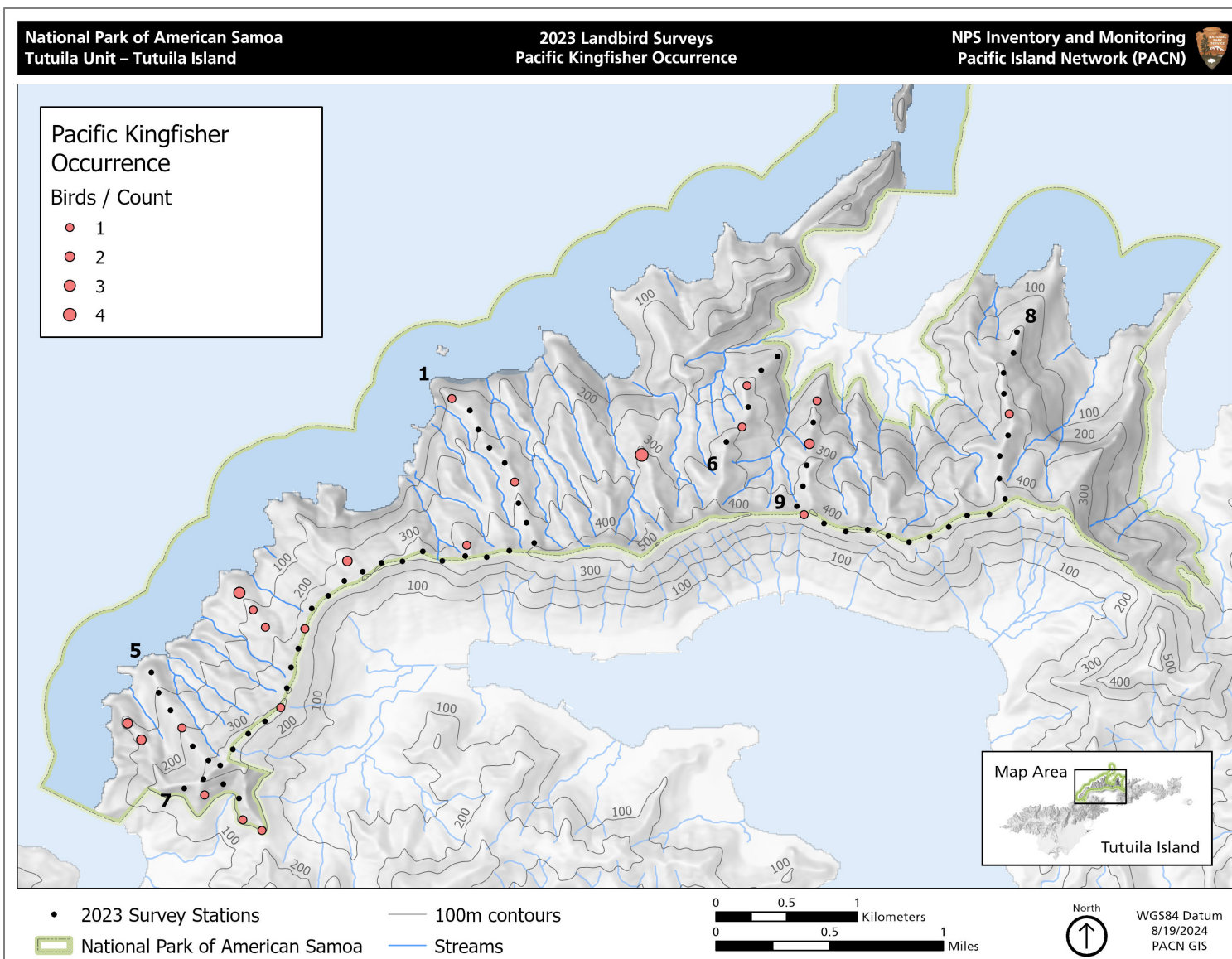


Figure 15. Pacific Kingfisher detections within the Tutuila Unit during the 2023 landbird survey.

NPS

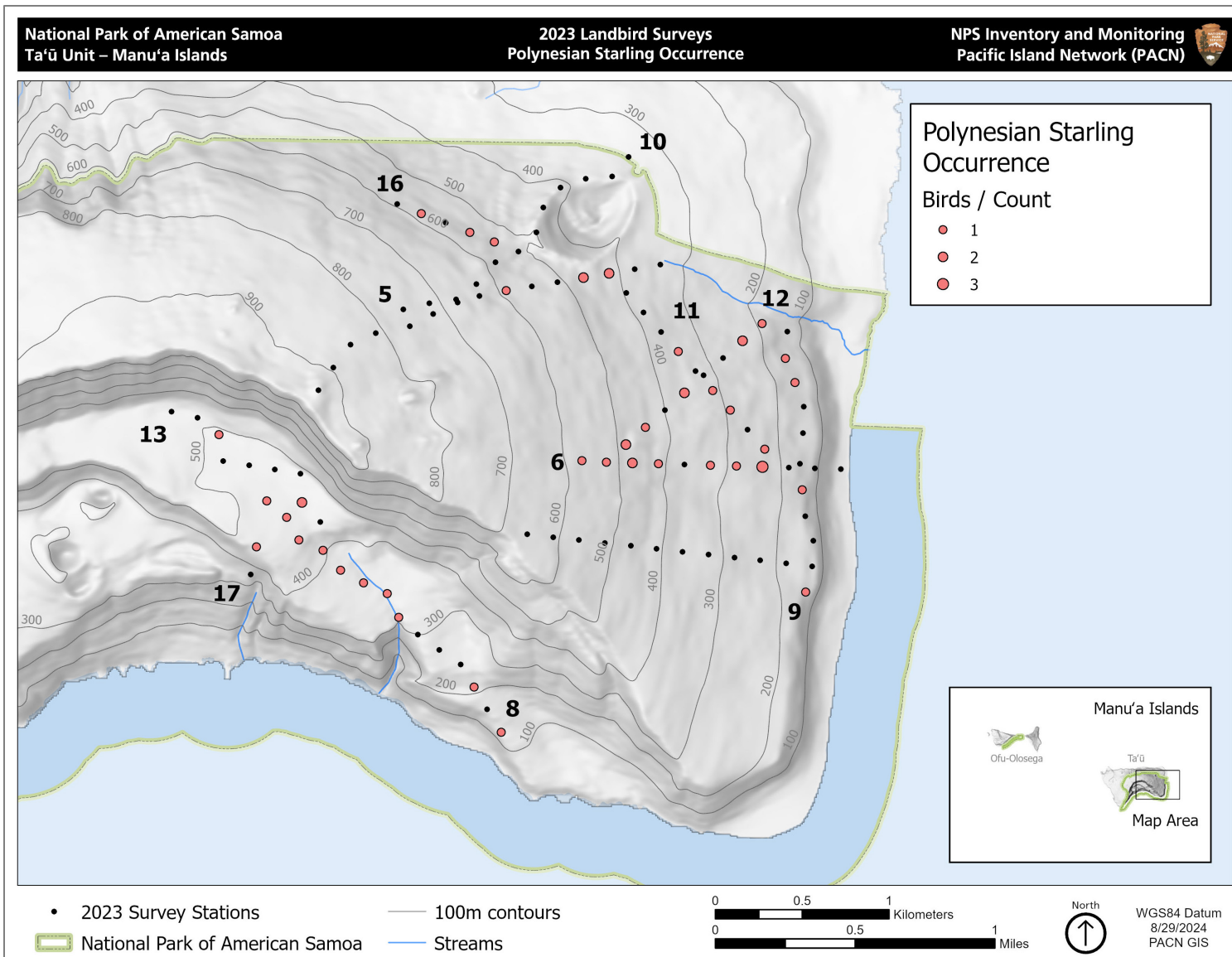


Figure 16. Polynesian Starling detections within the Ta'ū Unit during the 2023 landbird survey.

NPS

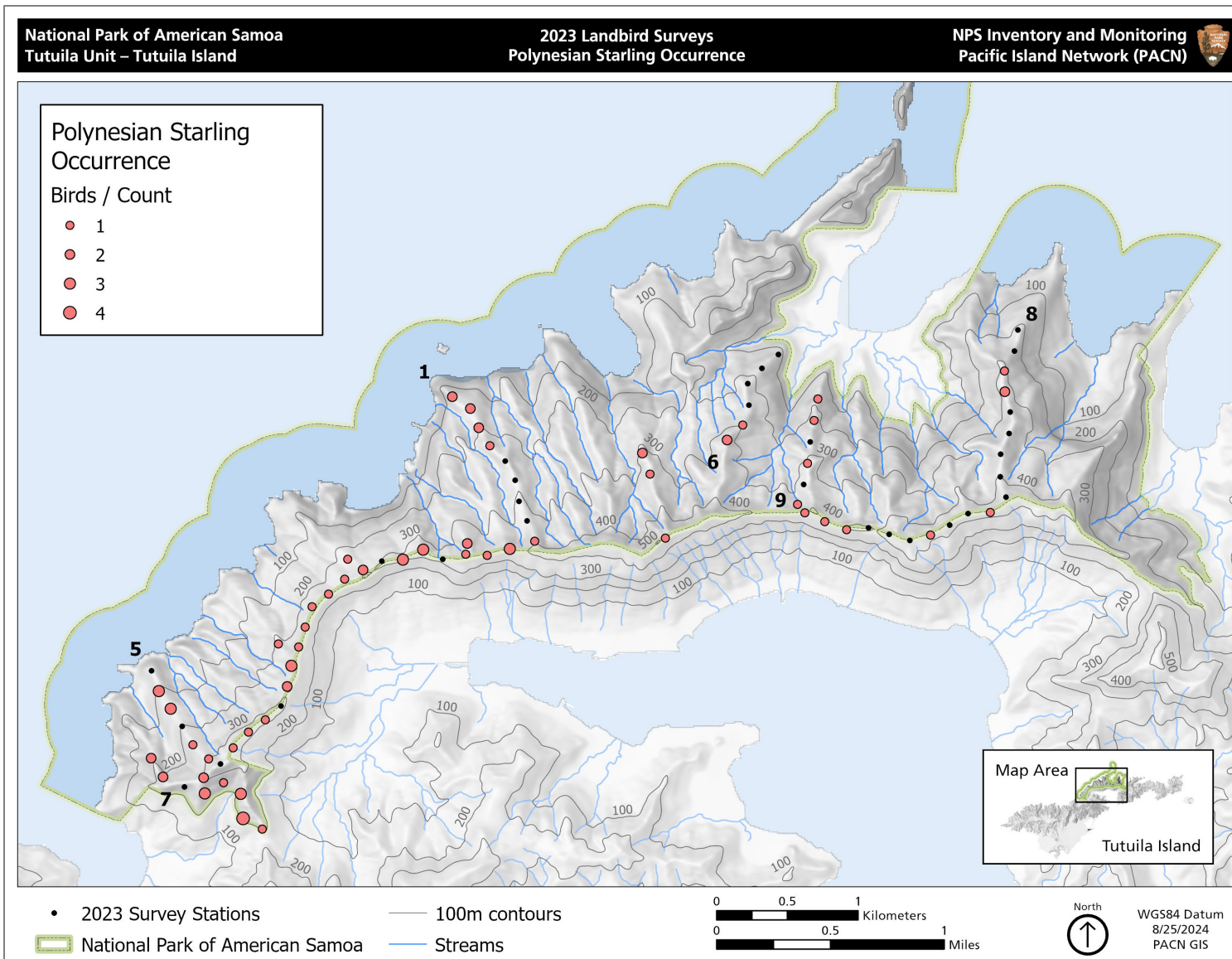


Figure 17. Polynesian Starling detections within the Tutuila Unit during the 2023 landbird survey.

NPS

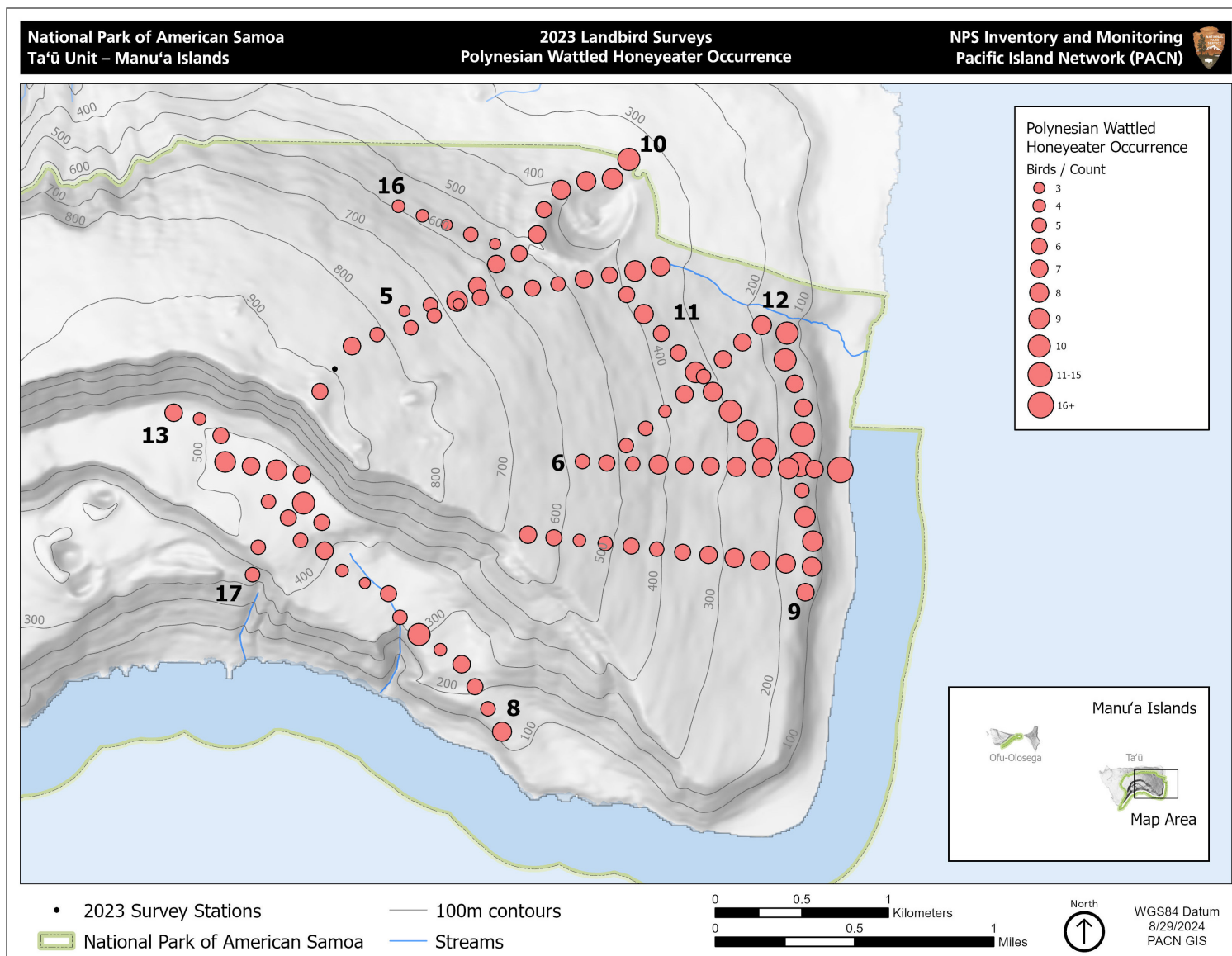


Figure 18. Polynesian Wattled Honeyeater detections within the Ta'ū Unit during the 2023 landbird survey.

NPS

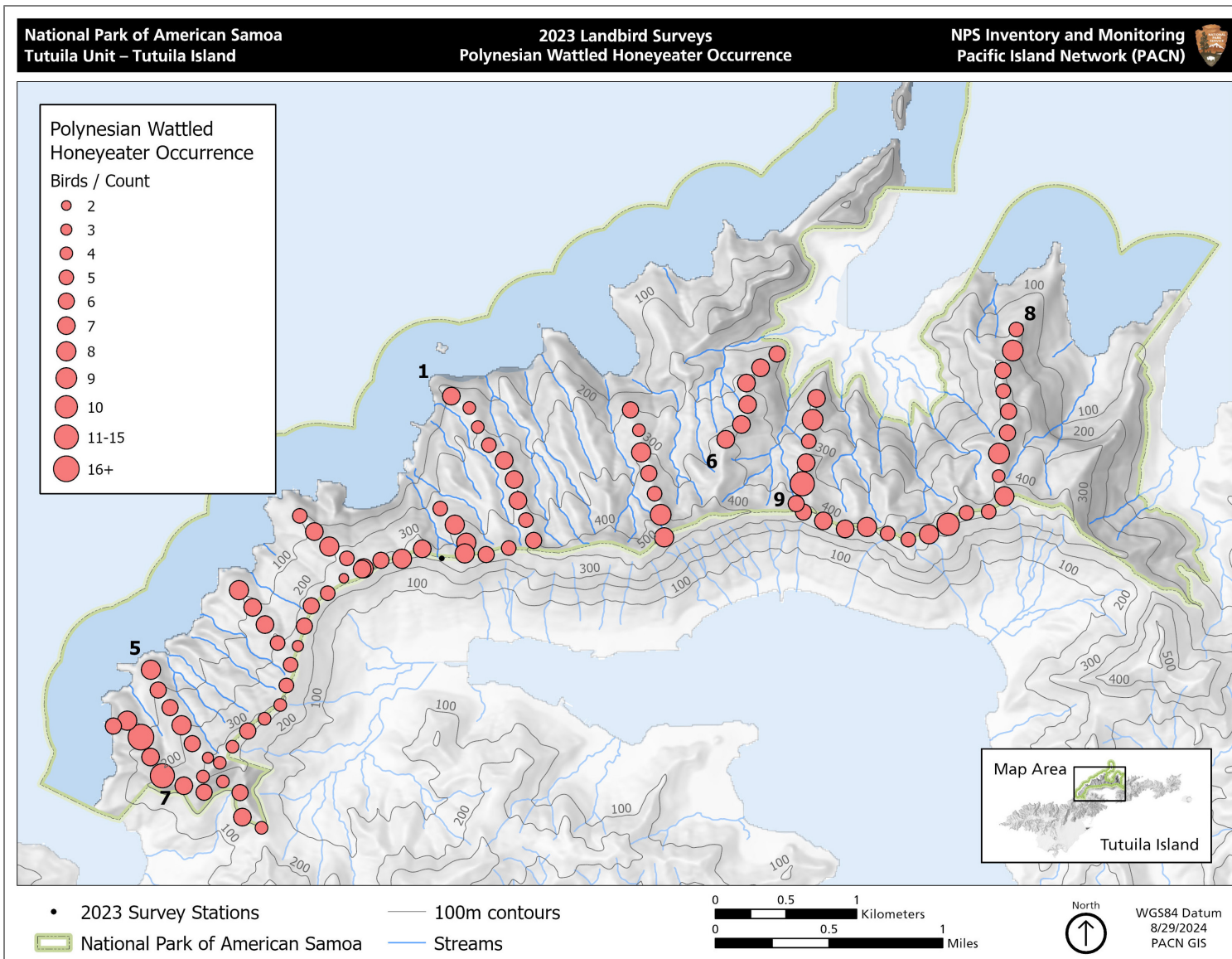


Figure 19. Polynesian Wattled Honeyeater detections within the Tutuila Unit during the 2023 landbird survey.

NPS

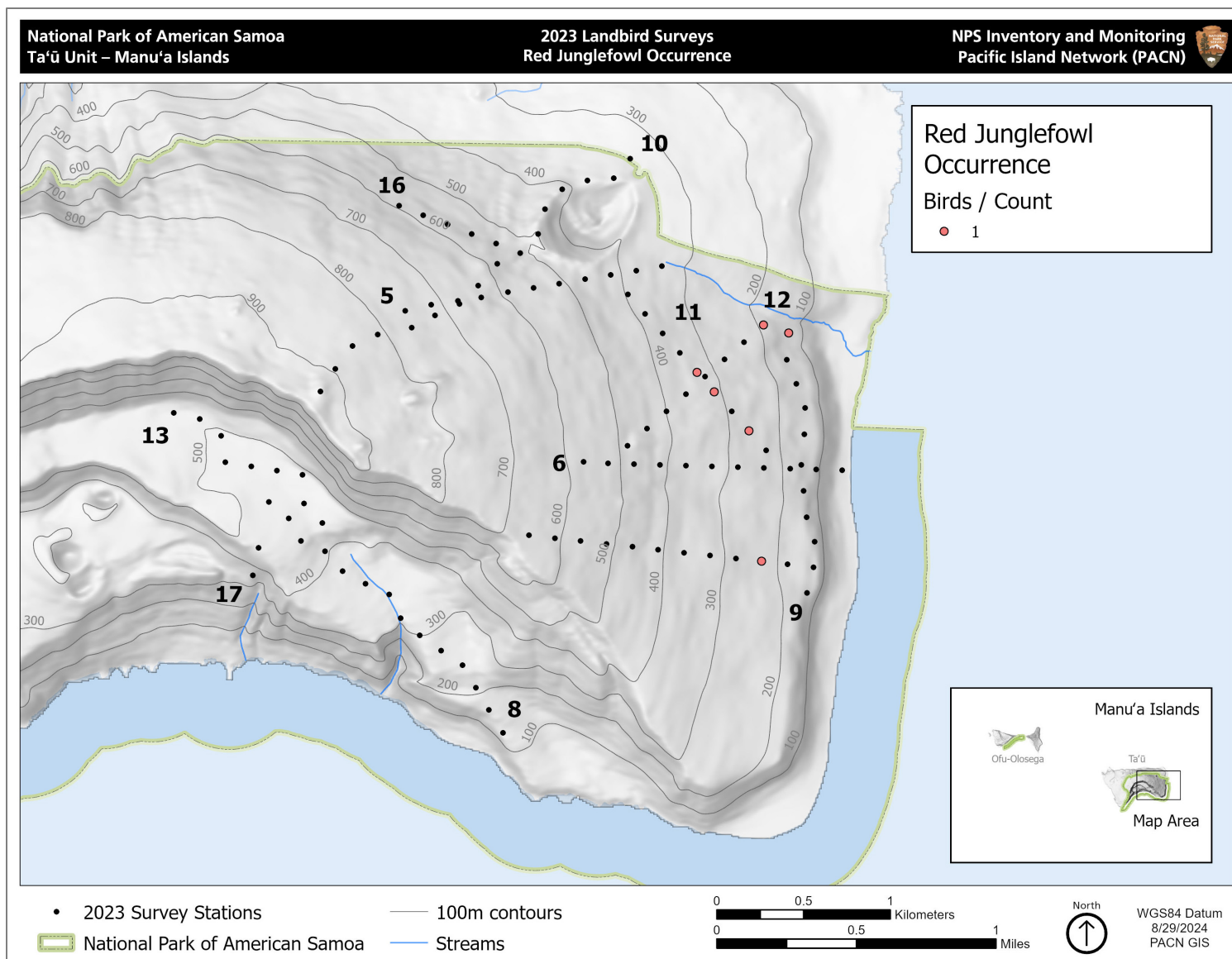


Figure 20. Red Junglefowl detections within the Ta'ū Unit during the 2023 landbird survey.

NPS

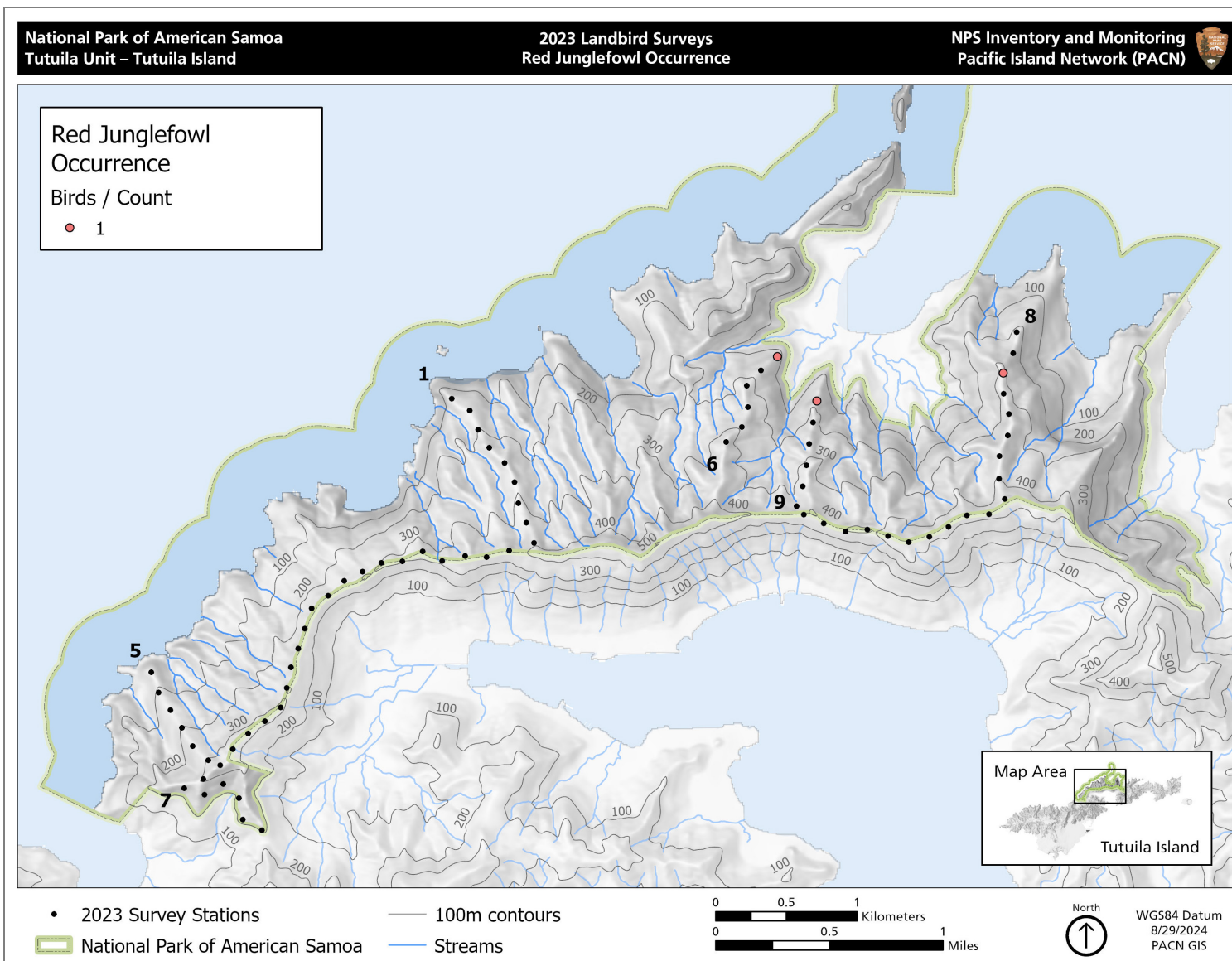


Figure 21. Red Junglefowl detections within the Tutuila Unit during the 2023 landbird survey.

NPS

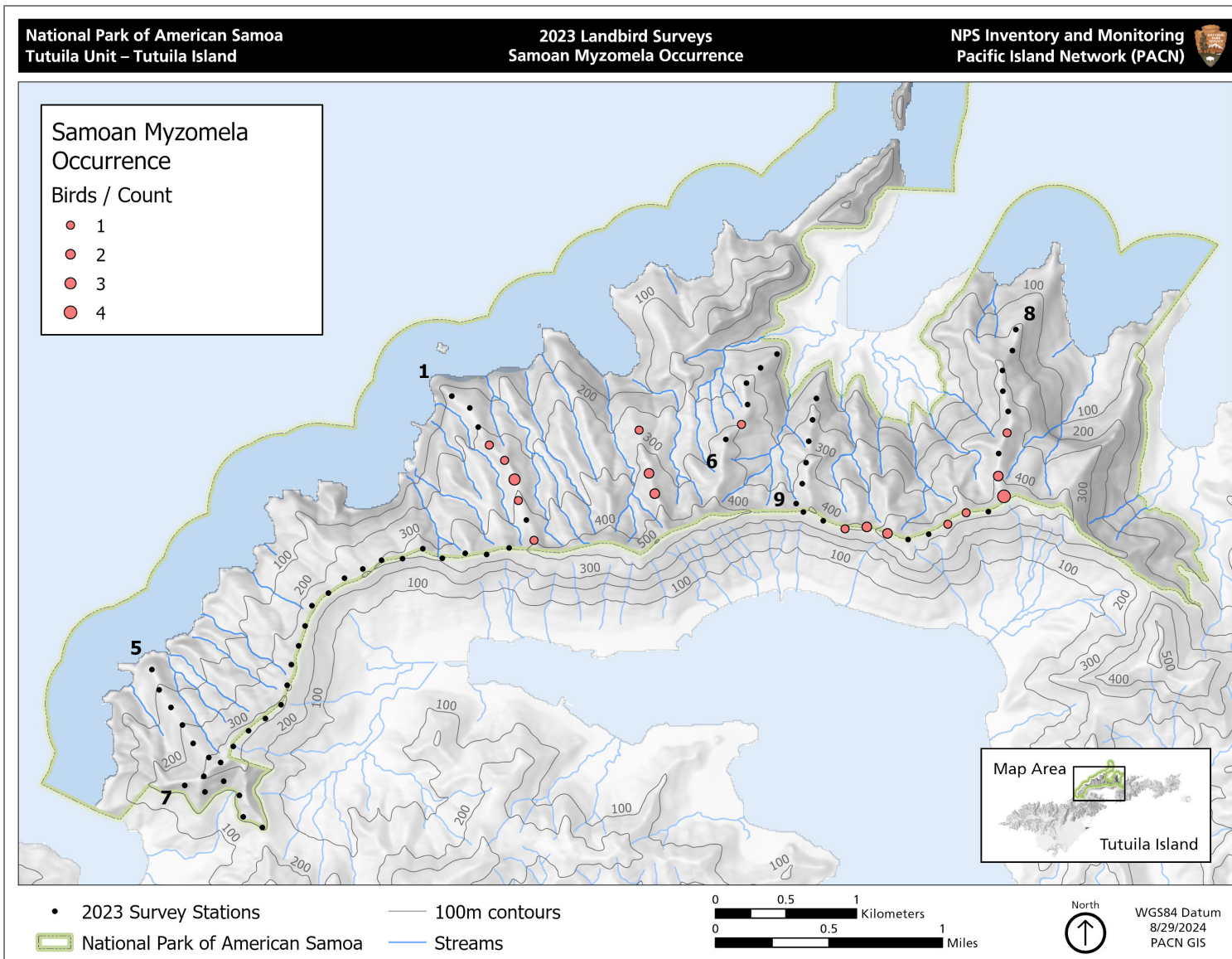


Figure 22. Samoan Myzomela detections within the Tutuila Unit during the 2023 landbird survey.

NPS

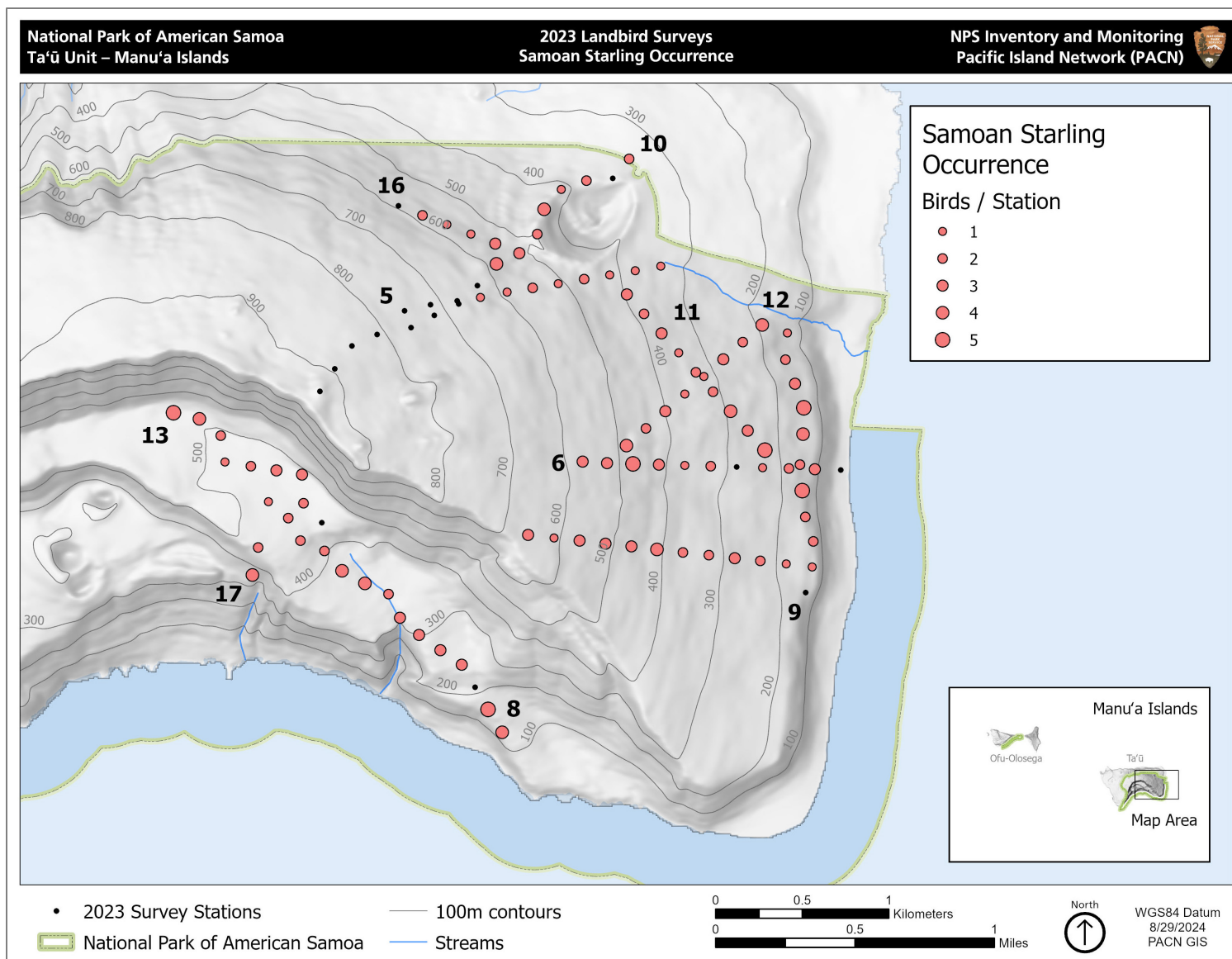


Figure 23. Samoan Starling detections within the Ta'ū Unit during the 2023 landbird survey.

NPS

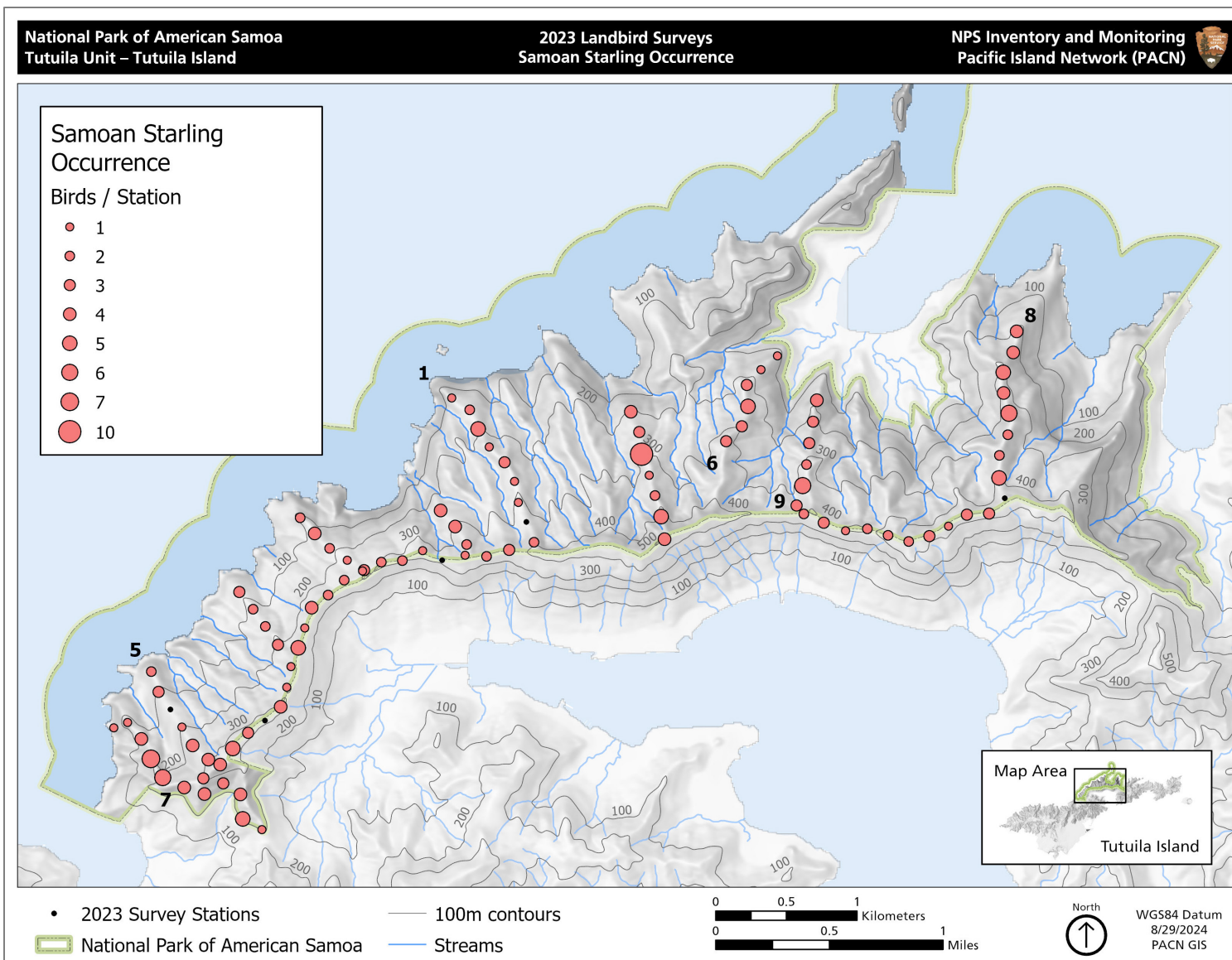


Figure 24. Samoan Starling detections within the Tutuila Unit during the 2023 landbird survey.

NPS

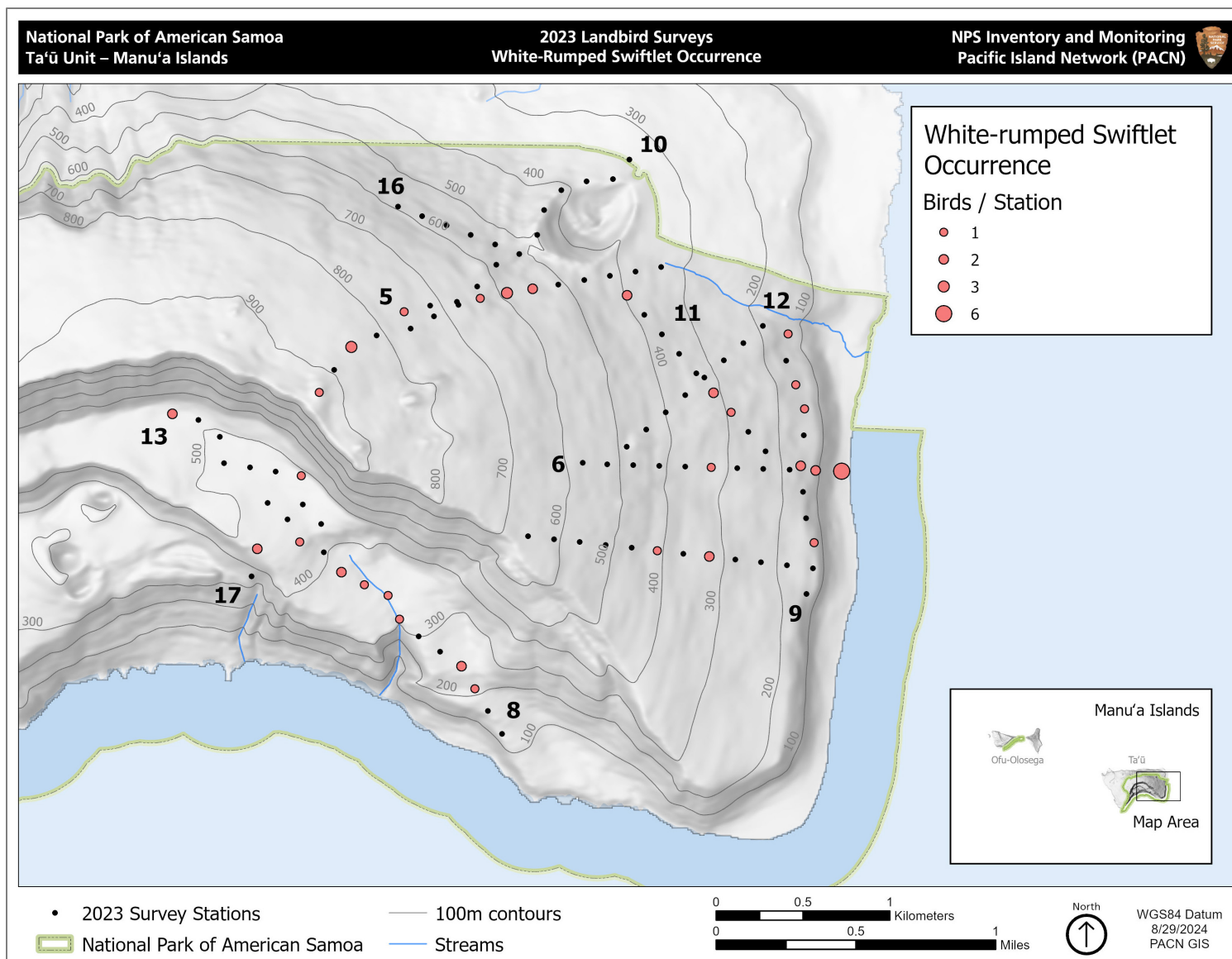


Figure 25. White-rumped Swiftlet detections within the Ta'ū Unit during the 2023 landbird survey.

NPS

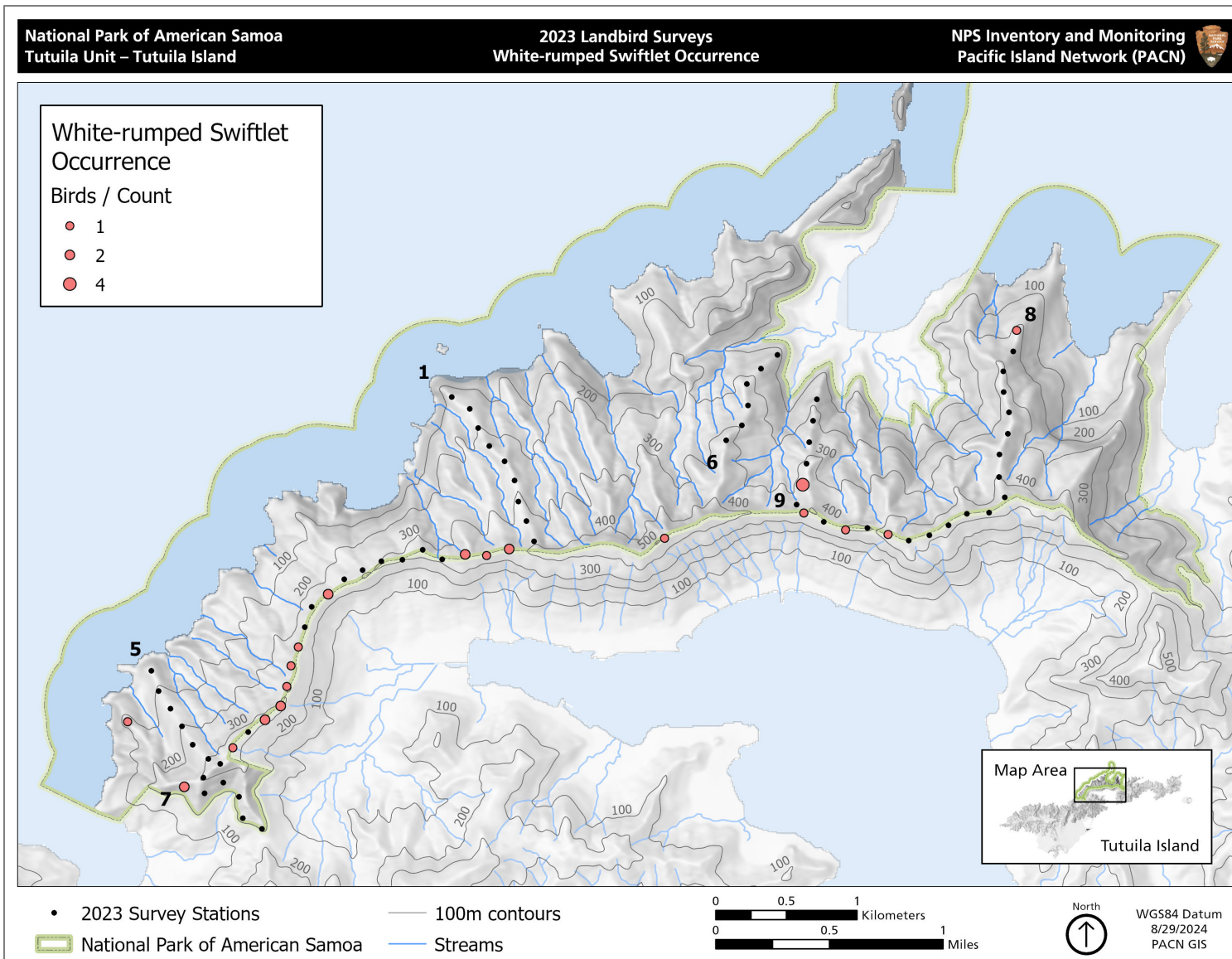


Figure 26. White-rumped Swiftlet detections within the Tutuila Unit during the 2023 landbird survey.

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Appendix C: Acoustic Monitoring

Using a Song Meter Mini (Wildlife Acoustics, Inc.), we recorded 25 hours of acoustic data near the summit of Lata Mountain, elevation 1,008 m, in an effort to detect the Spotless Crake (Vai; *Zapornia tabuensis*) and Tongan Ground Dove (Tu‘aimeo; *Pampusana stairi*; refer to Methods). Neither the Spotless Crake nor Tongan Ground Dove were detected, however, a sample of spectrograms for incidentally detected species are provided in Figures 27–30. These are not a comprehensive sample of landbird species detected during point count surveys (refer to Results). Spectrograms were produced in RavenPro (ver. 1.5; Cornell Lab of Ornithology, Ithaca, NY).

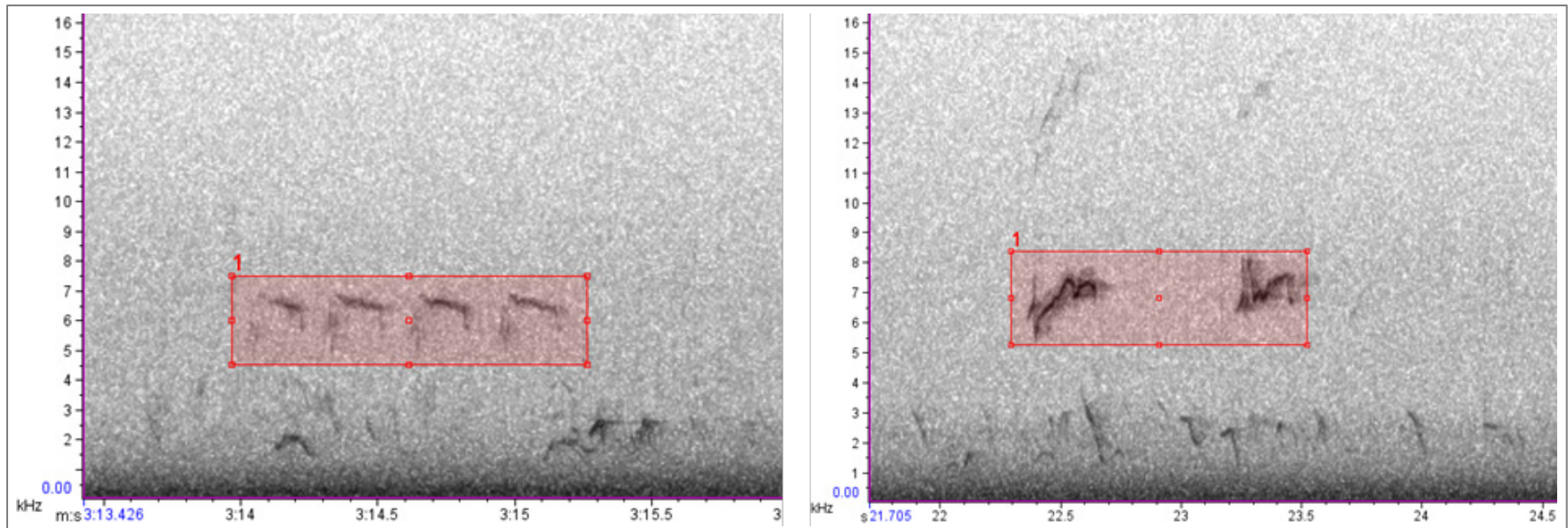


Figure 27. Blue-crowned Lorikeet (Sega; *Vini australis*) calls (selected in red) recorded near the summit of Lata Mountain between July 22 and 27, 2023.

NPS

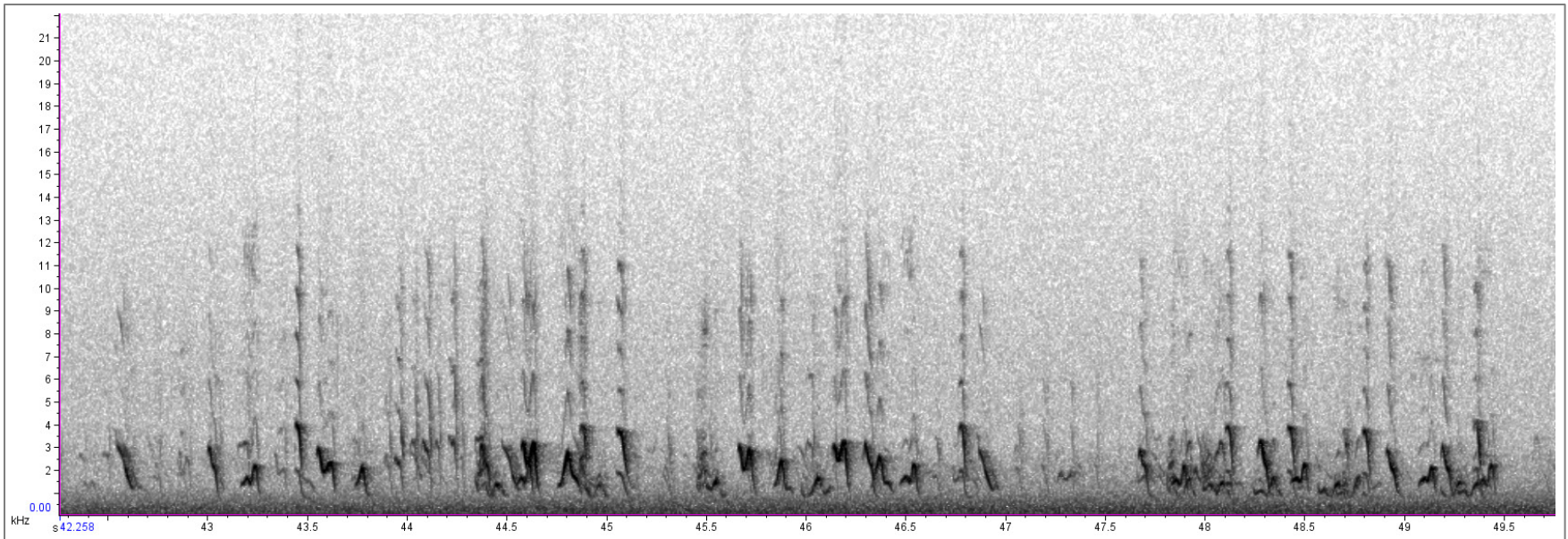


Figure 28. Polynesian Wattled Honeyeater (lao; *Foulehaio carunculatus*) calls recorded near the summit of Lata Mountain between July 22 and 27, 2023.

NPS

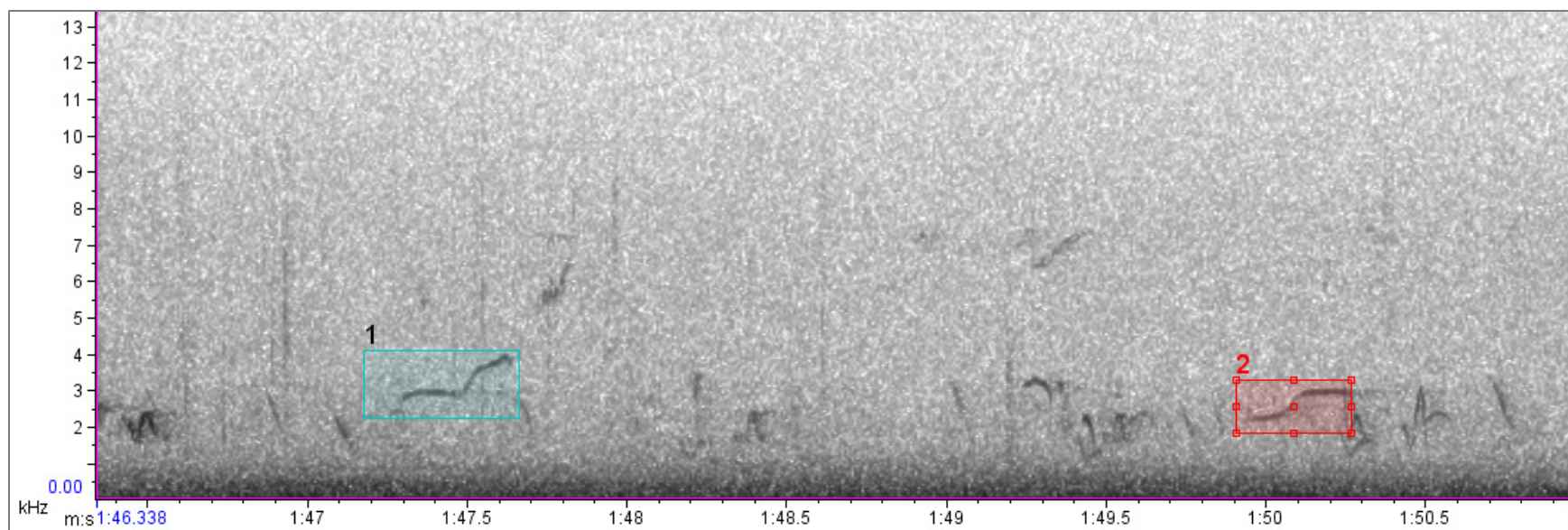


Figure 29. Samoan Starling (Fuia; *Aplonis atrifusca*) calls (selected in blue and red) recorded near the summit of Lata Mountain between July 22 and 27, 2023.

NPS

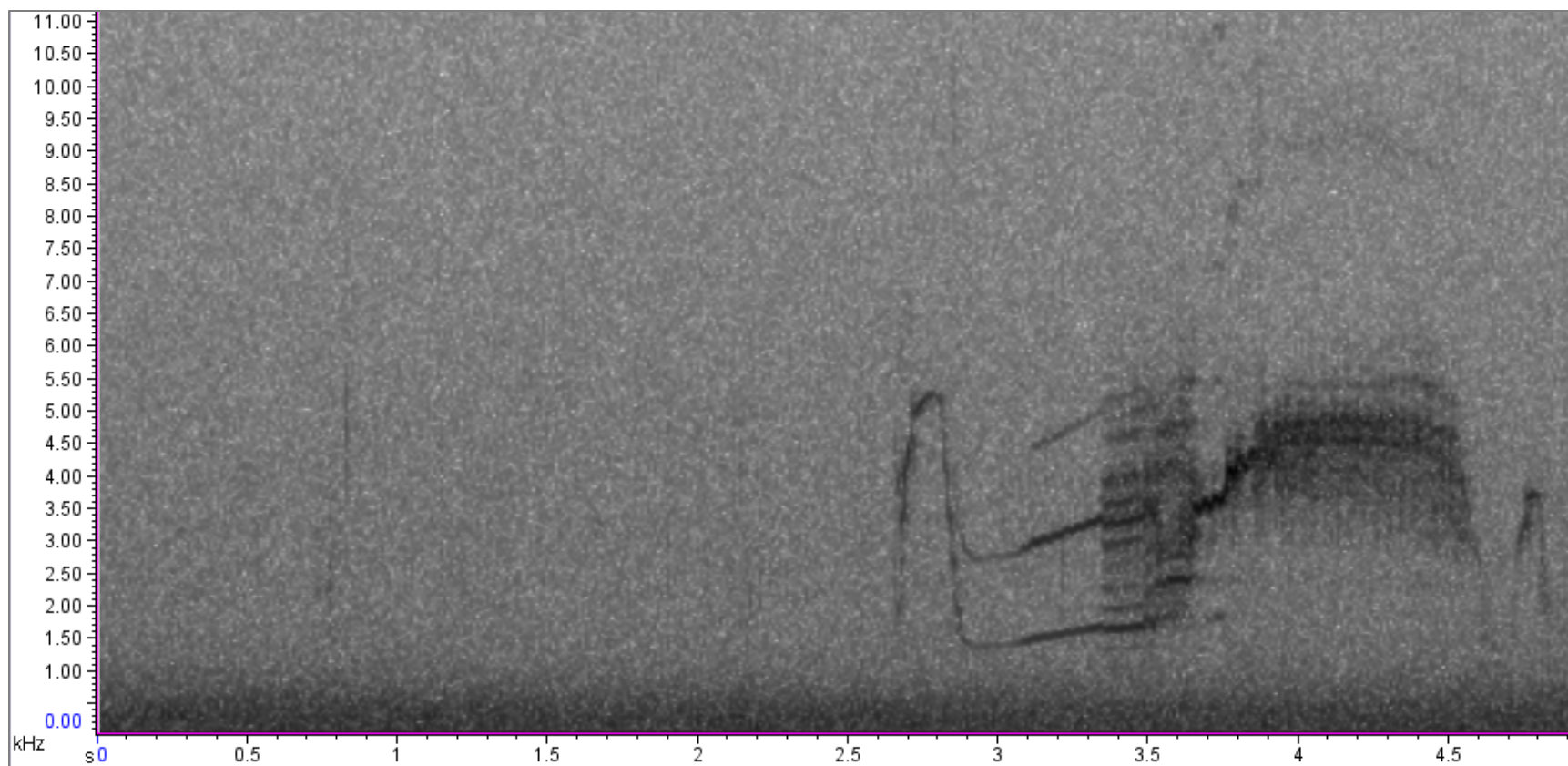


Figure 30. A Tahiti Petrel (Ta'i'o; *Pseudobulweria rostrata*) call captured on 22 July, 2023 on Lata Mountain.

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Appendix D: Habitat Survey Results

Ta'ū Unit

Habitat composition tables for the Ta'ū Unit are presented below (Tables 20–24). See the file of supplemental materials for the results of a “Relationships between landbird densities and forest structure in the National Park of American Samoa, 2011–2023” (Hunt et al. 2026).

Table 20. Dominant canopy species surveyed within the Ta'ū Unit during the 2023 landbird survey.

Dominant Canopy Species	Count	Occurrence (% of Stations)
<i>Syzygium samoense</i>	21	19.6%
<i>Didymocheton maota</i>	16	15.0%
<i>Talipariti tiliaceum</i>	11	10.3%
<i>Cyathea/Sphaeropteris</i> spp. (Tree Ferns)	11	10.3%
<i>Syzygium inophylloides</i>	10	9.3%
<i>Pterophylla affinis</i>	9	8.4%

Table 21. Canopy cover classes of the Ta'ū Unit landbird monitoring stations in 2023.

Canopy Cover	Count	Occurrence (% of Stations)
Closed (>60% cover)	82	76.6%
Open (25–60% cover)	12	11.2%
Scattered (5–25% cover)	13	12.1%

Table 22. Canopy height classes of the Ta'ū Unit landbird monitoring stations in 2023.

Canopy Height	Count	Occurrence (% of Stations)
3 (>10m tall)	62	57.9%
2 (5–10m tall)	39	36.4%
1 (2–5m tall)	6	5.6%

Table 23. Dominant understory composition classes documented at landbird monitoring stations in the Ta'ū Unit (50-m radius plot) in 2023.

Dominant Understory Class	Count	Occurrence (% of Stations)
Tree Ferns (<i>Cyathea</i> spp.)	32	29.9%
Bare Ground	23	21.5%
<i>Freycinetia</i> spp.	22	20.6%
Native Ferns	20	18.7%

Table 23 (continued). Dominant understory composition classes documented at landbird monitoring stations in the Ta'ū Unit (50-m radius plot) in 2023.

Dominant Understory Class	Count	Occurrence (% of Stations)
Tree Ferns (<i>Cyathea</i> spp.) – <i>Freycinetia</i> spp.	6	5.6%
Native Ferns – Tree Ferns (<i>Cyathea</i> spp.)	2	1.9%
Other	2	1.9%

Table 24. Number of stations detected with invasive plant species and percent occurrence among landbird monitoring stations in the Ta'ū Unit (50-m radius plot) in 2023.

Species	Count	Occurrence (% of Stations)
<i>Adenanthera pavonina</i>	8	7.5%
<i>Decalobanthus peltatus</i>	1	0.9%
<i>Hellenia speciosa</i>	12	11.2%
<i>Miconia crenata</i>	89	83.2%
<i>Mikania micrantha</i>	1	0.9%
No Invasives	10	9.5%

Tutuila Unit

Habitat composition tables for the Tutuila Unit are presented below (Tables 25–29).

Table 25. (Co)dominant canopy species surveyed within the Tutuila Unit during the 2023 landbird survey.

(Co)dominant Canopy Species	# of Landbird Stations	Percent
<i>Melanococca tomentosa</i>	30	30.9%
<i>Syzygium inophylloides</i>	27	27.8%
<i>Myristica inutilis</i>	7	7.2%
<i>Alphitonia zyzyphoides</i> - <i>Syzygium inophylloides</i>	5	5.2%
<i>Palaquium stehlinii</i>	4	4.1%

Table 26. Canopy cover classes of the Tutuila Unit landbird monitoring stations in 2023.

Canopy Cover	Count	Percent
Closed (>60% cover)	95	97.9%
Open (25–60% cover)	2	2.1%
Scattered (5–25% cover)	0	0%

Table 27. Canopy height classes of the Tutuila Unit landbird monitoring stations in 2023.

Canopy Height	Count	Percent
3 (>10m tall)	83	85.6%
2 (5–10m tall)	14	14.4%
1 (2–5m tall)	0	0%

Table 28. Dominant understory composition classes documented at landbird monitoring stations in the Tutuila Unit (50-m radius plot) in 2023.

Dominant Understory Class	Count	Percent
Bare Ground	35	36.1%
Native Ferns	20	20.6%
<i>Freycinetia</i> spp.	16	16.5%
Tree Ferns (<i>Cyathea</i> spp.)	7	7.2%
<i>Freycinetia</i> spp.—Bare Ground	4	4.1%
Other	15	15.5%

Table 29. Number of stations detected with invasive plant species and percent occurrence among landbird monitoring stations in the Tutuila Unit (50-m radius plot) in 2023.

Species	Count	Percent
<i>Adenanthera pavonina</i>	16	16.8%
Exotic Grasses	8	8.4%
Exotic Vines	3	3.2%
<i>Falcataria falcata</i>	17	17.9%
<i>Hellenia speciosa</i>	41	43.2%
<i>Hyptis capitata</i>	6	6.3%
<i>Leucaena leucocephala</i>	3	3.2%
<i>Miconia crenata</i>	56	58.9%
<i>Mikania micrantha</i>	9	9.5%
<i>Mimosa</i> spp.	13	13.7%
<i>Stachytarpheta jamaicensis</i>	10	10.5%
Unknown Trailside Weeds	1	1.1%
No Invasives	9	9.5%

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