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**MICRONESIAN RUFOUS FANTAIL (*Rhipidura versicolor*)**ROBERT J. CRAIG<sup>1</sup>

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**INTRODUCTION**

The Micronesian Rufous Fantail (*Rhipidura versicolor*), or Chuchurica in the Chamorro language, is a bird species of the western tropical Pacific's Mariana Islands and Yap. It has received limited study beyond periodic population surveys and there is virtually no information on the Yap population. In addition to studies into its population status and trends, investigations in the Mariana Islands have been conducted into its molts and plumages, population dynamics, foraging ecology, microhabitat use and social behavior. This member of the Australasian Rhipiduridae has dense populations across much of its range. One subspecies is known historically from the islands of Saipan, Tinian and Aguiguan, another occurs on Rota, still another occurs on Yap and a now extinct subspecies occurred on Guam.

The slender proportions, dark brown and rusty plumage and long tail cocked upward and fanned out separate this species from all others within its limited range. It defends all-purpose territories and often may be found foraging in family groups. Individuals principally forage by sallying out from a perch to capture flying insects in the forest understory. Population densities in the Mariana Islands are by far the greatest in native forest, although birds also occupy a variety of alien wooded habitats. Evidence suggests that breeding occurs year-round.

Although still abundant, the species is threatened with extirpation from its range by the possible introduction of the brown tree snake (*Boiga irregularis*)—a non-native predator responsible for the extinction of the Guam subspecies. To aid in its conservation, it has been translocated to the more northerly, uninhabited Mariana Islands of Sarigan, Guguan and Alamagan.

**IDENTIFICATION****Field Identification**

The Micronesian Rufous Fantail is notable for its delicate proportions, long, white-tipped tail often cocked upward and fanned out, and dark brown upperparts. It has splashes of bright rusty brown on its forehead, tail base and flanks. This small, sexually monomorphic passerine typically occupies the forest understory.

**Similar Species**

The Micronesian Rufous Fantail was once thought to be conspecific with the Pohnpei Fantail (*R. kubaryi*) and Australian Rufous Fantail (*Rhipidura rufifrons*). *R. kubaryi* resembles *R. versicolor*, but it is larger, lacks rufous coloring, has a smaller and shorter white malar stripe and has white on the chin reduced. *R. rufifrons* is also similar to *R. versicolor* but it is lighter brown above, has a wider white malar stripe and has a more distinct cinnamon patch on the forehead. The Palau Fantail (*R. lepida*) differs in its mostly rufous plumage above and its lack of black breast speckling. There are also a num-

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ber of generally similar fantail species distributed among the Melanesian islands.

## PLUMAGES, MOLTS AND STRUCTURE

### Plumages

Micronesian Rufous Fantails (Fig. 1) have 10 functional primaries (numbered distally, from innermost p1 to outermost p10; p10 is reduced in length), 9 secondaries (numbered proximally, from outermost s1 to innermost s9, including 3 tertials, s7–s9 in passerines), and 12 rectrices (numbered distally on each side of the tail, from innermost r1 to outermost r6). Wings are rounded, with p6 usually the longest primary or p6 and p7 equally the longest (Boles 2006, Higgins et al. 2006). Rectrices are relatively broad at the tips and graduated, frequently presenting a fan-shaped appearance when in the field the tail is cocked or spread. Geographic variation in appearance is slight to moderate.

The following molt and plumage descriptions cover all subspecies and are based primarily on the descriptions of Baker (1951), Pratt et al. (1987), Boles (2006), and Higgins et al. (2006, for formerly conspecific Australian Rufous Fantail (*Rhipidura rufifrons*)), along with examination of Macaulay Library images; see Rogers et al. (1986), Higgins et al. (2006), Pyle et al. (2008) and Radley et al. (2011) for information on age and sex. Sexes are similar in all plumages; definitive appearance is assumed following the second prebasic molt. Seasonal timing of plumages (fresh vs. worn) is dependent on seasonality of breeding and molts, which appear to be year-round in at least some individuals among the Saipan population. There are perhaps bimodal peaks of breeding in February–May and September–November followed by bimodal peaks in molting during April–July and November–January (Pyle et al. 2008).

**Natal down.** Based on Macaulay Library images, the natal down is dark gray.

**Juvenile (first basic) plumage.** Juvenile plumage is similar to the definitive basic plumage but the upperparts are washed with rufous (caused by rufous fringing to feathers) and the upperwing secondary coverts have broad rufous tips which, if not molted, wear off during the first two months following fledging (Pyle et al. 2008). The throat is often washed brownish and the breast is brown with a rufous wash. Juvenile body feathers, especially the undertail coverts, are more loosely textured than basic feathers. The outer primaries and rectrices average narrower and more tapered or pointed at the tips than formative or basic feathers due to lower barb densities.

**Formative plumage.** This plumage is similar to the definitive basic plumage but some birds can be distinguished by molt limits between worn juvenile

and fresh formative feathers among the upperwing coverts. From two to nine upperwing coverts are replaced during the preformative molt (Radley et al. 2011), and are fresher, dark brown and without rufous tips, which contrast with more worn outer coverts that have rufous tips fading to buff when fresher. Replaced coverts can be at various positions among the tract. Retained juvenile primary coverts are browner with reduced or no pale edging, which contrasts with newer formative greater coverts. Retained juvenile outer primaries and rectrices are thinner, more tapered or pointed at the tips and are relatively more worn. Some and perhaps most birds on Saipan may undergo complete preformative molts and be indistinguishable from those in definitive basic plumage (Pyle et al. 2008, Radley et al. 2011). Others may show suspension limits among primaries and secondaries and have retained juvenile outer primaries.

**Definitive basic plumage.** Prominent black rictal bristles are present at the base of the bill and are nearly as long or longer than the bill. The forehead is rufous, with this color extending behind the eye to form an abbreviated supercilium. The remainder of the crown and sides of the head, nape and upper back are uniformly brown. The auriculars are often darker. The lower back, rump and uppertail coverts are rufous. The rectrices have the basal half rufous and distal half dark brown with white tips, with the width of the tips expanding from narrow on the central rectrices (r1) to wider on the outer rectrices (r6). The upperwing coverts are brown to dusky brown, although some birds lack rufous tips on all coverts and others have rufous tips on some feathers—most commonly the outer median and greater coverts. The primaries and secondaries are uniformly dusky brown to brown. The chin and throat are white or variably speckled with black by subspecies. Below the throat there is a narrow blackish band that extends across the upper breast and transitions to whitish to white on the lower underparts. There are black spots on the mid-breast and belly and ventrally the feathers are whitish without markings to the undertail coverts. The sides and flanks are variably washed with gray. The underwing coverts are mostly whitish, although some feathers have a dusky center.

The definitive basic plumage is separated from the formative plumage in having the upperwing coverts uniform in quality and freshness and the primary coverts duskier and not contrasting in feather quality with greater coverts. The basic outer primaries and rectrices are broader, more truncate, duskier, and relatively fresher (Pyle 2022). Some birds show suspension limits among the basic primaries and secondaries.

### Molts

Molt and plumage terminology fol-



FIG. 1. A Saipan Micronesian Rufous Fantail adult.

lows Humphrey and Parkes (1959) as modified by Howell et al. (2003). Under this nomenclature, terminology is based on the evolution of molts along ancestral lineages from ecdysis (molts) of reptiles rather than on molts relative to breeding season, location or time of the year. The Micronesian Rufous Fantail exhibits a complex basic strategy (cf. Howell et al. 2003, Howell 2010b), which includes complete prebasic molts and a partial-to-complete preformative molt but no prealternate molts (Pyle et al. 2008, Radley et al. 2011; see also Higgins et al. 2006 for molt strategies in the formerly conspecific Australian Rufous Fantail (*Rhipidura rufifrons*)). Breeding and perhaps molts appear to occur year-round in Saipan Micronesian Rufous Fantails, with possible peaks occurring during April–July and November–January following peaks of breeding in February–May and September–November (Pyle et al. 2008).

**Prejuvenile (first prebasic) molt.** This is complete and occurs in the nest. No details are known about this molt.

**Preformative molt.** The preformative molt appears to vary from partial to complete (Pyle et al. 2008, Radley et al. 2011). On Saipan, it can include some to all (2–9) greater coverts and, at times, the carpal covert. Complete preformative molts may be those of birds that hatched in February–May undergoing a complete molt during the second peak in September–November (Radley et al. 2011). More study is needed.

**Definitive prebasic molt.** This molt is complete.

On Saipan, unusual variation in the sequence of primary replacement was found at capture stations (Junda et al. 2012). Most captures (62%) followed a typical replacement sequence, with primaries replaced distally from p1 to p10, as is typical of most passerines, but in the remaining 38% molt commenced from a node at p2 (3% of birds), p3 (77%), p3 or p4 (12%), or p4 (8%). Females and individuals undergoing the second prebasic molt were more likely to have a center among primaries 2–4 than males and older birds. Two females that showed normal distal replacement one year showed a node at p3 or p4 the following year, indicating that the node could vary inter-annually in an individual. Nodes other than p1 are an unusual strategy among passerines (Kiat 2017).

#### Bare Parts

Information below is based on descriptions in Rogers et al. (Rogers et al. 1986) and Higgins et al. (Higgins et al. 2006) for the formerly conspecific Australian Rufous Fantail, along with examination of Macaulay Library images.

**Bill.** In adults, the bill is dark gray to blackish, sometimes with a pink tinge to the base of lower mandible. In nestlings and juveniles, it can be pinkish or yellowish with a dark tip. The gape can be yellow or yellow-orange in nestlings and juveniles and is black in adults.

**Iris.** The iris is dark brown at all ages.



FIG. 2. A Micronesian Rufous Fantail on Saipan illustrating that foraging birds do not always fan their tail.

**Tarsi and toes.** In adults, the legs and feet are pinkish brown, grayish, or blackish, with grayish-yellow soles to the feet. In nestlings and juveniles, the legs and feet can be pinker.

#### Measurements

**Linear measurements.** The earliest reported measurements, although the details of measurement procedure are lacking, are for Saipan Micronesian Rufous Fantails. Hartert (1898) reported the total length of a Saipan adult male as 151 mm, wing 69 mm, tail 80 mm, bill 8 mm and tarsus 19 mm. Guam birds had measurements as follows: females total length =  $139.7 \pm 0.0$  mm, wing length =  $64.8 \pm 2.2$  mm, tail length =  $69.9 \pm 0.0$  mm, tarsus length =  $20.3 \pm 0.0$  mm, culmen =  $10.6 \pm 0.8$  mm, mid-toe =  $13.7 \pm 0.9$  mm ( $n = 3$ ); males total length =  $153.7 \pm 4.6$  mm, wing length =  $68.7 \pm 2.5$  mm, tail length =  $73.1 \pm 2.7$  mm, tarsus length =  $21.0 \pm 0.4$  mm, culmen =  $10.8 \pm 0.1$  mm, mid-toe =  $13.4 \pm 0.8$  mm ( $n = 3$ ). In addition, wing spread was 196.9 mm and bill depth at the nostril was 3.0 mm, although no sample size was given for these measurements (Seale 1901). Means and ranges for specimens of three of the subspecies are *uraniae* males ( $n = 11$ ): flattened wing length = 66 (64–69 mm), tail length = 78 (75–82 mm), exposed culmen = 13.6 (13.1–14.5 mm), tarsus length = 16.6 (15.6–17.2 mm); females ( $n = 6$ ): flattened

wing length = 65 (61–68 mm), tail length = 76 (73–81 mm), exposed culmen = 12.3 (11.6–12.5 mm), tarsus length = 16.8 (16.1–17.6 mm); *sai-panensis* males ( $n = 7$ ): flattened wing length = 68 (68–69 mm), tail length = 81 (80–83 mm), exposed culmen = 13.3 (13.0–13.5 mm), tarsus length = 17.3 (16.2–18.4 mm); females ( $n = 6$ ): flattened wing length = 64 (62–66 mm), tail length = 76 (72–81 mm), exposed culmen = 12.7 (12.4–13.4 mm), tarsus length = 17.9 (17.2–18.1 mm); *mariae* males ( $n = 2$ ): flattened wing length = 65, 67 mm, tail length = 82, 82 mm, exposed culmen = 12.1, 12.4 mm, tarsus length = 17.1, 17.2 mm (Baker 1951).

Captures on Saipan in 1988–1992 showed that males ( $n = 7$ ) had a wing chord =  $64.6 \pm 1.8$  mm, bill length from proximal nares =  $6.2 \pm 0.4$  mm, tarsus length =  $19.7 \pm 1.6$  mm, tail length =  $77.7 \pm 2.7$  mm. Females ( $n = 2$ ) had a wing chord =  $63.4 \pm 1.0$  mm, bill depth at proximal nares =  $2.6 \pm 0.2$  mm, tarsus length =  $19.3 \pm 1.8$  mm, tail length =  $78.1 \pm 2.3$  mm. Unknown sex or age birds ( $n = 15$ ) had a bill depth at proximal nares =  $2.8 \pm 0.2$  mm. A 1992 bird of unknown sex and age captured on Agui-guan had a wing chord = 64.6 mm, bill length from proximal nares = 6.8 mm, bill depth at proximal nares = 2.9 mm, tarsus length = 20.2 mm, tail length = 81.7 mm (Craig 2021a, R.J. Craig unpublished data). Captures on Saipan in 2008–2009 showed that males had wing chord =  $67.3 \pm 1.6$  mm ( $n = 67$ ) whereas females had





FIG. 3. A Saipan Micronesian Rufous Fantail nest.

wing chord =  $65.0 \pm 1.5$  mm ( $n = 94$ ) (Radley et al. 2011). Male Saipan captures in 2008 ( $n = 12$ ) had wing chord = 65–70 mm, whereas females ( $n = 11$ ) had wing chord = 63–67 mm (Pyle et al. 2008).

**Mass.** Means and ranges of undescribed subspecies' masses are males ( $n = 9$ ): 9.0 (9.0–10.0 g), females ( $n = 3$ ): 8.8 (7.2–9.6 g) (Baker 1951). Saipan males captured in 1988–1993 ( $n = 7$ ) had a mass of  $8.3 \pm 0.7$  g and females ( $n = 2$ ) had a mass of  $7.4 \pm 0.1$  g. An unsexed Aguiguan bird had a mass of 8.4 g (Craig 2021a, R.J. Craig unpublished data). 2008–2009 Saipan captures showed that males had a mass of  $8.2 \pm 0.4$  mm ( $n = 56$ ) whereas females had mass of  $7.9 \pm 0.6$  mm ( $n = 81$ ) (Radley et al. 2011).

## SYSTEMATICS

### Systematics History

The Guam population was first described as *Rhipidura pectoralis* (Gray 1859). It was given species status as *R. uraniae* (Oustalet 1881). Later, it was listed as *R. atrigularis* (Reichenow 1885) and as a part of *R. versicolor* (Oustalet 1895). It was then given subspecies status as *R. rufifrons uraniae* (Mathews 1930). The Saipan population was first considered *R. versicolor* (Oustalet 1889). It was later given species status as *Rhipidura saipanensis* (Hartert 1898) and then given subspecies status as *R. rufifrons saipanensis* (Kuroda, in Momiyama 1922). The Tinian population was similarly listed as subspecies *saipanensis* (Hachisuka et al. 1932). Stott

(1947) considered Saipan birds to be *R. lepida saipanensis*, however. The Rota population also was initially considered to be *R. rufifrons saipanensis* (Takatsukasa and Yamashina 1932), although it was then given subspecies status as *R. rufifrons mariae* (Baker 1946). Yap birds were first thought to be part of *R. versicolor* (Hartlaub and Finsch 1872) but then reassigned to *R. rufifrons versicolor* (Mathews 1930).

The taxonomy and classification of the Micronesian Rufous Fantail, as with the other members of the *Rhipidura rufifrons* complex, still needs further research to clarify the relationships among its members. It was previously treated as conspecific with the rest of taxa formerly grouped with Rufous Fantail (*Rhipidura rufifrons*), but it is here split based on vocal, plumage and genetic differences. In a vocal analysis (Boesman 2016), the Micronesian Rufous Fantail was composed of two distinct groups, with nominate *versicolor* closest to the Louisiade Fantail (*Rhipidura lousiadensis*), whereas *saipanensis* and *mariae* had a song consisting of rich descending whistles. In a molecular phylogenetic study, species *versicolor* was found to be sister to the Santa Cruz Fantail (*R. melanolaema*), with these two species in turn sister to the Solomons Rufous Fantail (*R. rufifrons*) (Klicka et al. 2023). More work is needed to understand the relationships among fantails not yet included in phylogenetic studies.

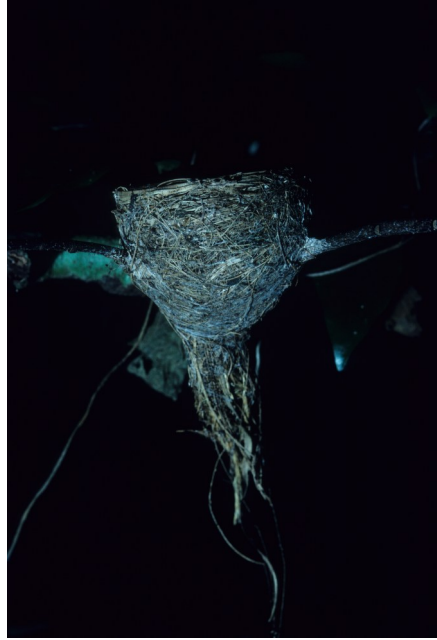


FIG. 4. Side view of Micronesian Fantail nest that shows fibers extending downward.

### Geographic Variation

**Subspecies.** Subspecies *uraniae*: the adult's forehead and anterior crown were cinnamon-buff; the lores and orbital ring were black; the auriculars were more brownish than the lores; the malar stripe was white; a few feathers in the posterior malar region were tipped with citrine drab; the anterior part of the chin was white; the posterior part of the chin, throat, and upper breast were black; the feathers on the breast were edged with white; the lower breast, abdomen, sides, flanks, tibia, vent and under-tail coverts were near royal brown and becoming lighter on the breast but more rufous on the under tail-coverts; the sides of the neck and back were near Dresden brown and becoming grayer on the neck and crown where feathers had darker shafts; the rump and upper tail-coverts were near orange rufous; the basal half of the tail was slightly lighter than the rump; the terminal part of the tail was black and tipped with white; the wings were dark-edged with coloring like the back; the under wing was grayish with axillaries tipped with buffy-white; the bill was black with the base of the upper mandible lighter; the feet were dark brown and the iris was dark brown (Baker 1951).

Subspecies *saipanensis*: the adult resembles the adult of *R. r. uraniae* but the forehead and anterior crown are more rufous, the posterior crown and nape are lighter, the rump and upper tail-coverts are lighter and richer in color, the white malar stripe is broader, the chin has white feathering more extensive and it covers the edge of the upper throat (Baker 1951).

Subspecies *mariae*: the adult resembles the adult

of *R. r. saipanensis* but has richer brown coloring on the breast and abdomen; it is darker above, especially on the forehead, rump and basal part of tail; the chin has a small amount of white and the malar line of white is thinner (Baker 1951).

Subspecies *versicolor*: The adult resembles *R. r. uraniae* but the chin and upper throat are white, the upper parts are darker and the abdomen is whitish (Baker 1951).

### Related Species

In a vocal analysis (Boesman 2016), the Micronesian Rufous Fantail was composed of two distinct groups, with nominate *versicolor* closest to the Louisiade Fantail (*Rhipidura lousiadensis*), whereas *saipanensis* and *mariae* had a song consisting of rich descending whistles. In a molecular phylogenetic study based on thousands of markers from ultra-conserved elements, species *versicolor* was found to be sister to the Santa Cruz Fantail (*R. melanolaema*), with these two species in turn sister to the Solomons Rufous Fantail (*R. rufofronta*) (Klicka et al. 2023). More work is needed to understand its relationships with other fantails not yet included in phylogenetic studies.

### Fossil History

Sub-fossils of *Rhipidura* bones have been uncovered only on Tinian (Steadman 1999).

## DISTRIBUTION

Subspecies *uraniae* occurred only on Guam. Subspecies *mariae* is present only on Rota. Subspecies *saipanensis* is known historically from Saipan, Tinian and, presumably Aguiguan. Birds from Aguiguan have not been definitively assigned to this subspecies, although there is no obvious difference between birds on this island and Saipan and Tinian (R.J. Craig personal observation). Subspecies *versicolor* is present only on Yap (Baker 1951).

### Historical Changes to the Distribution

Subspecies *uraniae* is extinct on Guam, with birds gone by 1984 (Wiles et al. 2003). Subspecies *saipanensis* has been translocated to the more northern, uninhabited Mariana Islands of Sarigan (Radley et al. 2013), Alamagan (Newland et al. 2019) and Guguan (Newland et al. 2017).

## HABITAT

Birds on Guam were described as inhabiting scrub forest along streams in grasslands (Stophlet 1946). Presumably, this referred to *Hibiscus tiliaceus* woodlands found in such areas. Birds also were reported to inhabit forest and forest scrub, where they appeared to prefer areas where leafy undergrowth was present (Baker 1951). Kibler (1950) found them in shrubbery and thickets including those dominated by tangantangan (*Leucaena leucocephala*). Historically, the species was reported in all habitats on Guam except for the southern savannas. It also was found in coastal strand vegetation and in mangrove swamps. In 1978–1979, it occurred commonly only in the mature limestone forests of the northern cliffline and uncommonly in the second growth and scrub forests of the Northwest Field area (Jenkins 1983). By this time, it was described as a conspicuous resident of the forest understory but restricted to forested habitats of northwest Guam, mostly in the Ritidian and Pajon Basin regions (Pratt et al. 1979, Engbring and Ramsey 1984).

On Saipan, the Micronesian Rufous Fantail was found inhabiting forested areas and vine-draped crevices in the lava above Magicienne (LaoLao) Bay (Stott 1947). It also was found to be abundant in the woodland understory vegetation on Saipan, Tinian and Guam (Marshall 1949). It was described as inhabiting dense forest on Saipan, Tinian and Rota (Pratt et al. 1979) and as occupying brushy thickets and forest understory, but infrequently-occurring in regions of Saipan dominated by savanna. Similarly, fewer birds occurred in regions on Tinian dominated by pastures (Engbring et al. 1986). It was thought to be most common on Saipan and Tinian in tangantangan thickets and less numerous, but still common, in dense forests (Pratt et al. 1979). On Rota, birds inhabited not only mature limestone forest but occurred even in strand forest within 10 m of the shore

(R.J. Craig unpublished data). On Aguiguan, it commonly occurred in forests at the height of goat browsing (ca. 2 m), although it also was present in the more open strata below this height (Engbring et al. 1986). On Yap, birds appeared to prefer the edges of low undergrowth in lowland jungles and the edges of mangrove swamps, but a few birds were found far back in the jungle (Fisher 1950).

On Saipan in 1988–1993, birds occurred commonly in a variety of wooded and thicket habitats, including beach strand and suburban habitats, but they were largely absent from swordgrass (*Miscanthus floridulus*) savanna. During population surveys, the species was studied in two principal habitats that it occupied: native limestone forest and largely alien disturbed woody habitats, including tangantangan thickets. In these two habitats, it occurred far more densely in the former (Craig 2021b, R.J. Craig pers. obs.).

Limestone forest in the Marpi region is dominated by such native canopy trees as *Meiogyne marianae*, *Neisosperma oppositifolia*, *Ochrosia marianensis*, *Melanolepis multiglandulosa*, *Cynometra ramiflora*, *Ficus prolixa*, *Pisonia grandis*, *Psycotria mariana*, *Aidia cochinchinensis*, *Premna obtusifolia*, *Morinda citrifolia*, *Guetarda speciosa*, *Pandanus* spp. and *Erythrina variegata*. In the Talufofo and Mt. Tapotchau regions, such native trees as *Artocarpus mariannensis*, *Cerbera dilatata*, *Hernandia nymphaeifolia*, *Hibiscus tiliaceus*, *Mammea odorata* and *Barringtonia asiatica* also are common. Canopy height is generally restricted to <15 m because of frequent typhoons and understory vegetation is dense. Such native forests are typical of the relatively xerophytic forest communities of the Mariana Islands of Saipan, Tinian and Aguiguan. On Mt. Tapotchau, which near its summit has near cloud forest-like conditions, birds frequented native forest and tangantangan copses, first appearing regularly at 1.3 km from the summit down the mountain's access road (Chandran et al. 1993, Craig 1989, 1992, R.J. Craig pers. obs.).

Disturbed habitats largely developed on abandoned agricultural lands and were vegetated particularly by elephant grass (*Pennisetum purpureum*) meadows and tangantangan thickets. Secondary forests of introduced tree species, particularly *Acacia confuse*, *Albizia lebbbeck*, and *Delonix regia* also were common, as were areas of agriforest, where trees such as *Cocos nucifera* and *Mangifera indica* were frequent (Craig 1996, 2021b). Tangantangan thickets are largely a monoculture of this woody, shrubby species, although in the shade of its canopy, the understory is invaded by native woody species when there is a nearby seed source (Craig 1994).

On Aguiguan, 1992 population surveys and behavioral studies of birds were conducted in steep limestone escarpments which, unlike level areas, were still vegetated by native forest dominated by such species as *Pisonia grandis*, *Cynometra ramiflo-*

*ra*, and *Meiogyne mariannae*. Unlike on Saipan, the forest understory was open due to intensive browsing by feral goats (*Capra hircus*). Birds also were mist-netted and banded in alien thickets principally comprised of *Lantana camara* that were present on level areas formerly cultivated for sugarcane (Craig et al. 1993a, R.J. Craig pers. obs.).

## MOVEMENTS AND MIGRATION

### Movements

The Micronesian Rufous Fantail has not been recorded to make inter-island movements, but the close proximity of Saipan, Tinian and Aguiguan and the similarity of birds on these three islands suggests that some gene flow occurs among these populations. The comparative isolation of the Rota and Yap populations and the distinctness of the birds that reside on them indicates that gene flow with these and other islands is minimal.

### Dispersal and Site Fidelity

Based on observations of banded individuals and behavior of singing males, the Micronesian Rufous Fantail defends all-purpose territories (Craig 2021b), but long-term banding studies that would reveal patterns of site fidelity have not been performed.

## DIET AND FORAGING

### Feeding

**Microhabitat for foraging.** On Guam, a bird was found foraging from a shrub in branches, a pair was observed feeding in a tree and four were seen in scrub forest (Stophlet 1946). Guam birds foraged low in the forest understory. Several times they were observed to land on the ground while foraging. Less frequently, they foraged from branches among the foliage (Jenkins 1983). On Saipan, birds foraged for insects through the undergrowth and along vine (Stott 1947). They were found in the woodland understory vegetation on Saipan, Tinian and Guam. Birds in the Mariana Islands were observed to feed from the surface of tree trunks, branches and foliage in habitats where the vegetation was dense (Marshall 1949).

During 1990–1991 in Saipan native limestone forest, the Micronesian Rufous Fantail, similarly to another small forest passerine, the Golden White-eye (*Cleptornis marchei*), commonly used both upper and mid/lower-forest strata, although the latter was used 69.4% of the time ( $n = 95$ ). Trees chosen for foraging were  $9.5 \pm 2.7$  m in height ( $n = 55$ ), again similar to those used by the Golden White-eye, although they were shorter than trees used by the Bridled White-eye (*Zosterops conspicillatus*) or Micronesian Myzomela (*Myzomela rubrata*). Percent use

of foraging surfaces were live leaves (44.2%), dead leaves (1.1%), branches and trunks (2.1%), flowers (1.1%) and aerial (49.5%;  $n = 95$ ). Few wet vs. dry season shifts in foraging were evident (Craig and Beal 2001).

1988–1989 Saipan dry season observations of foraging in limestone forest ( $n = 58$ ) demonstrated similar trends. Tree heights used as foraging perches were  $10.9 \pm 3.0$  m. These were canopy trees 91% of the time, with the remainder of them being understory trees. Percent use of foraging zones were upper strata 31.0%, mid strata 41.4%, lower strata 20.7% and ground 6.9%, almost always on the outer parts of trees. Percent use of foraging surfaces were 1.7% flowers, 34.5% live leaves, 3.5% dead leaves, 6.9% leaf litter and 53.5% aerial. Trees used as foraging perches included *Cynometra ramiflora*, *Eugenia* spp., *Meiogyne mariannae*, *Pisonia grandis*, *Morinda citrifolia*, *Samanea saman*, *Neisosperma oppositifolia*, *Premna obtusifolia*, *Ficus* spp., *Carica papaya*, *Psychotria mariana*, *Dendrocnide latifolia*, *Intsia bijuga*, *Albizia lebbbeck* and *Cerbera dilatata*. In addition, vines in trees occasionally were used as foraging perches (R.J. Craig unpublished data).

On Tinian in February 1988, in the presence of the Tinian Monarch (*Monarcha takatsukasae*), birds appeared to be more restricted to the forest understory than on Saipan. However, in one instance a Micronesian Rufous Fantail was perched within 1 m of a Tinian Monarch. In November 1990 on the high elevation Sabana of Rota, four observations in native forest were split evenly between birds using upper and mid-forest strata. One bird was seen using *Hernandia labrynnthica* as a foraging perch. In May 1992 on Aguiguan, birds were again found to use principally canopy trees to forage in the upper, middle and lower forest strata ( $n = 7$ ) (R.J. Craig unpublished data).

**Food capture and consumption.** On Guam, a bird was observed gleaning insects and a pair was seen sallying from a perch for flying insects (Stophlet 1946). Guam birds captured prey primarily in flight. Birds seldom, if ever, returned to the same perch but perched instead in a new area after each sally. Less frequently, they gleaned food from branches among the foliage. Once, a bird perched in the edge of a forest opening was observed to fly vertically upward and attempt to capture prey above the forest canopy. This individual also dived after prey with wings spread and tail held straight (Jenkins 1983). On Saipan, birds sallied from perches to capture flying prey (Stott 1947). Marianas birds were observed to feed on small insects caught on the wing or picked from surfaces. Prey were taken while birds progressed swiftly forward by zig-zag darting flights or rapid hopping. They did not return to a fixed perch after capturing an insect. Flights were usually in a horizontal plane and several insects were taken before birds landed. Birds darted rapidly through



dense growth with agility. The body was maintained in a horizontal position, the tail was kept spread and the wings were never tightly folded. They foraged singly (Marshall 1949).

During 1990–1991 in Saipan native limestone forest, the Micronesian Rufous Fantail foraged primarily aerially (sallying and hovering; 85.3% of the time), although birds also gleaned from foliage or the ground (14.7%;  $n = 95$ ). This was in dramatic contrast to other small forest passerines, which only rarely foraged aerially. The Micronesian Rufous Fantail was most ecologically dissimilar to the Micronesian Myzomela in its foraging. Few wet vs. dry season shifts in foraging were evident (Craig and Beal 2001). When foraging, birds appeared to brush purposefully against foliage while making fluttering flights in order to flush insects from it (R.J. Craig unpublished data).

1988–1989 Saipan dry season observations of foraging in limestone forest ( $n = 58$ ) demonstrated similar trends. Percent use of foraging methods was 1.6% gleaning, 53.5% sallying and 31.0% hovering. While foraging, birds fluttered from one perch to another, sometimes at the same height and sometimes from a higher to a lower perch. When insects were flushed, birds flew from a perch chasing them. When sallying, birds engaged in fluttering or circling when flying from perch to perch. In November 1990 on the high elevation Sabana of Rota, four observations in native forest revealed that sallying and hovering were foraging methods. In May 1992 on Aguiguan, birds sallied from perches in pursuit of flying insects as well as hovered and gleaned from leaves and branches to capture insects ( $n = 7$ ) (R.J. Craig unpublished data).

**Diet.** On Guam, stomach content analysis demonstrated that subspecies *uraniae* was entirely insectivorous (Jenkins 1983). On Rota, Saipan, Tinian and Aguiguan, only insects and particularly flying insects were observed to be taken (Stott 1947, Marshall 1949, Engbring et al. 1986, R.J. Craig pers. obs.). In one instance, a flying adult lepidopteran was observed to be chased (R.J. Craig pers. obs.).

## SOUNDS AND VOCAL BEHAVIORS

### Development

Food begging by Saipan juveniles was observed year-round (Craig 1996).

### Vocal array

**Song.** On Guam, the song of the Micronesian Rufous Fantail was described as a melodious tinkling of notes which, because of the species' abundance in the mature forests of the northern cliffline, continued to be one of the most frequently heard vocalizations into the 1970s (Jenkins 1983). Guam birds also were

reported to have a medium-volume, melodious song and to sing frequently throughout the morning (Engbring and Ramsey 1984).

Song was described from Tinian as involving a rolling whistle, starting shrilly, then rolling on and being like a meadowlark (*Sturnella* sp.) and Song Sparrow (*Melospiza melodia*) combined (Downs 1946). Birds in the Mariana Islands were reported to engage in a dawn chorus, with a song consisting of a descending cascade of thin piping notes, often preceded by longer high-pitched notes used separately as sequestration calls. The song was thought to resemble that of the Golden-crowned Kinglet (*Regulus satrapa*), but given at lower pitch and tinkling in quality rather than squeaky (Marshall 1949). More recently, song in the Marianas was described as being a jumble of *peet* notes followed by a cascade of whistles, all very high pitched, with the song varying among islands but all with the same quality (Pratt et al. 1987). Songs recorded in January–February 1988 on 270 min of bird sounds from Saipan limestone forest and tangantangan thickets consisted of a loud, descending series of high-pitched whistles that can be written as *PEET-PEET-tew-tew-teew-teew-teew-teew-teew* or *PEET-PEET-chut-chut-teew-teew-teew-teew-teew-teew* (R.J. Craig unpublished data).

**Calls.** On Guam, the species was described as making low, chirping notes (Seale 1901). Moreover, an aggressive call was heard to be given between members of a foraging pair when interacting agonistically. This call, a single note repeated three or more times, was unmusical and quiet. A bird sometimes would approach an observer to scold (Jenkins 1983). A variety of thin notes and scolding notes have been reported elsewhere in the Mariana Islands (Engbring et al. 1986).

Calls recorded in January–February 1988 on 270 min of bird sounds from Saipan limestone forest and tangantangan thickets consisted of series of or single high-pitched, metallic *peet* notes similar to those that comprise some song notes. Other notes from Saipan birds included high-pitched single or two-noted *tee* and *titt* calls as well as *tee-tee-tee-tit-tit-tit* calls. Birds on Tinian made similar call notes. In response to the presence of a Mariana Kingfisher (*Todiramphus albicilla*) on Saipan, two birds made loud chipping notes (R.J. Craig unpublished data).

**Geographic variation.** Songs recorded over 90 min in January 1989 from Tinian limestone forest and tangantangan thickets showed a difference from those of Saipan birds. Although beginning the same, they often ended with twittering notes instead of a descending series of single notes. This difference was noted in 1988 as well (R.J. Craig unpublished data). Songs also have been noted to differ between Saipan and Aguiguan populations, although the type of difference in this case was unrecorded (Craig et al. 1993b). Macaulay Library recordings from Rota showed songs similar to those made by Saipan birds,

although sometimes a series of ascending notes was added at the song's end and occasionally songs ended with faint twittering notes. Rota birds made series of *peet* calls similar to those made on Saipan. Recorded songs from Yap indicated a jumble of ascending and descending notes with a quality somewhat like songs of Mariana Island populations. Recorded songs of Guam birds did not appear to be appreciably different from those from Saipan (R.J. Craig pers. obs.).

## BEHAVIOR

### Locomotion

On Guam, birds were reported to move rapidly about, continually fluttering wings and spreading their long, fan-like tail (Baker 1951). Guam birds also were observed to spread their tails and hold their wings back and away from the body at a 45° angle (Jenkins 1983). In the Mariana Islands, foraging birds progressed swiftly forward by zig-zag darting flights or rapid hopping. The body was maintained in a horizontal position, the tail was kept spread during this activity and the wings were never folded tightly (Marshall 1949). However, the tail also may be folded and kept horizontal when individuals are moving through the forest (Fig. 2; R.J. Craig pers. obs.).

### Self-Maintenance

**Preening, head-scratching, stretching, sun-bathing, bathing, anting, etc.** While preening, birds consistently head scratched over the wing (R.J. Craig unpublished data).

### Agonistic Behavior

Males engaged in song duels with neighbors and responded aggressively to taped playback of songs (Craig 1996). Pairs of birds aggressively responded to the presence of neighboring pairs by chasing them. One bird dove on another making loud scolding notes in apparent male-male aggression (R.J. Craig unpublished data).

### Sexual Behavior

On Guam, birds were usually found in pairs (Baker 1951). Birds also often occurred in pairs on Saipan. In one instance, two birds repeatedly flew out from a perch when not flycatching and then returned to the same perch. This behavior may have been part of a courtship ritual (R.J. Craig unpublished data).

### Social and Interspecific Behavior

When in pairs or family groups, Guam birds

spread their tails and held their wings back and away from the body at a 45° angle (Jenkins 1983). The typical posture of perched Saipan individuals was with wings drooping and tail up and fanned out (R.J. Craig unpublished data). Frequently observed food begging (juveniles based on plumage; with wings drooped and fluttering) in small flocks of 3–4 Saipan birds indicated that these were family groups. Color banding further showed that groups remained at a single location. Hence, the species appeared to defend all-purpose territories (Craig 1996). As on Saipan, Aguiguan birds appeared to defend territories and to occur in family groups of 3–4 (Craig and Chandran 1993).

**Nonpredatory interspecific interactions.** On Saipan, interspecific aggression toward other birds was restricted to one instance each of supplanting a Bridled White-eye at a perch and chasing a foraging Golden White-eye from near a nest. More frequently, birds followed Golden ( $n = 10$ ) and Bridled white-eyes ( $n = 10$ ) to capture insects flushed by the foraging activities of these species. Micronesian Rufous Fantails ( $n = 2$ ) also chased Bridled White-eyes (Craig 1990). Additional observations of birds being aggressive toward Bridled and Golden white-eyes also occurred, including one of a pair of Micronesian Rufous Fantails repeatedly flying at and hitting a Golden White-eye that had landed <1 m from their nest. As the Golden White-eye moved away, the pair followed it calling loudly. Golden White-eyes also chased foraging Micronesian Rufous Fantails (R.J. Craig unpublished data). Still another interspecific social interaction involved a single observation of a Bridled White-eye following a foraging Micronesian Rufous Fantail (Craig 1996). On Aguiguan, both Golden White-eyes and Micronesian Myzomelas chased foraging Micronesian Rufous Fantails, and Micronesian Rufous Fantails followed Golden and Bridled white-eyes while they were foraging (Craig and Chandran 1993).

### Predation

**Kinds of predators.** On Guam, the Guam Kingfisher (*Todiramphus cinnamominus*) was known to attack small passerines (Marshall 1949). The non-native Black Drongo (*Dicrurus macrocercus*) also was reported to prey upon the Micronesian Rufous Fantail (Maben 1982). On Saipan and Tinian, the Mariana Kingfisher was observed to attack small passerines (Marshall 1949) and on Aguiguan it preyed upon a Micronesian Rufous Fantail (Engbring et al. 1986). The Micronesian Starling (*Aplonis opaca*) is documented to prey upon nests of the Micronesian Rufous Fantail on Saipan (Sachtleben 2005).

**Response to predators.** At least two Micronesian Rufous Fantails mobbed and chased a Mariana Kingfisher on Saipan in response to its presence perched on an interior limestone forest tree (Craig

1996, R.J. Craig unpublished data).

## BREEDING

### Phenology

On Guam, nests were first reported in February–March (Hartert 1898). Marshall (1949) believed, based on gonad condition of specimens, that breeding occurred year-round. However, field data were insufficient to confirm this. Breeding was later documented in January–April, June and November. The lack of nesting records from the latter part of the year was thought to reflect inconsistent and scanty field work (Jenkins 1983). During 1988–1993, breeding on Saipan was recorded for January (nest construction, eggs, fledglings, juveniles), February (eggs, juveniles), March (nest), April (nestlings), October (nest construction, eggs), and November (nestlings) (Craig 1996). Nests were found in June 2003 as well (Sachtleben 2005). Saipan capture data showed that the proportions of adults in breeding condition was ca. 40% in April but it trailed off to few or none by the end of May. Hatching year birds were captured throughout the April–July period. This suggested possible bimodal breeding, with peaks occurring in February–May and September–November (Pyle et al. 2008).

### Nest

**Nest site.** Guam nests were found to be 0.6–1.8 m in height (Hartert 1898). Nests were thought to be built primarily in *Aglaia mariannensis* trees where a number of branches converged 3–7 m from the ground (Seale 1901). Two more recent nests were built in *Hibiscus tiliaceus* and another two were in *Leucaena leucocephala*. Three nests were located an average of 1.7 m above the ground (Jenkins 1983).

A partly constructed January, 1988 Saipan nest was 2 m up in a 10 m tall *Meiogyne mariannae* tree in limestone forest. A second January, 1988 inactive nest was 1 m up in a 7 m sapling in 13 m canopy limestone forest that had a dense understory of vines and saplings. A February 1988 nest was 1 m up in a shrub in interior limestone forest. A March 1991 nest was 4 m up in an 8 m tall *Aglaia mariannensis* in limestone forest. An October 1991 nest with two eggs was 1.5 m up in a 3 m tall *Cynometra ramiflora* sapling in limestone forest. Another October 1991 nest was under construction 2 m up in a tree in limestone forest. A November 1991 nest with two fully feathered young was 1.5 m up in a 6 m *Meiogyne mariannae* understory tree in limestone forest (R.J. Craig unpublished data).

The following nest trees have been used on Saipan: *Aidia cochinchinensis* ( $n = 6$ ), *Albizia lebbeck* ( $n = 2$ ), *Cynometra ramiflora* ( $n = 9$ ), *Eugenia* spp. ( $n = 4$ ), *Meiogyne mariannae* ( $n = 22$ ), *Leucaena leucocephala* ( $n = 36$ ), *Maytenus thompsonii* ( $n = 1$ ), *Melanolepis multiglandulosa* ( $n = 1$ ), *Ochrosia mariannensis* ( $n = 1$ ), *Pithecellobium dulce* ( $n = 2$ ), *Psychotria* spp. ( $n = 1$ ). On Rota, nests also were found in *Hernandia labyrinthica* ( $n = 1$ ), *Merrilliodendron megacarpum* ( $n = 2$ ) and *Piper guahamense* ( $n = 2$ ) (Sachtleben 2005, MAC Working Group 2014).

On Saipan, mean nest height was 2.1 m (range = 0.5–6.5 m;  $n = 101$ ), whereas mean nest tree height was 4.4 m (range = 0.8–12.6 m;  $n = 100$ ). Nest densities were 0–16/km<sup>2</sup> in native/mixed forest and 0–25/km<sup>2</sup> in non-native forest. Forest type did not affect nesting success or survival. There was often a long delay between nest building and egg laying (Sachtleben 2005, MAC Working Group 2014).

**Structure and composition.** A Guam nest was described as having a round cup with a smooth, whitish outer surface, resting on the top of a branch (Hartert 1898). Another was compactly woven in and out with fine vegetable fibers, with the outside covered with a fine padding of material resembling the paper fibers made by wasps. The nest had a projection of fibers extending from the bottom (Seale 1901). Other Guam nests were compact and fastened around a branch or fork of a tree. One nest was composed of fine grasses, *Casuarina equisetifolia* needles, hair-like matter and spider webs, all held solidly together by a mucus-like secretion (Jenkins 1983).

A Saipan nest (Fig. 3, 4) was attached on its side to a branch and had a thin-walled, round cup lined with grass-like fibers. The outside was in part covered in spider webs and from its base long, downward-pointing fibers tapered to a point (R.J. Craig unpublished data).

**Dimensions.** A Guam nest cup measured 3.9 x 3.8 cm inside and was 2.2 cm deep. The outside measured 4.6 x 4.7 cm and had a height of 6.4 cm (Seale 1901). Guam nests also were reported to be 3.7 cm in outer diameter, 2.2 cm deep and 4.8 cm high, with fibrous matter extending another 3–5 cm below the nest (Jenkins 1983). An inactive Saipan nest had outside dimensions of 4 cm wide x 6 cm deep (R.J. Craig unpublished data). Sachtleben (2005, MAC Working Group 2014) reported the following nest measurements from Saipan: mean inner nest cup diameter: 42 mm (range = 37–46 mm;  $n = 49$ ); mean outer cup diameter: 51 mm (range = 44–55 mm;  $n = 49$ ); mean depth of cup: 22 mm (range = 17–30 mm;  $n = 52$ ); mean nest height: 46 mm (range = 31–60 mm;  $n = 52$ ); mean length of nest tail: 64 mm (range = 0–147 mm;  $n = 51$ ).

## Eggs

On Guam, the eggs were described as creamy buff with a zone of tiny patches and spots of brown and grayish, sometimes nearer the thick end and sometimes in the middle. They were elongated and measured 16.5 x 12.5 mm (Hartert 1898). Two eggs (18 x 13 mm) were dull white, each with a ring of brownish spots diffused around the center or nearer the large end (Jenkins 1983). Saipan eggs were creamy white with brown speckling at the larger end (R.J. Craig unpublished data).

## Incubation

On Guam, both adults typically incubated the young. A brood fledged in 14–15 days (Jenkins 1983). On Saipan, incubation is 15–17 days and the nestling stage 12–17 days (Sachtleben 2005, MAC Working Group 2014).

## Young Birds

The following is adapted from Sachtleben (2005) and unpublished data from Saipan:

Day 0: hatch at ca. 1.5 cm long; with dark pink/purple skin, either naked or covered with light fuzzy down.

Day 1: 1.5–2 cm long; with dark pink/purple skin and usually with light down on the head and body.

Day 3: 2.5–3 cm long; with skin pale to dark pink, wing pins 1–3 mm and back pins beginning to erupt: still no head pins and generally still covered in light down on the head and back.

Day 6: ca. 4 cm long; with skin light to dark pink/purple, wing pins 4–8 mm, back pins 2–3 mm, head pins visible, head still covered in down; feathers may be erupting from the wing and back pins.

Day 9: 4–5 cm long; with dark gray feathers 4–10 mm long erupted from the pin tracts on the wings, rufous feathers 4–5 mm long erupted from the pin tracts on the back, head pins erupted as have tail pins (ca. 2 mm); eyes beginning to open.

Day 12: ca. 5 cm long; with eyes open, fully feathered although the feathers appear downy, head pin tracts still visible (MAC Working Group 2014).

## Parental Care

On Guam, both adults brooded the young. Both adults fed the young, but apparently one (sex undetermined) fed more frequently than the other (Jenkins 1983). Kibler (1950) reported a juvenile being fed in June and a dead bird in juvenal plumage was found

in November (Jenkins 1983).

On Saipan, the nesting period was up to 36 days (Sachtleben 2005). Saipan adults sat low on eggs with tail bent upward at a ca. 45° angle and head out and held at a ca. 20° angle. When undisturbed, birds remained on the nest for at least 10–15 min (R.J. Craig unpublished data).

## DEMOGRAPHY AND POPULATIONS

### Causes of Mortality

**Depredation.** After its accidental introduction to Guam from the north Australia-New Guinea-Solomon Islands region, the predatory brown tree snake decimated native bird populations within several decades (Savidge 1987, Wiles et al. 2003). On Guam, the Guam Kingfisher was known to attack small passerines (Marshall 1949). The non-native Black Drongo also was reported to prey upon the Micronesian Rufous Fantail (Maben 1982). On Rota, predation by the Black Drongo was suggested to be a reason why it was less common there than on other of the Northern Mariana Islands (Craig and Taisacan 1994). Baker (1951) reported the Micronesian Rufous Fantail to be common on Rota, but by 1982 Engbring et al. (1986) found that it occurred less densely there than on Saipan, Tinian and Aguiguan, where drongos were absent. However, the species' susceptibility to avian predation is likely limited because it is territorial (thus spread out) and forages in the forest understory, where the Black Drongo occurs less frequently than in open habitats (Craig and Taisacan 1994).

On Saipan and Tinian, the Mariana Kingfisher was observed to attack small passerines (Marshall 1949, Craig 1996) and on Aguiguan it preyed upon a Micronesian Rufous Fantail (Engbring et al. 1986). Other nest predators in the Mariana Islands include the introduced green tree skink (*Lamprolepis smaragdina*) and rats (*Rattus* spp.) (BirdLife International 2024). However, such predators as rats, monitor lizards (*Varanus indicus*) and cats (*Felis catus*) are not known to be major predators of tree nesting birds in the Marianas, although the native Micronesian Starling (*Aplonis opaca*) is documented to prey upon nests of other forest birds (Sachtleben 2005) and a Yellow Bittern being scolded by Bridled White-eyes on Saipan suggests that this species may act as a predator as well (R.J. Craig pers. obs). Differences in rat species occupying Saipan vs. Aguiguan have been suggested to be related to differing population densities on these islands (Amidon et al. 2014), although no empirical evidence supports this possibility. The cause for the decline of several bird species on Tinian has been suggested to be predation (Camp et al. 2012), although evidence for this is conjectural. Moreover, the Micronesian Rufous Fantail population on Tinian appears to have increased.

Still camera surveillance of 33 artificial nests on Saipan in 2003 revealed two instances of predation. In 2004, 6 of 21 nests were depredated. Based on the size and characteristics of the bill imprints on artificial eggs, four were made by Micronesian Starlings, one was by a Mariana Kingfisher and one was by an unidentified bird smaller than a Micronesian Starling—possibly a parent bird trying to remove the bait egg from the nest. Video cameras in 2003 revealed that one nest was depredated in the nestling stage by a Micronesian Starling. In 2004, one nest was depredated in the nestling stage by a Micronesian Starling and a second nest was depredated by a Mariana Kingfisher (Sachtleben 2005).

**Exposure.** 1982–2003 variable circular plot surveys on Rota and U.S. Fish and Wildlife Service roadside surveys showed that typhoon frequency and severity appeared to affect the abundance of the Micronesian Rufous Fantail (Ha et al. 2012). However, 1991–2010 U.S. Fish and Wildlife Service roadside surveys on Saipan showed no significant relationships between typhoon activity and bird counts (Ha et al. 2018).

**Disease.** A potential threat from West Nile virus exists, although to date this virus has not been detected in the Mariana Islands (USFWS 2007).

### Population Status

**Numbers and trends.** The Micronesian Rufous Fantail was initially found to be abundant on Guam (Seale 1901). In the 1940s, it was infrequent in the southern part of the island but common to the north in forests near Ritidian Point (Stophlet 1946). It was missed in roadside counts in 1945 (Baker 1947). Kibler (1950), however, reported that the species was present throughout the island. During 1963–1968 monthly roadside counts at Alamagosa Springs, it was not recorded, so it appeared to have been extirpated from southern Guam by that time. By the 1970s, it was common only in the mature forests along the northeastern cliffs, but still present uncommonly in second growth and scrub habitats of northwestern Guam (Jenkins 1983). In 1976, the population was found to be much smaller than on other Mariana islands, but the birds were not uncommon in forests and thickets in the northern third of the island. However, by 1978 the species had disappeared from most of this area. Brunet and Pratt could find only a single individual in the areas where two years before it had been present in fair numbers. Only in the limestone forests near Ritidian Point were fantails to be found in any numbers (Pratt et al. 1979). The Pajon Basin was the last area on Guam to support the full ensemble of native forest birds at historical densities, with count results high and relatively consistent for the nine species of forest birds present in 1981 and 1982. Declines were first detected in 1982, however, when Micronesian Rufous Fantail abundance fell sharply. They were well underway by

May 1984, when four species had been extirpated and two others were in rapid decline. Average counts of birds per survey were 36.5 in 1981, 27.5 in 1982, 21.8 in 1983 and zero thereafter. The last confirmed sighting was in 1984 (Wiles et al. 2003).

In 1931, Coultas found birds on Tinian but not on Saipan (Baker 1951). In 1945, 40–50 were found on Tinian (Gleize 1945). All birds were thought to have declined in numbers during World War II (Baker 1946), although on Saipan the Micronesian Rufous Fantail was found to be numerous in forested areas and vine-draped crevices above Magicienne (LaoLao) Bay (Stott 1947). It also was described as being abundant in the woodland understory vegetation on Saipan, Tinian and Guam (Marshall 1949). Owen (1974) found it common on Tinian in 1974. On Rota, it was reported numerous in forested areas in 1945 (Baker 1951), although by 1982, even though considerable native and secondary forest was present, it was found to be common but not abundant (Engbring et al. 1986).

In the first quantitative population survey, which used the strip census technique along 44 km of route, Ralph and Sakai (1979) found 390/km<sup>2</sup> on Saipan, 180/km<sup>2</sup> on Rota, 70/km<sup>2</sup> on Guam and 120/km<sup>2</sup> on Yap. In a 1981 quantitative survey on Guam using the variable circular plot (VCP) technique, 199 birds were recorded, with a population density of 33/km<sup>2</sup> (range = 0–269/km<sup>2</sup>) and population size estimated at 1,048 (95% CI = 860–1290). The species was restricted to forested habitats of northwest Guam, mostly in the Ritidian and Pajon Basin regions (Engbring and Ramsey 1984). In VCP surveys of the Northern Mariana Islands, it was widespread, with 456/km<sup>2</sup> on Saipan, 382/km<sup>2</sup> on Aguiguan, 369/km<sup>2</sup> on Tinian and 178/km<sup>2</sup> on Rota. Lower densities were found in areas with extensive savanna or pasture and densities were highest along transects through prime mature native forest habitat (Engbring et al. 1986).

Using updated analytic methodology to examine data from several island-wide surveys, estimates of birds/km<sup>2</sup> for Saipan were  $886 \pm 114$  for 1982 (nearly twice that of the Engbring et al. 1986 computation),  $790 \pm 109$  for 1997 and  $469 \pm 63$  for 2007, with a total 2007 population estimate of 52,318. The 25-year population trend showed a significant decline (Camp et al. 2009). Additional analysis of 1991–2010 standard U.S. Fish and Wildlife Service roadside surveys on Saipan demonstrated that the Micronesian Rufous Fantail showed an increase followed by a decrease during this time period (Ha et al. 2018).

Using similar updated methodology on Tinian, estimates were  $655 \pm 41$  for 1982,  $780 \pm 43$  for 1996 and  $1001 \pm 59$  for 2008, with a total 2008 population estimate of 68,884, and with the 26-year population trend showing a significant increase (Camp et al. 2012). On Aguiguan, updated methodology yielded density estimates of  $642 \pm 86$  in 1982,  $1,788 \pm 259$  in



1995,  $2,830 \pm 447$  in 2000,  $2,799 \pm 385$  in 2002 and  $1,717 \pm 247$  in 2008, with a 2008 total population estimate of 10,939. The difference in estimates among years was significant although not consistent over time (Amidon et al. 2014). However, the wide differences in estimates among years suggests that surveys conducted by multiple and differing observers with varying experience and perceptual abilities may have obscured any actual temporal change in population size (see also Camp et al. 2015).

On Rota, the species was widespread and abundant in 1982, with an estimated population of 29,931. The population appeared to increase to 38,092 by 2012, although multiple surveys over these years showed wide variation in results. There was moderate evidence that the population in the Plateau region was stable. The trend in the Sabana region indicated strong evidence of an increasing population. Driven by the Sabana region, the overall pattern for the island showed strong evidence of an increasing trend, weak evidence of a stable trend, and no evidence of a declining trend (Camp et al. 2015).

In a 1990–1993 seasonal VCP study of bird populations in native limestone forest on Saipan, densities of birds/km<sup>2</sup> were  $1,739 \pm 376$  for the wet season and  $1,666 \pm 194$  for the dry season. In contrast, there were  $638 \pm 122$  for disturbed habitat in the dry season. On Aguiguan in the dry season of 1992, density was estimated at  $1,777$  birds/km<sup>2</sup> for limestone forest. All these studies were performed by a single observer (Craig 2021b). A difference among Saipan habitats in population densities also was noted by Camp et al. (2009). In addition to these surveys, in 1991–1992 standard U.S. Fish and Wildlife Service roadside surveys were conducted quarterly on Saipan. January counts averaged lowest, probably because higher winds at this season reduced the detectability of this species. Like for most passerines, variation among counts was relatively low (Craig 1996).

### Population Regulation

Daily nest survivorship and 95% CI for nest stages were for egg-laying 0.835 (0.594–0.946), incubation 0.967 (0.956–0.975) and nestling 0.967 (0.956–0.975), which was higher than for the Bridled or Golden white-eyes. Nest survival did not differ by forest type or year. Overall nest survival was 28.0% (16.6–43.1). Exploratory analysis indicated that nest survival did not differ from early (February/March) to late (April/May) season in 2004. No nest site characteristics measured (nest height, % native trees, native vs. non-native nest tree, number of support branches, diameter of support branches, side cover, canopy cover) appeared to influence nest survival (Sachtleben 2005).

Based on 2008–2018 capture-recapture data from six mist net sites on Saipan, population growth rate estimates suggested a population decline in the Micronesian Rufous Fantail, with survival the largest

contributor to annual growth rate. Survival and recruitment were equally important in driving population growth in years of population increase. Spaced at approximately annual intervals, the mean population growth rate was 0.90, the adult apparent survival probability was 0.52, the recruitment rate estimate was 0.45, the proportionate contribution of survival to population growth was 0.56 and the proportionate contribution of recruitment to population growth was 0.44 (Saracco et al. 2021). Variable circular plot survey and U.S. Fish and Wildlife Service roadside survey data generally support this finding (Camp et al. 2009, 2012, Amidon et al. 2014, Ha et al. 2018).

Cover conversion from forest to anthropogenic-dominated habitats on Saipan has been implicated in producing declines in some of Saipan's bird species. Moreover, the invasive non-native vine *Coccinia grandis*, introduced to Saipan ca. 1998, has altered bird habitat by smothering woody and other vegetation. Causes for the decline of several bird species on Tinian are thought to be predation and site-specific habitat loss/degradation, such as that due to the expansion of Tinian airport (Camp et al. 2012), although evidence for this is conjectural. The Micronesian Rufous Fantail's population on Tinian is thought to have increased.

## CONSERVATION AND MANAGEMENT

### Conservation Status

The Micronesian Rufous Fantail is regarded as a species of least conservation concern (BirdLife International 2024), although this evaluation includes populations now considered to be distinct species. However, subspecies *uraniae* is extinct, with the last individuals observed in 1984 (Wiles et al. 2003). Subspecies *saipanensis* appears to have a large albeit declining population on Saipan, although such a decline is not evident on Tinian or Aguiguan (Camp et al. 2009, 2012, Amidon et al. 2014). Subspecies *mariae* may have increased since 1982 (Camp et al. 2015). Still, the species' range is small and threatened by the possibility of introduction of the predatory brown tree snake to islands in its range. This could result in rapid elimination of populations, as it did for land birds on Guam (Wiles et al. 2003). Based on the most recent estimates from transect counts, the current total Rota, Saipan, Tinian and Aguiguan population is 170,233 (Camp et al. 2009, 2012, 2015, Amidon et al. 2014).

### Effects of Human Activity

**Habitat loss and degradation.** Habitat loss has been cited as a cause of concern for the Micronesian Rufous Fantail's Saipan and Tinian population. Since the 1980s, considerable uninhabited land on Saipan and Tinian has been developed for residential, commercial and tourist-related purposes (Camp et al.

2009, 2012, Craig 2021b). Moreover, on Tinian airport-related development has occurred and much of the island is leased by the U.S. military for training purposes (Camp et al. 2012). In contrast, on uninhabited Aguiguan, abandoned agricultural land has reverted to thickets and secondary forest (Amidon et al. 2014). Despite the potential for forest cover reduction to influence populations, it is likely to persist in the face of such change, albeit at reduced densities in alien habitats (Craig 2021b). Changing climatic conditions related to fossil fuel consumption also might affect populations, as wet and dry seasons are predicted to be wetter and warmer in the western tropical Pacific (BirdLife International 2024). Survival of the Micronesian Rufous Fantail was positively related to remotely sensed dry season greenness and negatively related to wet-season greenness. This highlights the potentially important role of rainfall regimes in affecting population dynamics of species on oceanic tropical islands. Greater rainfall is associated with increased greenness at all but the highest rainfall levels (Saracco et al. 2016).

**Effects of invasive species.** Perhaps the most ominous threat to face Micronesian Rufous Fantail survival is the potential for introduction of the brown tree snake (Rodda and Savidge 2007). Once the snake became established on the southernmost Mariana Island of Guam in the 1940s, most endemic landbirds declined to extinction within ca. 40 years (Savidge 1987, Wiles et al. 2003). Accidental introduction via cargo ships and planes has been the primary dispersal mechanism from Guam. All goods received in the Northern Mariana Islands are shipped through Guam, with most arriving on Saipan. There have been over 70 reports of brown tree snakes on Saipan, including sightings away from port areas (Rodda and Savidge 2007, MAC Working Group 2014). Saipan was feared to have an incipient population, but based on available evidence and modeling of surveillance efforts, there is presently a low probability of this on Saipan (Yackel-Adams et al. 2021). In contrast to Saipan, the risk of snake introduction to the more northern uninhabited Mariana Islands is low.

The invasive non-native vine *Coccinia grandis*, introduced to Saipan ca. 1998, has altered bird habitat by smothering woody and other vegetation. In addition, the demise of *Erythrina variegata* due to invasion of the Marianas by an alien gall wasp (*Quadrastichus erythrinae*; Rubinoff et al. 2010) may negatively impact populations, although the Micronesian Rufous Fantail did not appear to use this tree frequently (R.J. Craig pers. obs.) even though it was the 8th most important tree in Saipan's native forests (Craig 1992) and the 5th most important tree in Aguiguan's forests (Chandran et al. 1993).

## Management

**Conservation areas.** Protected areas have been established by the Commonwealth of the Northern Mariana Islands on Saipan (MAC Working Group 2014) and Aguiguan is set aside as a reserve (Engbring et al. 1986). Additionally, Guguan, Asuncion, Maug and Uracas have been designated as conservation areas to be used only for the protection of natural resources. Furthermore, Asuncion, Maug and Uracas are federally protected within a 153,235 km<sup>2</sup> Marine National Monument (MAC Working Group 2014).

**Conservation measures and habitat management.** Because of the limited range of the Micronesian Rufous Fantail and its potential for extirpation from this range by introduction of the brown tree snake, a captive breeding and translocation program has been developed. A captive program was initiated in 2009 when four birds from Saipan were brought into captivity at the Honolulu Zoo. In both 2010 and 2011 an additional 12 birds were captured and housed at three additional institutions. These 24 fantails suffered high mortality during quarantine periods at their respective zoos and from symptoms observed it appeared that deaths were caused by deficiency of vitamin D or E. Veterinarian advisors are developing protocols to improve captive diets. As of 2014, the captive population consisted of two birds held each at Honolulu Zoo and Riverbanks Zoological Gardens, Columbia, South Carolina (MAC Working Group 2014).

On 4–12 May 2013, 36 color banded Micronesian Rufous Fantails were captured on Saipan. By 15 May, 32 had been translocated to Sarigan. Twenty of these were re-sighted after release, with nine seen on multiple days. During the monitoring period, some birds appeared to be paired and disputing territories with other individuals or pairs. On 21 May, a pair was observed building a nest, with one of the pair soliciting copulation (Radley 2013). In April 2014, 51 birds were captured on Tinian. On 21 April, all were translocated to Sarigan. A monitoring crew in June observed 20 banded individuals were re-sighted, of which six had been released on Sarigan in 2013 and 14 released in 2014. Six unbanded birds were also observed. A number of the re-sighted birds appeared to be paired or otherwise in close association (Radley 2014). On 20–28 April 2017, 61 birds were captured on Saipan. Six were transferred to the Guam Zoo and 54 were translocated to Guguan on 3 May (Newland et al. 2017). On 27 April–4 May 2019, 60 birds were captured on Saipan, of which 51 were translocated to Alamagan on 9 May (Newland et al. 2019).

To prevent establishment of the brown tree snake on Saipan, cargo arriving from sea and at airports is checked for snakes. Moreover, traps have been installed to catch any snakes that are missed and barriers have been constructed at docks to allow es-

caping snakes to be contained. Sniffer dogs have been trained to detect snakes at Saipan airport. Port officers have been trained in prevention of snake establishment and educational programs have been developed to increase awareness among the population of the importance of reporting sightings (MAC Working Group 2014).

#### PRIORITIES FOR FUTURE RESEARCH

1. The highest priority is continued monitoring and implementation of interdiction efforts at ports to prevent the establishment of brown tree snake populations on other Mariana islands.
2. As the highest densities of the Micronesian Rufous Fantail are attained in native limestone forest, a second priority is the preservation of this habitat by setting it aside from any encroachment by agriculture, residential or commercial development. In addition, much of secondary forest that is presently dominated by alien species, particularly that adjacent to seed sources in native forest, has the potential to be revegetated by native forest species (Craig 1994). Native birds and Mariana fruit bats (*Pteropus mariannus*) are major dispersers of native seeds (Caves et al. 2013), so further research into facilitating conversion of alien forest into that dominated by native species is needed.
3. High feral goat densities on Aguiguan are interfering with reproduction of native trees in the forest and goat reduction efforts yield improvement in native seedling development (Rice and Stinson 1993). Hence, ongoing management of feral goats on Aguiguan is required to maintain high densities of the Bridled White-eye and other native bird species.
4. Expand translocation efforts to additional Mariana islands. The Mariana Islands of Alamagan, Pagan, Agrihan and Asuncion, all of which have apparently suitable areas of forest habitat, are also candidates for translocation of the Micronesian Rufous Fantail.

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