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MICRONESIAN MYZOMELA (*Myzomela rubrata*)

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INTRODUCTION

The Micronesian Myzomela (*Myzomela rubrata*), called Chuchurica in the Mariana Islands, Chesisebangiau on Palau, Srusr on Kosrae, Pwiliet on Pohnpei, Likeitepar on Chuuk and Umel on Yap, is widespread in the western tropical Pacific's Mariana Islands, Kosrae, Pohnpei, Chuuk, Palau and Yap. It has received limited quantitative study beyond periodic population surveys and much of the available information on it is from the Mariana Islands. In addition to studies into its population status and trends, investigations in the Mariana Islands have been conducted into its foraging ecology, microhabitat use and social behavior. This member of the Meliphagidae, a diverse family found in Australia, New Guinea and much of the tropical Pacific, has dense populations across much of its range.

This sexually dimorphic species, with scarlet and black males and dull red and brown females, is a nectarivorous inhabitant of a variety of habitats where nectar-bearing flowers are present. It often is less common in native forest than in coconut or mangrove forests. It appears to defend all-purpose territories but also moves opportunistically to locations where sources of nectar become available. Evidence suggests that breeding can occur year-round.

Although still abundant and widespread, the species is threatened with extirpation from portions of its range by the possible introduction of the brown tree snake (*Boiga irregularis*)—a non-native predator responsible for the extinction of the Guam population.

IDENTIFICATION

Field Identification

The sexually dimorphic Micronesian Myzomela is notable for its distinctive and frequently given vocalizations, slender curved bill, red body feathers and active foraging at flowers in the forest canopy.

Similar Species

Within the Micronesian Myzomela's range, no other small bird species has red plumage. It was once thought to be conspecific with birds from Melanesia and Polynesia, including the Cardinal Myzomela (*M. cardinalis*) of the Solomon Islands in which the male is mostly black, the Rotuma Myzomela (*M. chermesina*) of Rotuma Island, the Samoan Myzomela (*M. nigriventris*) of the Samoan Islands and the New Caledonian Myzomela (*M. caledonica*) of the New Caledonia Islands (Mayr 1932), all of which have somewhat similar plumage. The species is also rather similar in appearance to the Scarlet Myzomela (*M. sanguinolenta*) of eastern Australia.

PLUMAGES, MOLTS AND STRUCTURE

Plumages

Plumage characteristics permit separation of four age/sex classes: 1) juvenile/hatching year (HY) females are primarily brown, 2) after hatching year (AHY) females are brown washed dull to medium-bright red, 3) juvenile/HY males are brown mottled

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with medium-bright to bright red, and 4) AHY males are black and bright red. Acceptable age coding is Juvenile/HY (March–June), HY/second year (SY; May–April), Unknown/AHY (October–September), AHY/after second year (March–February). Some molting birds with juvenile outer primaries, middle secondaries or rectrices can be aged SY through April or later. Some molting birds with older basic flight feathers or birds with retained basic feathers or suspended molts can be aged ASY through February or later. Otherwise, birds with dark gapes and uniform basic-like wings and tails should be aged unknown/AHY in October–September. In addition, males and females appear to be reliably separated by wing and exposed culmen lengths and CP/BP (Pyle et al. 2008).

Juvenile (First Basic) Plumage

On Guam, Seale (1901) reported that the young are olive brown above, yellowish on the underparts and washed with red on the sides of the forebreast and back. A pair of fledglings recently out of the nest included a female that was mouse gray and had a faintly rusty red chin. A similar male had the middle of the back, chin and lower half of the head faintly cardinal red (Sachtleben 2005).

Molts

On Kosrae, evidence of molt was observed in a few specimens taken in January and in a larger number taken in March. In addition, some skins from March showed fresh plumage. Although there is little evidence available, molt may begin in January, especially in the males, and possibly reaches a peak in March. On Ponphei, most birds taken in November and December were in molt. On Chuuk, specimens examined from November, December and February were in fresh or molting plumages. In the Mariana Islands, specimens showing molt have been taken at most times of the year (Baker 1951).

In the Mariana Islands, juveniles undergoing the preformative (PF) molt were collected and captured in May–July and were primarily replacing body feathers before 1 June but had begun flight-feather molt in June–July. Lack of molt limits in non-molting spring AHY birds indicates that the preformative molt may be complete and include wing feathers following flight feathers but study is needed. One apparent SY bird captured 23 April was finishing wing molt, indicating that it can be protracted or suspended in some (perhaps late-hatching) individuals. Capture data and 10 specimens in wing molt indicate an extended period for the prebasic (PB) molt (March–October) but not all birds are in molt during this period. Molt can be variable and protracted; e.g., one recaptured bird proceeded only from primary 3 to primary 10 in 10 weeks. The sequence appeared typical of North American passerines. Some birds also could retain feathers and/or undergo suspended prebasic molts, further adding variability to the molt strategies in this species (Pyle et al. 2008). A HY female captured on Aguiguan in May, 1992 showed heavy molt (R.J. Craig unpublished data).

Based on examination of 532 specimens, 121 individuals and 142 captures from the Mariana Islands, the PF is incomplete to complete and includes body feathers, secondary coverts and some to all primaries, secondaries, primary coverts and rectrices in typical sequence. The definitive prebasic molt is complete but can be protracted and suspended. Juveniles with fleshy yellow gapes have not yet initiated molt. Contrasts are often observed between inner primaries and outer secondaries due to protracted and/or suspended molt and normal fading and wear. First molt cycle birds in formative plumage (FCF) often retain blocks of middle secondaries and, less often, outer primaries and primary coverts, which are more tapered, worn and faded than replaced feathers. FCF females have brown formative flight feathers and mottled brown and red body plumage, whereas FCF males have dark brown formative flight feathers and red body plumage mottled brown. Definitive molt cycle birds in basic plumage (DCB) have one feather generation, although a gradient of fading and wearing is often evident within the primaries and secondaries. DCB females can be quite red with brown mottling and medium brown wings whereas DCB males are bright red with black wings. Plumage is useful for assigning age and gender, whereas biometrics appear to be of little help with the latter. The extent of skull pneumatization is difficult to ascertain because of the species' dark, non-transparent skin. Brood patches and cloacal protuberances are reliable for classification of males and females during breeding periods (Radley et al. 2011).

Bare Parts

Bill and gape. On Kosrae, the male has a long, curved and black bill (Baker 1951). On Guam, the bill was dark and there was yellowish at the base of lower mandible (Seale 1901). On Saipan, the male has a curved, black bill (R.J. Craig personal observation). The gapes of young birds in the Mariana Islands are yellowish and this appears to be useful in determining HY/SY status through the first six months or more of life (Pyle et al. 2008). The fledgling bill also is reported as black with a yellow stripe on its edge and a yellow base on the bill top (Sachtleben 2005). Juveniles on Aguiguan showed a yellow gape (R.J. Craig unpublished data). The yellow gape also was noted in Kosrae birds (Finsch 1880).

Iris. On Kosrae, males have a dark brown iris (Finsch 1880). On Guam, the iris also was dark

FIG. 1. A Saipan Micronesian Myzomela male.

(Seale 1901). Saipan and Aguiguan males and females have dark brown irises (R.J. Craig personal observation).

Tarsi and toes. On Kosrae, the male has dark brown-gray legs and yellow soles of feet (Finsch 1880). On Guam, the feet were dark (Seale 1901). On Saipan and Aguiguan, the male and female have black legs and feet but the undersurfaces of feet are yellowish (R.J. Craig personal observation).

Measurements

Linear measurements. Specimen measurements from individual island chains are reported in Table 1 and specimen measurements from islands in the Mariana chain are in Table 2.

Captures on Saipan from 1988−1992 showed that males (*n* = 6) had a wing chord = 71.7 ± 1.1 mm, bill length from proximal nares = 13.1 ± 2.4 mm, bill depth at proximal nares = 3.4 ± 0.1 mm, tarsus length = 21.1 ± 1.5 mm and tail length = 55.3 ± 4.1 mm. Females (*n* = 5) had a wing chord = 66.2 ± 3.3 mm, bill length from proximal nares = 11.3 ± 0.9 mm, bill depth at proximal nares = 3.1 ± 0.2 mm, tarsus length = 19.8 ± 1.7 mm and tail length = 48.8 ± 3.5 mm. Based on results of *t*-tests, sexes differed significantly in wing chord and tail length, although these measures were highly correlated. Hence, as the strength of the difference appeared greatest for wing chord, it was the best measure for distinguishing sex. The 95% confidence interval showed that birds with a wing chord > 70.3 mm were males and ≤ 70.3 mm were females (Craig 2021a, R.J. Craig unpublished data). Pyle et al. (2008) believed that males and females could be reliably separated by wing and exposed culmen lengths, although they provided no statistical evidence for this.

Specimens at the Museum of Vertebrate Zoology, Berkeley, CA males (*n* = 9) had a wing chord = 71–76 mm and exposed culmen = 10.7–12.4 mm. Females (*n* = 4) had a wing chord = 62–64 mm and exposed culmen = 9.8–11.0 mm. 2008 captures from Saipan had male (*n* = 29) wing chord = 66–77 mm and female (*n* = 19) wing chord = 61–68 mm (Pyle et al. 2008). Captures on Saipan in 2008−2009 showed that males (*n* = 72) had a wing chord of 71.8 ± 2.9 mm and females (*n* = 45) had a wing chord of 64.9 ± 1.9 mm (Radley et al. 2011).

Male captures on Aguiguan in May 1992 (*n* = 3) had wing chord = 75.1 ± 3.9 mm, bill length from proximal nares = 13.0 ± 0.3 mm, bill depth at proximal nares = 3.5 ± 0.2 mm, tarsus length = 22.0 ± 1.0 mm and tail length = 56.3 ± 1.8 mm. Females (*n* = 4) had wing chord = 64.7 ± 5.8 mm, bill length from proximal nares = 12.1 ± 0.8 mm, bill depth at proximal nares = 3.2 ± 0.3 mm, tarsus length = 20.0 ± 1.3 mm and tail length = 51.9 ± 5.5 mm (R.J. Craig unpublished data).

Wing length of adult males is reported to be 76–79 mm for birds collected in the northern, volcanic Mariana Islands (Salomonsen 1966). This larger size compared with birds from the southern Marianas is supported by the single Agrihan specimen reported in Table 2 by Baker (1951), although substantial varia-

FIG. 2. A Saipan Micronesian Myzomela female.

tion also may be seen in Table 1 and 2 in measures for birds of the southern coral Mariana Islands.

Mass. On Guam, adult male mean mass = 15.0, (*n* = 17, range = 12.7-18.0) and adult female mean mass = 12.7, (*n* = 5, range = 10.4-15.0) (Baker 1951). Saipan males captured in 1988−1992 (*n* = 6) had a mass = 14.8 ± 1.5 g and females (*n* = 5) had a mass = 11.8 ± 3.0 g. Aguiguan males captured in 1992 (*n* = 3) had a mass = 14.5 ± 0.9 g and females (*n* = 4) had a mass = 11.4 ± 3.0 g. Craig 2021a, R.J. Craig unpublished data). 2008−2009 Saipan captures showed that males had a mass of 14.2 ± 1.5 g (*n* = 56) whereas females had mass of 11.8 ± 1.5 g (*n* = 37) (Radley et al. 2011).

SYSTEMATICS

Systematics History

The Micronesian Myzomela was first described from Kosrae as *Cinnyris rubrater* (Lesson 1828). It was then described as *Certhia Cardinalis* (Kittlitz 1835) and *Cinnyris cardinalis* (Kittlitz 1835). It was first assigned to *Myzomela* (*Myzomela sanguinolenta*) by Bonaparte (1850), then to *M. rubrater* by Hartlaub (1852) and then to *rubratra,* also by Hartlaub (1854). It was placed in *Myzomela cardinalis* by Mayr (1932, 1945), although based on region-wide differences in coloration and vocalizations, the *M. rubratra* group of Micronesia is now considered separate from the *M. cardinalis* group of eastern Melanesia and Samoa (Pratt et al.1987)

The Kosrae population was first assigned to subspecies *rubrata* and Mariana Islands birds were first assigned to subspecies *saffordi* by Wetmore (1917). Pohnpei birds were first assigned to subspecies *dichromata* by Townsend and Wetmore (1919). Chuuk birds were first assigned to subspecies *major* by Mayr (1945). Yap birds were first assigned to subspecies *kurodai* and Palau birds were first assigned to the subspecies *kobayashii* by Momiyama (1922).

Geographic Variation

Subspecies. Kosrae: The adult male has the head (except lores), neck, back, rump, upper tail coverts, chin, throat, breast and upper abdomen black with feathers tipped with coloring between scarlet and scarlet-red. The rest of the feathering is black (Baker 1951).

Pohnpei: The adult male resembles the Kosrae male but it has more extensive black on the lores and below the eye. The feather tips are lighter scarlet. The adult female resembles the Kosrae female but it is duller and has red much reduced. The head, neck, shoulders, ear coverts and sides of the neck are sooty brownish-gray and the rest of the upperparts are dark brownish-gray. The plumage of the back middle, rump and upper tail coverts are tipped with scarlet, the wings and tail are dark brown and they have their outer edges olivaceous-gray. The chin and throat are

TABLE 1. Mean measurements (mm) with ranges of Micronesian Myzomela specimens (Baker 1951).

Subspecies	*n, age and sex*	Flattened wing	Tail	Full culmen	Tarsus
M. r. rubratra	21 adult males	79	55	19.5	22
		(76-81)	(53-56)	(18.5-20.5)	(21-22)
	20 adult females	71	49	18.5	20
		(69-74)	(45-51)	(17.5-19.5)	(19-21)
M. r. dichromata	24 adult males	78	53	21.5	22
		(76-80)	(51-56)	(20.0-23.0)	(21-23)
	22 adult females	69	47	19	20
		(66-72)	(45-49)	(17.5-20.5)	(19-21)
M. r. major	9 adult males	77	55	20	22
		(75-78)	(54-59)	(19.5-20.5)	(21-22)
	2 adult females	70	50	19.0, 20.5	21.5
M. r. saffordi	47 adult males	73	55	20	22
		(69-77)	(51-56)	(19.0-20.5)	(21-24)
	14 adult females	65	49	18.5	21
		(63-71)	(46-51)	(17.5-19.5)	(19-21)
M. r. kurodai	2 adult males	74, 75	52	20.0, 20.5	20, 21
M. r. kobayashii	17 adult males	74	54	20.5	21
		(71-76)	(51-57)	(19.0-22.0)	(20-22)
	8 adult females	67	48	18	20
		(65-68)	(45-50)	(17.5-19.0)	(19-21)

reddish, the breast is light brownish-gray and may be washed with reddish and the axillaries, abdomen and undertail coverts are grayish. The juvenile male resembles the adult, but the scarlet is less brilliant and thinner on the forehead, back middle, rump, upper tail coverts and underparts but it is absent or nearly absent on the crown and neck. The juvenile female resembles the adult but the scarlet is thinner and present only on the underparts, back, rump and upper tail coverts. The abdomen and undertail coverts are washed with buff (Baker 1951).

Chuuk: The adult male resembles the Kosrae male, but the tips of the plumage are lighter scarlet. The adult female resembles the Kosrae female but the underparts are more heavily tipped with scarlet. The abdomen and undertail coverts are black and the tail is slightly darker. It differs from the Pohnpei female by the presence of scarlet tips on the head feathers. The juvenile male resembles the adult female but the scarlet coloring of the feather tips of the head and neck are narrower. The juvenile female resembles juvenile Kosrae birds but the upperparts are grayer and the underparts are darker (Baker 1951).

Yap: The adult male is similar to the southern Mariana Islands male but the tarsus is decidedly shorter, not exceeding 21 mm, and the plumage is less tinged with vermillion. It differs from the Kosrae and Pohnpei male in being shorter and having scarlet plumage less pronounced. The adult female has upperparts that are dark olivaceous brown and underparts, including the chin, throat and foreneck like the upperparts but paler. The breast and abdomen are yellowish ashy-white and the head, lower back, rump, upper tail coverts, chin, throat and lower breast are tinged with scarlet. Red is more distinct on the lower back but less so on the lower breast. There are also pale olive margins on the outer web of flight feathers (Baker 1951).

Palau: The adult male resembles the Kosrae male but it is smaller and has red darker and near scarlet. The margins of the wing feathers are olivaceous. It differs from the males of other subspecies by the red of feathers being darker. The adult female resembles the Pohnpei female but the red is darker, the top of the head is only partly red, the abdomen, undertail coverts and axillaries are buff-gray and the outer edges of the wing and tail are light olive. It differs from the female of other subspecies by having the top of the head only partly red. The juvenile male resembles the adult male but its red is lighter and thinly distributed, the wings and tail are brownish-olive and the abdomen and undertail coverts are grayish. The juvenile female resembles the adult

TABLE 2. Mean measurements (mm) with ranges of Micronesian Myzomela specimens from the Mariana Islands (Baker 1951).

Island	*n*	Flattened wing	Tail	Full culmen	Tarsus
Guam	35	72	54	20	22
		(69-75)	(51-56)	(19.5-20.5)	(21-23)
Rota	1	73		20	22
Tinian	5	73	53	19.5	22
		(71-74)	(52-55)	(19.0-20.0)	(21-24)
Saipan	4	74	54	19.5	22
		(72-76)	(53-55)	(19.0-20.5)	(22-23)
Agrihan	1	77	55	20	22

female but the red is paler and the underparts are more buffy and less grayish (Baker 1951).

Mariana Islands: The adult male (Fig. 1) resembles the Kosrae male but it is smaller and has its red lighter and more orange and the edges of the wing and tail feathers olivaceous. It differs from Pohnpei and Chuuk males by being smaller and having olivaceous edgings on the wing and tail feathers. The adult female (Fig. 2) resembles the Kosrae female but it is smaller and paler with upper parts dark olivaceous-gray and sparsely mottled with scarlet. The outer edges of the wing and tail feathers are greenish-olive and the abdomen and undertail coverts are buffy-gray. It differs from the Pohnpei female by being smaller and having scarlet tips of the head feathers. It differs from the Chuuk female by being smaller and having broad olivaceous edges on the tail feathers. The juvenile male resembles the adult male but the red is less brilliant and the upperparts, lower breast and abdomen are more narrowly edged with red. The plumage of the breast, abdomen and undertail coverts is buffy-gray, although it is lighter in very young birds. The juvenile female resembles the adult female but it is paler, has upperparts darker brown and underparts pale buffy-brown. The outer edges of the wing and tail feathers are greenish-olive (Baker 1951).

Mariana Islands populations have been split into two subspecies, with the southern coral islands inhabited by subspecies *saffordi* and the northern volcanic islands inhabited by *asuncionis* (Salomonsen 1966). However, based on Salomonsen's description of birds on Saipan being intermediate between *saffordi* and *asuncionis*, as well as on Baker's (1951) reports of wing measurements (Table 2), Mariana Island populations may be better considered to exhibit clinal variation or variation due to differing nutritional regimes in northern vs. southern islands rather than to represent separate subspecies. Jenkins (1983) considered all Marianas birds as belonging to *saffordi*.

Related Species

The Micronesian Myzomela was once thought to be conspecific with birds from Melanesia and Polynesia, including the Cardinal Myzomela (*M. cardinalis*) of the Solomon Islands in which the male is mostly black, the Rotuma Myzomela (*M. chermesina*) of Rotuma Island, the Samoan Myzomela (*M. nigriventris*) of the Samoan Islands and the New Caledonian Myzomela (*M. caledonica*) of the New Caledonia Islands (Mayr 1932), all of which have somewhat similar plumage.

Fossil History

Sub-fossils of *Myzomela* bones have been uncovered from Tinian, Aguiguan and Rota (Steadman 1999).

DISTRIBUTION

Subspecies *rubrata* is present on Kosrae, subspecies *dichromata* is present on Pohnpei, subspecies *major* is present on Chuuk and subspecies *kurodai* is present on Yap (Baker 1951). Subspecies *kobayashii* is present on the Palau Islands of Koror, Babeldaob, Peleliu, Angaur, and the Rock Islands of Ngeruktabel, Ulong, Mecherechar, Ngerechong, Ngemelis, Babelchomekang, Ulebsechel, Ngerukuid, Ngeanges and Kmekumer (Engbring 1992, Olsen and Eberdong 2017). Subspecies *saffordi* is present on at least the southern Mariana Islands from Rota to Saipan (Fig. 3). It is extinct on Guam. Subspecies *asuncionis* is reported from Asuncion, Agrihan, Pagan and Alamagan (Salomonsen 1966). Hence, the subspecific identity of populations on the other northern volcanic islands of Anatahan, Farallon de Mendinilla, Sarigan and Guguan is undescribed.

Historical Changes to the Distribution

Subspecies *saffordi* is extinct on Guam, with birds gone after 1984 (Wiles et al. 2003).

FIG. 3. An Aguiguan Micronesian Myzomela female or hatching year bird.

HABITAT

On Kosrae, the Micronesian Myzomela was found in tall trees along lagoons, canals and riverbanks but also was present in coconuts (*Cocos nucifera*) near houses and gardens (Finsch 1880). In 1931, it was common in the lowlands, especially in coconut groves, but absent from high elevations. It was common in every terrestrial habitat, including mangroves (Baker 1951). Hayes et al. (2016) also reported it from all terrestrial habitats, including mangroves, and to be present at elevations to 589 m. On Pohnpei, it was found to be present in most habitats (Baker 1951). More recently, higher densities were found to be positively associated with undisturbed vegetation, mangroves and agroforest (forests composed of cultivated trees). Secondary vegetation was negatively associated with density, although the species' detections showed a positive association with disturbed habitats (Oleiro and Kesler 2013, Oleiro 2014). On Yap, it was present in all suitable habitat on all islands. It was most abundant in low brush, whether it was in the jungle, in otherwise open country or in mangrove swamps (Fisher 1950). On all these island chains, densities were generally greatest in mangroves, particularly *Sonneratia alba.* Densities in mangroves appeared to be related in part to tree maturity, with densities lower in the scrubby mangroves of Pohnpei (Engbring et al. 1990).

In the Palau Islands, birds were found in open woodlands, coconut groves and about human habitations. It was not seen in dense jungle and appeared to prefer the plantation areas (Baker 1951). The species was common and conspicuous in edges and forest openings, as well as in flower gardens and other human-associated habitats (Pratt et al. 1980). During 1991 population surveys, it was found to be uncommon to rare in unbroken mature native forest and more common in second growth, broken forest and agroforest near villages (Engbring 1992, R.J. Craig unpublished data).

On the Mariana Island of Guam, it was described as inhabiting gardens and particularly coconut groves (Seale 1901). Stophlet (1946) found it in grassland and riparian habitats in southern Guam. Ten were seen in the partially open country of the west side of the island and birds were found in low shrubs along a stream. Kibler (1950) noted it in open habitats and around mangrove swamps. Birds also were described as being found at flowers of an inkberry (*Cestrum diurnum*) and coconut palms (Baker 1951). In 1960, it was reported to frequent banana trees (*Musa* sp.) and coconut palms (Hartin 1961). In the 1970s, it was found in gardens and yards. It also was present in coconut palms around the resort hotels of Guam's Tumon Bay. It was uncommon but widespread elsewhere in northern Guam in both 1976 and 1978 (Pratt et al. 1979). Also in the 1970s, it was more common in scrub, second growth and mixed woodland of northern Guam than in the mature native limestone forest of the northern cliff line. It similarly was observed more commonly in the coastal strand around Tarague Beach than in the adjacent mature limestone forest. It often was recorded near wetlands and in coastal strand, where birds visited the buds and flowers of coconut palms (Jenkins 1983). By 1981, however, the highest densities were in the relatively undisturbed forests of northern Guam (Engbring and Ramsey 1984).

In the Northern Mariana Islands in 1982, it was reported to occur in a variety of habitats but particularly where there were nectar-producing flowers. Within native forest, it primarily occupied the upper canopy. It appeared to be most abundant in mixed second growth, particularly near village gardens. It was typically absent in open, grassy savanna but sometime foraged in areas where there was flowering herbaceous vegetation (Engbring et al. 1986).

On Rota, it was present in *Pemphis* scrub near the beach and occasionally occurred even in fields on the high elevation Sabana plateau (Engbring et al. 1986). On Rota in 1990, birds occupied open forest mostly composed of *Hernandia labyrnthica*, *Eleocarpus joga* and *Guettarda speciosa*, although *Ficus* sp. and *Neisosperma oppositifolia* also were present (R.J. Craig unpublished data). On Sarigan in 1990, it occupied native and coconut palm forest (agroforest) (Craig 2021b). On Aguiguan in 1992, it occupied native forest and thicket habitats in which *Lantana camara* was often a principal constituent (Craig and Chandran 1993). 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 ramiflora*, 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.).

On Saipan in 1945, it was found in littoral *Casuarina* stands, in trees and shrubs of cultivated areas and in vegetation about habitations, although it was most abundant in upland forested areas (Stott 1947). On Tinian, it was found to inhabit woodlands (Marshall 1949). On Saipan and Tinian, it was more abundant in native forest and second growth than in homogeneous *Leucaena leucocephala* thickets, where there appeared to be less available nectar for birds (Engbring et al. 1986). On Saipan in 1988−1993, it occupied a variety of habitats, including beach strand, mangroves, upland forest, suburban areas and disturbed habitats. It was largely absent from swordgrass (*Miscanthus floridulus*) savanna, but was particularly common in the vicinity of coconut groves (Craig 1996). It was common in secondary forest of *Cocos nucifera, Delonix regia* and various large fruit trees (R.J. Craig unpublished data). Of seven nests found on Saipan in 2003–2004, four were located in the secondary forest and three were in native forest (Sachtleben 2005).

Limestone forest in the Marpi region of Saipan is dominated by such native canopy trees as *Meiogyne mariannae, Neisosperma oppositifolia, Ochrosia mariannensis, Melanolepsis multiglandulosa, Cynometra ramiflora, Ficus prolixa, Pisonia grandis, Psycotria mariana, Aidia cochinchinensis Premna obtusifolia, Morinda citrifolia, Guettarda 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 and secondary forest, 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 unpublished data).

Disturbed Saipan habitats largely developed on abandoned agricultural lands and were vegetated particularly by elephant grass (*Pennisetum purpureum*) meadows and *Leucaena leucocephala* thickets. Secondary forests of introduced tree species, particularly *Acacia confusa, Albizia lebbeck*, and *Delonix regia* also were common, as were areas of agroforest, where trees such as *Cocos nucifera* and *Mangifera indica* were frequent (Craig 1996, 2021b). *Leucaena leucocephala* 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).

MOVEMENTS AND MIGRATION

Movements

The Micronesian Myzomela has not been recorded to make inter-island movements, but the close proximity of islands in some of the chains within the species' range suggests that some gene flow may occur among islands. The recent colonization of the Mariana Island of Sarigan from Saipan by the Mariana Fruit Dove (*Ptilinopus roseicapilla*) (Radley 2012) provides additional evidence for the potential for inter-island gene flow, as does the steady colonization of land birds onto Krakatau following its 1883 eruption (Thornton 1996).

Dispersal and Site Fidelity

Based on observations of banded individuals and behavior of singing males, the Micronesian Myzomela defends all-purpose territories. However, birds also appeared to converge on nectar sources in a manner that indicated movement outside of territories (Craig 2021b). Long-term banding studies that would reveal patterns of site fidelity have not been performed. At Capitol Hill, a color banded male had a territory of ca. 0.7 ha. Two additional banded territorial males were observed to within 150 m from the banding site. However, repeated mist netting at one site yielded regular capture of unbanded birds (mostly females or juveniles, based on plumage and measurements) which indicated the existence of a population of nonterritorial birds. These floaters or nomadic birds may account for seasonal variation in native forest census data, because birds may opportunistically follow ephemeral nectar sources as do certain of the Hawaiian Honeycreepers (Scott et al. 1986, Craig 1996).

DIET AND FORAGING

Feeding

Microhabitat for foraging. In Micronesia, pairs have been observed to have a fixed foraging circuit that includes widely separated, selected trees (Marshall 1949). On Pohnpei, birds were found to be distributed throughout the forest but concentrations were near nectar sources. On Kosrae, birds were attracted to small ravines with flowering shrubs. On Yap, they foraged in shrubs in savanna habitat (Engbring et al. 1990). A single May, 1991 observation on the Rock Islands of Palau was of a bird on a 0.5–1.0 cm branch foraging in the upper strata of a 12 m *Guettarda speciosa* canopy tree. Other individuals in the Rock Islands occupied the upper to mid-strata of flowering trees, although they descended to the lower portion of trees at the forest edge and in strand forest where low flowers were present. On Peleliu, birds similarly occupied upper to lower forest strata (R.J. Craig unpublished data).

In the Mariana Islands, Guam birds were observed to feed in tree branches, tree flowers and shrub flowers (Stophlet 1946). Hartin (1961) saw the species use particularly ornamental *Hibiscus* hedges but also *Musa* sp. and *Cocos nucifera*. Baker (1951) thought it preferred *Cestrum diurnum* and *Cocos nucifera*. Birds also were found foraging in *Morinda citrifolia, Scaevola taccada*, *Premna obtusifolia*, *Cassia occidentalis, Vitex parviflora* and *Cynometra ramiflora* (Jenkins 1983).

In the Northern Mariana Islands in native forest, it is typically found foraging in the upper canopy (Engbring et al. 1986). 1988−1989 Saipan dry season observations of microhabitat use in native and secondary largely alien forest (*n* = 40) demonstrated that foraging occurred in tree heights of 33.8 ± 13.6 m. These were canopy trees 82.5% of the time, with the remainder being understory trees (*n* = 40). Percent use of foraging zones were 92.5% upper strata and 7.5% mid-strata (*n* = 40). Percent use of foraging surfaces were 90.0% flowers, 7.5% live leaves and 2.5% buds (*n* = 40). Perch sizes chosen were 36.1% ≤0.5 cm and 63.9% >0.5 cm (*n* = 36). Trees used included *Erythrina variegata, Cocos nucifera, Premna obtusifolia, Leucaena leucophylla, Delonix regia, Aidia cochinchinensis* and *Hibiscus* sp. In addition, the vine *Momordica charantia* was used (*n* = 40) (R.J. Craig unpublished data).

During 1990−1991 in Saipan native forest, the Micronesian Myzomela, similarly to the Bridled White-eye (*Zosterops conspicillatus*), occupied upper forest strata 85.0% of the time but also used mid-lower strata 15.0% of the time (*n* = 20). Trees chosen for foraging were 35.0 ± 7.6 m in height (*n* = 15), again similar to those used by the Bridled White-eye, although in this case the Micronesian Myzomela primarily used flowering *Erythrina variegata* trees. Percent use of foraging surfaces were 14.3% live leaves, 81.0% flowers and 4.8% aerial (*n* = 21). Perch sizes chosen were 35% ≤0.5 cm and 65% >0.5 cm (*n* = 20). Birds occupied native forest particularly during the dry season when *Erythrina* was in flower. Other trees used included *Cynometra ramiflora, Psychotria mariana* and *Aidia cochinchinensis.* In addition, vines in trees were used (*n* = 15). A single June, 1991 observation on Rota was of a bird foraging from a 0.5 cm branch in a mid-strata vine on a 9 m canopy tree (Craig and Beal 2001, Craig 2021b, R.J. Craig unpublished data).

On Aguiguan in May, 1992 in native forest, secondary forest and thickets (*n* = 19), birds occupied upper forest strata 73.7% of the time but also used mid-lower strata 26.3% of the time. Percent use of foraging surfaces were 15.8% live leaves, 68.4% flowers and 15.8% branches. Perch sizes chosen were 72.2%≤ 0.5 cm and 27.8% >0.5 cm. Vegetation used included *Psychotria mariana, Bikkia mariannensis, Delonix regia, Lantana camara* and *Albizia lebbeck* (Craig et al. 1993b, R.J. Craig unpublished data).

Food capture and consumption. On Kosrae, the species was described as shy and to forage by hopping among branches to examine flowers and the undersides of leaves (Finsch 1880). Marshall (1949) found in Palau and the Mariana Islands that it had a fixed foraging circuit in which it travelled among widely separated trees. A May, 1991 observation made on the Rock Islands of Palau was of a bird probing the flowers of a tree (R.J. Craig unpublished data).

In the Mariana Island of Guam, birds searched tree branches, apparently for insects. Birds were highly active when feeding and fed among flowers and also gleaned insects from the foliage. When foraging at flowers, birds moved among flower clusters and systematically inserted their bills into every flower, presumably to extract nectar. They fed on up to 30 flowers/min. (Jenkins 1983).

1988−1989 Saipan dry season observations of foraging (n = 40) showed that percent use of foraging methods was 10.0% gleaning and 90.0% probing (R.J. Craig unpublished data). During 1990−1991 in Saipan native limestone forest, percent use of foraging methods was 16.7% gleaning and 83.3% probing (n = 18) (Craig and Beal 2001). When foraging, birds typically perched on a flower or branch and probed flowers. Birds also were observed picking at or probing the buds at the top of a *Ceiba pentandra* tree (R.J. Craig unpublished data).

In May, 1992 on Aguiguan, percent use of foraging methods was 30.0% gleaning and 70.0% probing (n = 20) (Craig et al. 1993b). Aguiguan birds were reported to feed on the flowers of *Erythrina variegata* (Engbring et al. 1986).

Diet. In Micronesia, birds forage on flowers of *Sonneratia alba, Rhizophora apiculata, Cocos nucifera, Clinostygma* sp., *Parinarium* sp., *Hibiscus* sp., *Musa* sp., *Manihot escuelenta, Cyrtandra* sp., *Schefflera* sp., *Morinda citrifolia, Lantana camara* and *Eleaocarpus* spp. On Pohnpei, it fed on flowering *Eleaocarpus carolinensis* and on insects and spiders in addition to nectar. In June 1983, a concentration of 15 birds fed on the nectar of *Parinarium* sp. (Engbring et al. 1990). On Kosrae, it was observed to drink nectar and to eat insects (Finsch 1880) and it also fed from the flowers of the understory shrub *Cyrtandra* sp. On Yap, it fed on *Scaevola taccada* flowers (Engbring et al. 1990). On Palau, stomachs of specimens obtained in August and September, 1945 contained vegetable matter, seeds and small insects (Baker 1951).

On the Mariana Island of Guam, the species was observed to be nectarivorous but also to eat insects and snails (Marshall 1949, Stophlet 1946, Jenkins 1983). Hartin (1961) saw it feed extensively on the flowers of ornamental *Hibiscus* sp. and Baker (1951) observed a preference for the flowers and insects found in *Cestrum diurnum* and *Cocos nucifera*. It also fed on nectar from morning glory flowers (Convolvulaceae) (Stophlet 1946). Stomach contents included insects, coconut honey and pollen (Seale 1901). Mayr (1945) estimated that the diet was 60% nectar and 40% insects. On Saipan, a bird was observed to eat green insect larvae from a *Delonix regia* tree. Nectar was taken from the flowers of *Cynometra ramiflora, Erythrina variegata, Psychotria mariana, Aidia cochinchinensis, Bikkia mariannensis, Hibiscus tiliaceus, Delonix regia, Lantana camara, Albizia lebbeck* and *Cocos nucifera* (Craig 1996, R.J. Craig unpublished data). On Sarigan, birds commonly probed *Cocos nucifera* flowers. A single June, 1991 observation of a bird on Rota was of one probing a flower (R.J. Craig unpublished data). A Rota bird also was found feeding on *Pemphis acidula* flowers along the beach (Engbring et al. 1986).

SOUNDS AND VOCAL BEHAVIORS

Development

On Saipan, juveniles were observed to food-beg from adults (R.J. Craig unpublished data). Food-begging also was observed on Rota (Engbring et al. 1986), Yap, Kosrae, Pohnpei and Chuuk (Engbring et al. 1990).

Vocal array

Song. *Myzomela* taxa are known for singing complex dawn songs that are distinct from calls made later in the day. Birds in Micronesia have been described as having a long dawn song of a complex series of tweets and chirps (Pratt et al. 1987).

On Pohnpei, the song consists of several whistles followed by a series of chips (Engbring et al. 1990). On Palau, the dawn song has been described as a complex and pleasing series of whistles that are different from the burry or wheezy chirps and whistles made during the day (Pratt et al. 1980). On Kosrae, an early description of dawn song was that it was given from a perch or in flight and consisted of fluting, pure whistles that could be written as *zat-sitt-sitt-tschrii-dahinter* (Finsch 1880). More recently, the dawn chorus is reported to sound like many species singing together. Singing begins when it is still too dark to see birds and continues for about 25 min, until it becomes light, when it suddenly ceases. The dawn song is a continuous series of burry whistles and jerky back-and-forth phrases, many segments of which can be written as *cheeky cheeky can't beat the heat, too sweet to eat,* or *she eats a pizza*. It is generally similar to the dawn song of Pohnpei and Yap birds, but it has a quicker pace and fewer slurred notes. Individual variation is great, and some dawn songs are more lilting and less jerky. The daytime song, in contrast, is short, highly variable and usually includes one emphatic note and two notes slurred together such as *seee-oo-SEET* or *schweer-cheap-beer* (Hayes et al. 2016).

On the Mariana Island of Guam, the song initially was described as consisting of 8–10 notes and given at dawn (Seale 1901). It was later described from the Mariana Islands in general as a wheezy whistle (Marshall 1949), although this was more likely a call note. It was also reported from Guam as a loud whistle with many variations; sometimes a loud *wheeee,* a wolf whistle, or a *bob-white* (Hartin 1961), that apparently also were call notes rather than song. The daytime song was described as a simple, melodious *per-mit-you* that was heard primarily in the early morning (Kibler 1950). Males were similarly reported to sing primarily during the morning, often from open perches (Jenkins 1983).

In the Northern Mariana Islands, the pre-dawn song consists of mixed whistles and chirps (Engbring et al. 1986). Calls recorded in secondary forest in January−February 1988 on 270 min of bird sounds from Saipan had daytime songs consisting of grating, emphatic *zeerr-zo-witt* calls, much like those reported from Kosrae. Dawn songs were recorded as *zee-zoo-zee-zoo-zee* and *zeeoo-ZEE-zoo-zee* (R.J. Craig unpublished data).

Calls. Micronesian birds have been described as having calls that consist of wheezy chirps, buzzy notes and whistles (Pratt et al. 1987). On Kosrae, the daytime vocalizations are highly varied, with short buzzy calls, raspy scolds and sharp *tseep*! notes that may be repeated as a sequence. Birds also make a rapid trill or whinny that seems to be an alarm call (Hayes et al. 2016). Dusk calls have been described as a succession of chips (Engbring et al. 1990). In Micronesian birds, food begging calls have been described as having a rising inflection and being repeated incessantly (Engbring et al. 1990).

On the Mariana Island of Guam, both sexes produced calls that were similar to but softer and less harsh than the calls of the Micronesian Starling. Occasionally, a much softer, scratchy or wheezing note was given, the significance of which is unknown. Males also gave short, low volume staccato notes during courtship flights (Jenkins 1983). On Saipan, the call was described as a high, piercing whistle (Stott 1947). In the Northern Mariana Islands in general, calls also have been described as series of sharp, wheezy whistles given throughout the morning (Engbring et al. 1986). Calls recorded in January−February 1988 on 270 min of bird sounds from secondary forest on Saipan consisted of single note, sharp *wheee* calls (R.J. Craig unpublished data).

Geographic variation. On Palau, calls appeared to differ with those from the Mariana Islands, with a quality like that of the North American Great-crested Flycatcher (*Myiarchus crinitus*) (R.J. Craig unpublished data). The calls are lower in pitch than those of Marianas birds and have been described as being easily confused with those of Micronesian Starlings (*Aplonis opaca*) (Marshall 1949), although R.J. Craig (pers. obs.) noted no such confusion.

In vocal comparisons of dawn song of the Pohnpei, Yap and Kosrae races, all are an endless series of different short, melodious notes delivered at a stable, moderate pace. Notes are mainly sharply downslurred, sharply overslurred and less frequently sharply upslurred. Sometimes, phrases are repeated and then the song switches to another phrase of several notes, whereas at other times no clear pattern is apparent. Comparison of basic sound parameters does not show any significant differences:

M. r. kurodai:
min. freq. 1800 - 2200Hz
max. freq. 6000 - 8000Hz
longest note 0.13 - 0.15s
M. r. rubrata:
min. freq. 2000 - 2600Hz
max. freq. 5800 - 8350Hz
longest note 0.12 - 0.18s
M. r. dichromata:
min. freq. 1750 - 2140Hz
max. freq. 6600 - 8400Hz
longest note 0.12 - 0.18s

There seems to be as much difference within races as between them. There appear to be no distinguishing features that would permit separation of songs if not labeled (Boesman 2016).

BEHAVIOR

Locomotion

On Palau and in the Mariana Islands, females were observed to precede males while foraging (Marshall 1949). On Yap, birds in brush habitat appeared to be weak flyers, with fluttering flights generally <5 m in length, although one was observed over a harbor >900 m from land (Fisher 1950). On Saipan, birds moved among perches while foraging by flying or hopping between flower clusters (R.J. Craig unpublished data).

Self-Maintenance

Preening, head-scratching, stretching, sunbathing, bathing, anting, etc. A preening bird on a 12 m high dead branch was observed to head-scratched over the wing. While sunning afterwards, the bird elevated its head and partly spread its drooping wings. It retained this posture for ca. 3 min (R.J. Craig unpublished data).

Agonistic Behavior

On Pohnpei, 2–3 birds would scold and chase one another, flying above the forest and sometimes grappling in mid-air (Engbring et al 1990). On Chuuk, the birds were pugnacious around the nesting area and vigorously drove off other birds, although human intrusion causes only a mild demonstration (Brandt 1962). Territories at nectar rich trees were thought to be vertical as well as horizontal (Engbring et al. 1990). On the Mariana Island of Guam, territorial disputes involved males fiercely attacking one another in flight. Attacks were common and followed by the males perching apart and calling or singing (Jenkins 1983). On Saipan, the species also was aggressively territorial against conspecifics and engaged in song duels with them, although territoriality appeared to break down around dense sources of nectar, such as at *Lantana camara*, where multiple birds could be present (Craig 1996, R.J. Craig unpublished data).

Sexual Behavior

On Guam, courtship interactions took place at any time of day throughout the year. These interactions involved 20–30 sec flights in which the male usually pursued the female along circular, zig-zag or vertical paths, with the two often touching wingtips. Birds usually perched together for a few seconds after a courtship flight (Jenkins 1983). On Pohnpei, displaying males held their heads high and neck straight (Engbring et al. 1990). In May, 1992 on the Mariana Island of Aguiguan, courtship involved a male and female following each other on a heavy branch with heads elevated. First one bird led and then they turned around and headed in the opposite direction with the other bird leading (R.J. Craig unpublished data).

Social and Interspecific Behavior

Nonpredatory interspecific interactions. In Micronesia, males appear to be strongly aggressive, chasing other species, especially white-eyes, away from defended flowering trees. On Pohnpei, the species was observed to dive at or chase the Pohnpei Flycatcher (*Myiagra pluto*), Pohnpei Kingfisher (*Todiramphus reichenbachii*) and Pohnpei White-eye (*Zosterops ponapensis*) (Engbring et al. 1990). On Chuuk, a Caroline Reed Warbler (*Acrocephalus syrinx*) was observed to perch on the rim of a nest contained one egg, but the parents showed little aggression (Brandt 1962). On Kosrae, birds moved from coastal lowlands toward the interior, apparently to feed in interior upland forests after roosting at low elevations. Birds flew above the forest canopy singly or in small groups, often in association with Kosrae White-eyes (*Zosterops cinereus*) (Engbring et al. 1990).

In 1988–1993 on the Mariana Islands of Saipan and Aguiguan, the Micronesian Myzomela chased individuals and dispersed flocks of Golden White-eyes (*Cleptornis marchei*) (*n* = 4), Bridled White-eyes (*n* = 1) and Micronesian Rufous Fantails (*Rhipidura rufifrons*) (*n* = 2). The Micronesian Starling also was observed to supplant a Micronesian Honeyeater at a perch. (Craig 1996, R.J. Craig unpublished data). On Aguiguan, Micronesian Myzomelas similarly chased foraging Micronesian Rufous Fantails (Craig and Chandran 1993).

Predation

Kinds of predators. On the Mariana Island of Guam, the Guam Kingfisher (*Todiramphus cinnamominus*) was known to attack small passerines. On Saipan and Tinian, the Mariana Kingfisher (*Todiramphus albicilla*) was observed to attack small passerines (Marshall 1949).

Response to predators. On Saipan, a Micronesian Myzomela called aggressively in response to a Mariana Kingfisher perched nearby (R.J. Craig unpublished data).

BREEDING

Phenology

On Yap in August, a brood of three was following a pair of adults, a female was starting a nest and another female was observed carrying food (Fisher 1950). On Pohnpei, eggs were obtained in July–September (Yamashina 1932). A nest with young also was found in November–December, 1930. The species appeared to nest there at all times of the year (Baker 1951). On Chuuk, nests were found from May–July and in March (Hartert 1900). Three December males had swollen testes. The species also may nest there at all times of the year (Baker 1951). The number of nests found by Brandt (1962) with eggs were: January, 2; February, 2; March, 2; April, 6; May, 4; June, 2; September, 1 and December, 1. Nesting appeared to occur throughout the year. On Kosrae, an unfinished nest and recently fledged birds were found in late February (Finsch 1880, 1881). Females were feeding young long after they could fly and adult males copulated with juvenile females. A nest with nestlings was found in April (Hayes et al. 2016). Based on examination of molt in specimens, Baker (1951) concluded that nesting on Kosrae occurred from December to March. In 1983–1984, recently fledged birds were detected on Kosrae (July), Pohnpei (May), Chuuk (March), and Yap (May). In May, 1984 many more recently fledged birds were apparent on Yap than on Chuuk (Engbring et al. 1990).

On the Mariana Island of Guam, nests and eggs were found in May–July (Seale 1901). Hartert (1898) reported that collectors obtained nests in January, February and March. Strophlet (1946) observed a pair with two young in October. In 1945, individuals with enlarged gonads were collected in January, June and July, and evidence of nesting was obtained in June (Baker 1951). Kibler (1950) observed an adult feeding a fledgling in April and an adult feeding young in December. Evidence of nesting is available for every month except November, with staff records of nests from January through March and a nest and nestling in August. A recently fledged bird was observed in September. Although the species appeared to be a year-round breeder, the seasonal frequency of nesting activity was unclear (Jenkins 1983).

On Saipan in 1988–1993, breeding was recorded in February (nest building) and May (courtship) (Craig 1996, R.J. Craig unpublished data). In 2003–2004, seven nests were found: 31 May 2003, 17 February, 9 March, 12 March, 7 April, 9 April and 26 April 2004. Two nests had eggs, two had nestlings, and two did not yet have contents when located (Sachtleben 2005). On Rota in March, 1982 recently fledged birds were present (Engbring et al. 1986).

Nest

Nest site. On Kosrae, a nest was placed 3 m up in a forked branch of a mangrove standing in water (Finsch 1880). On Pohnpei, a nest with young was in a tree fern (*Cyathea* sp.) (Baker 1951). On Yap, a nest was in the outer tips of a branch 3 m from the ground (Fisher 1950). On Palau, a 1978 nest was 2 m up in a lateral branch extending over a sand beach (Pratt et al. 1980). On Chuuk, it most commonly nested in proximity to houses with flowering plants nearby. The birds most frequently built frail-looking nests in small trees with thick concealing foliage. Most nests were ≤4.6 m above the ground and placed at the outer tip of a branch and hidden in a terminal cluster of leaves. The nests were located in a variety of trees but usually those in open locations or at the outer perimeter of wooded areas. Attachment to branches was often weak and nests could blow down in storms (Brandt 1962). An unfinished nest found in April, 1984 was 16 m up in the twigs of a large, dead *Mangifera indica* (Engbring et al. 1990).

On the Mariana Island of Guam, nests were placed in shrubs or trees, chiefly *Pithecellobium dulce*, 1.2–2.4 m from the ground (Hartert 1898). Additional nests were 2.5–4.6 m above the ground and usually placed in the outer branches of *Citrus* sp. or *Pithecellobium dulce* (Seale 1901). Nests usually were constructed on the outer branches of a tree, often where branches fork. Two reported nests were 3.1 and 4.6 m above the ground in *Casuarina equisitifolia* and *Delonix regia* (Jenkins 1983). Nests also were reported in *Bruguiera gymnorrhiza* (Sachtleben 2005).

On Saipan, a 1989 nest under construction was 12 m up in a 15 m *Casuarina equisitifolia*, suspended from above and near the outer tip of the branch (R.J. Craig unpublished data). In 2003–2004, nests were located at <25 m to >100 m from roads. Four nests were placed in *Meiogyne mariannae* and three were in *Psychotria* sp. Nest and tree heights in *Meiogyne mariannae* were 1.5/5.6 m, 3/5 m, 3.5/6 m, and 5.1 m/undetermined, and in *Psychotria* sp. were 1.5/2 m, 1.7/2.3 m and 3.8/8 m. Nests were 83–184 cm from the trunk in *Meiogyne mariannae*, 0–103 cm from the trunk in *Psychotria* sp. and generally near the outer edge of the tree. The number of nest support branches was 2–5 and support branch diameter was 1.5–9.7 mm in *G. mariannae* and 1.5–2.5 mm in *Psychotria* sp. (Sachtleben 2005).

Structure and composition. On Kosrae, a nest was cupped and composed of fine roots, fibers, fine moss stems, leaf buds and wool-like material loosely woven together. It was protected from above by mangrove leaves (Finsch 1880). A Pohnpei nest was cup-shaped and made of ferns and fine grasses and lined with lichens (Baker 1951). On Chuuk, nests were constructed of grasses, weed stems, leaf fragments and shreds of coconut bast. The outer covering was often of dark tendrils and apparently aerial rootlets of saprophytes. The linings were of lighter fine grasses. Some nests were constructed in small crotches, whereas others hung from forks of branches (Brandt 1962).

On the Mariana Island of Guam, nests had deep cups woven with rootlets and fine grasses. The outside was covered with leaves, sheep's wool, cobwebs and similar materials (Hartert 1898). Nests also were described as neat cup-like structures of rootlets, plant fibers and wild cotton (Seale 1901). More recently, they were reported to be deep, cup-like and loosely woven of fine grasses, *Casuarina equisitifolia* needles, rootlets and leaves intertwined with spider webs. They were loosely constructed, fragile and with daylight penetrating the walls (Jenkins 1983).

On Saipan in 1989, a female gathered spider webs to place on a nest (R.J. Craig unpublished data). In 2003–2004, nests tended to be thinner and to deteriorate more rapidly than nests of the Bridled or Golden White-eye, whose nests they otherwise resembled. Nests were comprised of vine tendrils and apparently *Casuarina equisetifolia* needles. One of the nests also had part of a leaf skeleton from *Pandanus* sp. entwined around its outer base (Sachtleben 2005, Sachtleben et al. 2006).

Dimensions. On Chuuk, outside measurements of 18 nests averaged 20.0 mm in depth and 50.0 mm in width (Brandt 1962). Guam nests were 50–70 mm deep and 60–80 mm wide (Hartert 1898). Another nest had an internal size of 51 x 50 mm and 32 mm deep and an external size of 51 x 76 mm and 51 mm deep (Seale 1901). The inner depth of a cup was ≥30 mm (Jenkins 1983). The range of nest sizes has been reported to be: cup height = 25–50 mm, outer height = 50–120 mm, internal diameter = 25–60 mm and external diameter = 35–80 mm. Of three accessible Saipan nests, mean cup height = 41.3 mm (range = 39–45 mm, total nest height = 55.3 mm (range = 41–75 mm), internal diameter = 46.7 mm (range = 43–50 mm) and external diameter = 65.7 mm (range = 55–73 mm) (Sachtleben 2005).

Eggs

On Pohnpei, of 13 sets of eggs, 10 included two eggs per set and three include one egg per set. Eggs were white with gray and with dark yellow-brown speckling concentrated near the sharper end (Yamashina 1932). On Chuuk, the species most frequently laid two eggs, although some nests contained only one egg. Whether this constituted a normal clutch or whether the other egg was lost through predators or other causes could not be determined. The eggs were a glossy white or light cream color. The large end was heavily marked with spots of reddish brown. Brown spots were sprinkled over the surface of some. Eggs averaged 18.5 x 13.6 mm (n = 22) (Brandt 1962).

On the Mariana Island of Guam, nests had two eggs, were white or cream-color, richly marked with deep rufous brown spots, especially on the wider end. They measured from 17.1 x 14 to 10 x 14 mm. In some clutches, the spots were paler and brick-red (Hartert 1898). Other eggs, usually 2/nest, measured 19.0 x 14.5 mm, white and marked with brownish dots and splotches particularly at the larger end (Seale 1901). Mayr (1945) reported that the species rarely may lay three-egg clutches. Six Saipan nests found in 2003–2004 contained two eggs or two nestlings. Eggs in one nest from 26 April 2004 were creamy white and had one ring of brown speckles near the broad end and another near the narrow end (Sachtleben 2005).

Incubation

Incubation and brooding by both sexes is characteristic of the family Meliphagidae (Mayr 1945). On Saipan, incubation in one nest lasted 15–16 days. Only females were observed to incubate or brood nestlings (Sachtleben 2005).

Young Birds

Nestlings are altricial and closely resemble Bridled White-eye nestlings in their development until they grow red pin feathers. A 2003 nest with eggs had two nestlings appear at day 0–1. They were ca. 2 cm, had dark pink skin and were downy on the wings and back. On day 3–4, they had grown to 3–3.5 cm, were still covered with down and had skin color dark pink/purple. They appeared to be well fed and had large, rounded stomachs. At day 6–7, the nestlings' eyes began to open. They were 4–4.5 cm, had wing pins approximately 5 mm and back pins beginning to erupt. The head was covered in long down. On day 7–8, the nestlings were still 4–4.5 cm, had wing pins 8 mm, back pins 2 mm and bills beginning to curve, but head pins were not yet present. Underlying skin color progressively lightened throughout nestling development and was pale pink by this stage. At day 9–10, the wing pins were 10 mm and tail and head pins had erupted 1 mm. Tan-brown feathers had erupted from the wing pins, red feathers were beginning to erupt from the back pins and on day 10–11 1–2 mm head pins were visible. Both nestlings prematurely fledged on day 13–14 when disturbed by an observer. One was returned to the nest. At this time, nestlings were 5.5 cm but were not yet fully feathered. Red feathers, 1 mm in length, were erupting on the back, gray feathers had erupted on the head, 8 mm tail pins did not yet have feathers erupted and the breast was bare. On day 14–15, the nestlings' tan-brown wing feathers had turned dark gray and fledging occurred on day 15–16.

A second nest that fledged young was found on 12 March 2004. When found, the two nestlings were ca. 4 cm, had eyes open and had 2 mm downy feathers erupting from the pins on the wings, back and head. On 15 March, only one nestling remained. On 18 March the nestling, estimated at 4–4.5 cm and not fully feathered, prematurely fledged but could not fly and was returned to the nest. The erupted feathers were mostly black and had small red patches appearing on the head and back. This nestling fledged by 22 March.

A third nest was found on 9 April 2004. A female brought food to two nestlings. The nestlings were 3–3.5 cm and were developing pin feathers. On 13 April, the nestlings were ca. 4 cm, were covered with long black pins from which feathers had erupted and had their eyes open. On 16 April, the nestlings were 4–4.5 cm and their bills were visible over the rim of the nest. They were black all over with no red visible. By 19 April, the nestlings had fledged (Sachtleben 2005).

Parental Care

On Kosrae, birds occurred as pairs and in family groups (Finsch 1881). On Pohnpei, only the female was observed to feed the young (Baker 1951). On Yap, birds were usually observed in pairs (Fisher 1950). On Guam, a female with two young was observed to performed injury-feigning. It spread its tail, quivered its wings and called while hopping on a branch close to the ground (Stophlet 1946). This behavior also was reported by Jenkins (1983). On Pohnpei, injury feigning near a nest involved quivering wings, fluffing feathers and falling forward on a branch (Engbring et al. 1990).

On the Mariana Island of Saipan in 2003–2004, one or both members of a pair were often observed close to the nest, with adults tending to show agitation. Typically, one or both adults would feign injury by fluttering low to the ground and drooping one wing. If only one adult was present, this was sometimes accompanied by scolding. If both adults were present, often one adult would feign injury while the other scolded. This behavior was only observed at nests containing nestlings. Micronesian Myzomelas were intolerant of disturbance during incubation, and incubating females would abandon the nest after disturbance. Parental behavior of the species on Guam appeared to be the same as on Saipan, with females also feigning injury (Sachtleben 2005).

DEMOGRAPHY AND POPULATIONS

Causes of Mortality

Depredation. After its accidental introduction to the Mariana Island of 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 also was known to attack small passerines (Marshall 1949). In addition, the non-native Black Drongo was reported to prey upon small passerines (Maben 1982). On Rota, predation by the Black Drongo was implicated in the decline of the Rota White-eye and Micronesian Rufous Fantail (Craig and Taisacan 1994). Because the Black Drongo is associated with more open habitats also frequented by the Micronesian Myzomela, it is possible that the drongo may be involved in the possible decline of the species on Rota. 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 cattus*) are not known to be major predators of tree nesting birds in the Marianas, although the native Micronesian Starling 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 including the Micronesian Myzomela on Tinian has been suggested to be predation (Camp et al. 2012), although evidence for this is conjectural.

Of seven nests found on Saipan in 2003–2004, four failed (three during incubation and one undetermjned), and three fledged young. Causes of failure were uncertain. Still camera surveillance of 33 artificial nests on Saipan in 2003 revealed two instances of predation. In 2004, six 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 some bird species but not the Micronesian Myzomela (Ha et al. 2012). Similarly, 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. Kosrae: Early assessments were that the species was common to abundant (Finsch 1881, Baker 1951). In 1983–1984, it was found to be one of the most abundant and widespread species, with 1,433/km^2 (range = 1,200–1,850 km^2) and a total population of 136,358. Densities were highest in mangroves, particularly heavily flowering *Sonneratia* sp., where there were 3,975/km^2. The density at 0–100 m elevation was 1,325/km^2, whereas at 400-600 m it was 495/km^2 (Engbring et al. 1990, Hayes et al. 2016).

Pohnpei: Described as the most common native bird, in 1977 Ralph and Sakai (1979) calculated a density of 423.4/km^2. In 1983–1984, it was found to be abundant and widespread, with a population density of 1,071/km^2 (range = 995–1,118 km^2) and a total population of 358,065. The density at 0–100 m was 1,096/km^2, whereas at 400–600 m it was 917/km^2 (Engbring et al. 1990). In 2012, the density was estimated at 1,077.7 ± 11.2 in mangroves, 807.6 ± 2.5 at 0–100 m and 807.7 ± 3.9 at 600–800 m, although detections declined with increasing elevation. Species detections declined from 1983–1984 to 2012 except at the highest elevations, where detections increased. Moreover, when compared to Buden's (2000) 1994 detections, mean detection rates declined by 28.9% (Oleiro 2014).

Chuuk: Reported to be common (Brandt 1962), Ralph and Sakai (1979) calculated a density of 688.3/km^2 in 1977. In 1983–1984, it was found to be abundant and widespread, with 2,067/km^2 (range = 1,564–4,803 km^2) and a total population of 165,440. The density in mangroves was highest at 3,801/km^2, whereas the density in native forest was lowest at 1,687/km^2 (Engbring et al. 1990).

Yap: Reported to be common by Fisher (1950), in 1977 Ralph and Sakai (1979) considered it less common and calculated a density of 169.0/km^2. In 1983–1984, it was found to be abundant and widespread, with 1,098/km^2 (range = 836–1,792 km^2) and a total population of 109,363. The density in mangroves was highest at 1,850/km^2, whereas the density in savanna was lowest at 463/km^2 (Engbring et al. 1990).

Palau: It was reported common by Marshall (1949), but Ralph and Sakai (1979) considered it less common and calculated a density of 36.6/km^2 in 1977. Pratt et al. (1980) found it common throughout, including on Angaur. A 1991 survey of the Palau Islands yielded a density estimate of 138/km^2 with a total population of 35,362. Notably, it was not recorded on Angaur (Engbring 1992).

In the Mariana Islands, it was reported common on Agrihan by Borror (1947) and a 2000 survey yielded a density estimate of 2,239/km^2. A 2008 survey of Asuncion yielded a density of 713/km^2 (Williams et al. 2009). A 2017 survey of Alamagan yielded a density of 390.5/km^2 and a total island population of 1,526 ± 166. The highest densities were in *Cocos nucifera* forests and the lowest were in broadleaved and mixed forests. Population estimates averaged lower than that of 2000 (ca. 2,200) although this appeared due to a change in methodology (Murray et al. 2018). On Guguan in 2016, the species was present in forest and non-forest and the population density was estimated to be 197.5/km^2. The total population in forest was estimated to be 327 and the total island population was 876. Population estimates were higher than that of 2000 (ca. 450) (Liske-Clark et al. 2016). A 1990 survey of Sarigan yielded a density estimate of 2,398/km^2 in agroforest (principally *Cocos nucifera*) and 231/km^2 in native forest (Craig 2021b). Later estimates over all habitats, including swordgrass savanna, were as follows: 1990 = 1,679/km^2, 1997 = 1,677/km^2, 1999 = 945/km^2, 2000 = 859/km^2 and 2006 = 1,240/km^2. Breeding pairs were estimated at 4,130 in 2006. Despite these population estimates, the detections/station grew from 1990 to 2006. Moreover, detections were greatest in native forest (Martin et al. 2008), which is at odds with most other reports on habitat-specific population densities of the species.

On Guam, the species was found to be common by Seale (1901), Strophlet (1946), Kibler (1950) and Hartin (1961). In 1945, Baker (1947) found it on 37.6% of 125 roadside counts. In 1976 and 1978, it was uncommon but widespread in northern Guam (Pratt et al. 1979) with Ralph and Sakai (1979) describing it as one of the most common remaining native birds with a density of 231.3/km^2 in 1977. By the early 1980s, it was found regularly only in the northernmost portion of the island. It appeared to have disappeared entirely from southern and central Guam as well as from most of the northern plateau (Jenkins 1983). In 1981, its population density was computed as 62/km^2 (range = 3–160/km^2 at sites where it was present). The total population was estimated to be 2,682 (range = 2,300–3,140) (Engbring and Ramsey 1984). 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. In 1983, populations underwent a precipitous decline, decreasing by 73% in only two months. The last individual recorded on a survey was in 1984 (Wiles et al. 2003).

On Tinian and Saipan, it was thought to be uncommon to rare (Baker 1951), although Stott (1947) found it to be fairly common throughout Saipan. It also was found to be less common than other endemic passerines by Pratt et al. (1979). Ralph and Sakai (1979) similarly described the Saipan population as less common compared with other native species and in 1977 computed a density of 101.3/km^2 for it. A 1990–1993 series of surveys on Saipan yielded a native limestone forest wet season estimate of 117.1 ± 88.0/km^2 and a dry` season estimate of 282.4 ± 222.8/km^2. Individuals appeared to move into native forest during the dry season flowering of *Erythrina variegata*. A dry season estimate in disturbed habitats vegetated by *Leucaena variegata, Cocos nucifera* and primarily non-native trees was 259.5 ± 64.2/km^2 (Craig 2021b). In limestone forest, between-season variation in density was high compared with within-season variation. Variation also was greater than that observed in other passerines. These observations indicated that seasonal shifts occurred in populations or breeding status. The species was uncommon in limestone forest compared with other passerines (Craig 1996). Island-wide population density estimates for Saipan using updated analytic techniques were of: 1982 = 360.1 ± 57.6/km^2, 1997 = 386.7 ± 63.8/km^2 and 2007 = 482.3 ± 76.7/km^2. The total 2007 population was estimated at 64,351 (range = 47,192–86,556). The 25-year population trend showed a significant increase (Camp et al. 2009). A reanalysis of these surveys yielded somewhat different figures and also added a 2018 estimate of 254 ± 230/km^2. Reassessed total populations were 1982 = 49,831 ± 3851, 1997 = 35,157 ± 3680, 2007 = 51,058 ± 5,179 and 2018 = 30,207 ± 2775 (Bak et al.2024).

In addition to these surveys, in 1991−1992 standard U.S. Fish and Wildlife Service roadside surveys were conducted quarterly on Saipan. Counts showed limited variation although January counts averaged lowest, probably because higher winds at this season reduced the detectability of the species. No clear seasonal trend emerged in census data (Craig 1996). Additional analysis of 1991−2010 Saipan roadside surveys demonstrated a significant increase after populations appeared to dip to a low in the mid-1990s (Ha et al. 2018).

On Tinian, updated analytic procedures yielded population density estimates of: 1982 = 87.6 ± 13.5/km^2, 1996 = 35.6 ± 6.8/km^2 and 2008 = 47.3 ± 9.0/km^2, with a 2008 population estimate of 3,254 (range = 2,305–4,662) (Camp et al. 2012). A reanalysis yielded density estimates of: 1982 = 172 ± 22/km^2, 1996 = 68 ± 11/km^2, 2008 = 56 ± 5/km^2 and 2012 =

59 ± 6/km^2. Population estimates were: 1982 = 16,862 (range = 13,473–21,754), 1996 = 6,675 (range = 4,896–9,247), 2008 = 5,456 (range = 4,560–6,462) and 2012 = 5,779 (range = 4,768–6,918). These figures suggest a population decline (Spaulding et al. 2022), although the 1982 estimate may be an outlier perhaps due to observer differences (Craig 2021b).

On Rota, the Micronesian Myzomela was initially reported to be abundant (Baker 1951). It was similarly described as common by Pratt et al. (1979). In 1977, Ralph and Sakai (1979) found it common and computed a population density of 306.7/km^2. A 1982 survey yielded a similar density estimate of 352/km$^{2.}$ (Engbring et al. 1986). A 2012 survey estimated a density of 173.8 ± 2.0 /km^2. Population estimates using updated analyses were as follows: 1982 = 49,962 (range = 38,276–63,191), 1987 = 50,877 (range = 36,417–70,026), August 1988 = 25,676 (range = 19,173–33,670), December 1988 = 28,410 (range = 21,180–37,057), 1989 = 33,303 (range = 25,346–42,613), 1994 = 32,319 (range = 23,755–43,288), 1995 = 49,050 (range = 37,608–62,694), 1998 = 16,340 (range = 12,162–21,359), 2003 = 21,021 (range = 15,673–27,442), 2006 = 21,317 (range = 14,860–29,138) and 2012 = 16,441 (range = 12,399–21,270), which suggested a downward population trend. Densities also appeared to decline with altitude (Camp et al. 2014).

A 1982 survey of Aguiguan yielded an estimate of 570/km2, with a population of 2,195 (Engbring et al. 1986). A 1992 wet season survey there yielded a native limestone forest estimate of 1,949.8/km^2 (Craig 2021b). A 2000 island-wide estimate was 1,310/ km^2 with a total population of 3,611, whereas a 2002 estimate was 1,420/ km^2 with a total population of 3,913 (Esselstyn et al. 2003). A 2016 survey showed that bird detections/station tended to decline from 1982 to 2008 but then increased to levels similar to 1992 by 2016. Whether these findings reflected actual population change or differences due to time of sampling, changes in methodology or observer bias was unclear (Liske-Clark et al. 2018).

Population Regulation

Mayr (1945) reported that males outnumbered females by ca. 4:1, although whether this referred to Micronesian birds or to populations now considered to be distinct species is unclear. Baker (1951) later found a ratio of slightly above 2.5:1 in the Marianas and did not consider females more secretive than males. Of 108 birds seen in Jenkins' (1983) study, 65 were male for a ratio of about 1.5:1. Much of this discrepancy is likely due to males being more conspicuous than females due to their frequent singing and aggressive behavior (Engbring et al. 1990, R.J. Craig personal observation).

Population change was largely determined by recruitment, including one year-old recruits and immigrating adults (Saracco et al. 2021). Saipan capture-recapture data from 2008–2018 showed a mean population growth rate of 0.92, adult apparent survival probability of 0.37, recruitment rate of 0.55, proportional contributions of survival and recruitment of 0.40 and proportional contributions of these two to population growth of 0.60. The population appeared to be declining. The relatively low survival, high recruitment and seniority estimates for the species suggest that movement is likely an important factor in determining local population dynamics. Typhoons also may play a role in population trends (Saracco et al. 2021). This finding is contrary to that found from periodic population surveys, which indicate a population increase (Camp et al. 2009).

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. In the case of the Micronesian Myzomela, however, such changes may be a net plus, as is also indicated by population survey data (Camp et al. 2009). 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.

CONSERVATION AND MANAGEMENT

Conservation Status

The Micronesian Myzomela is regarded as a species of least conservation concern. It has an estimated total population of 850,000–900,000 (BirdLife International 2025). However, the Guam population is extinct, with the last individuals observed in 1984 (Wiles et al. 2003). On Kosrae, with a low human population and relatively pristine environments, resident breeding birds are thriving and have no serious threats to survival (Hayes et al. 2016). In contrast, encounter rates of the species on Pohnpei dropped by over half from 1983–1984 to 1994 (Buden 2000).

In the Mariana Islands, the Micronesian Myzomela appears to have large populations on most islands and has an apparently increasing population on Saipan, although it is possibly declining on Rota and Tinian. However, interpreting population trends must be done with caution because of the species' seasonal shifts in occurrence (Craig 2021b), likely due to birds opportunistically following ephemeral nectar sources, much as Hawaiian Honeycreepers do (Scott et al. 1986). Moreover, differences in population estimates among years may be related to surveys being conducted by multiple and differing observers with varying experience and perceptual abilities. Such differences can obscure any actual temporal change in population size (see also Camp et al. 2015). Still, the species is threatened by the potential for establishment of the predatory brown tree snake on islands within its range. Such an introduction could result in rapid elimination of populations, as it did for land birds on Guam (Wiles et al. 2003).

Effects of Human Activity

Habitat loss and degradation. Habitat loss has been cited as a cause of concern for the Micronesian Myzomela's Pohnpei, Saipan and Tinian populations. On Pohnpei since the 1980s, large tracts of native forest have been transformed to primarily agricultural land. Estimates of native forest on Pohnpei dropped from 42% cover in 1975 to 15% cover by 1995 (Buden 2000). Unlike other islands in the region, Pohnpei does not have introduced snakes and other introduced species have low densities. Hence, habitat alteration appears to be the major driver for any changes in populations. Habitat occupancy model results for the species indicated a positive association with climax forest and a negative association with anthropogenic habitats (Oleiro 2014).

In the Mariana Islands 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). 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 2025).

Survival of three other Mariana Islands passerines was positively related to remotely sensed dry season greenness and negatively related to wet-season greenness, so it appears likely that the Micronesian Myzomela may show a similar relationship. The association with greenness 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 Myzomela 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 the island (Yackel-Adams et al. 2021). In contrast to Saipan, the risk of snake introduction to the more northern uninhabited Mariana Islands and other island chains is likely 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, particularly in light of the Micronesian Myzomela's frequent foraging on its flowers (Craig 2021b).

Management

Conservation areas. On Chuuk, the Weno Ridge Forest and UFO Forest Stewardship Area are protected. On Yap, there is a mangrove reserve and a traditional management zone that are protected areas. On Pohnpei, the Pohnpei Watershed Forest Reserve, Pwudoi Mangrove Forest Reserve, Seinpehn Mangrove Forest Reserve and the Enipein Mangrove Reserve ae protected (Digital Atlas of Micronesia 2025). On Palau, there are 59 conservation and protected areas, with many on the island of Babelthuap and the Rock Islands (Palau Conservation and Protected Areas 2024). The Commonwealth of the Northern Mariana Islands (CNMI) has the following wildlife conservation areas: on Saipan, there is Bird Island, Kagman, Lake Susupe, Megapode, Upland Mitigation Bank and Costco Park; on Rota, there is Mariana Crow, Sabana, I'Chenchon Park and Liyo. Guguan, Asuncion, Maug and Uracas are parts of the As Gani Conservation Area (CNMI Department of Lands and Natural Resources 2025). Aguiguan is also set aside as a reserve (Engbring et al. 1986).

Conservation measures and habitat management. Because of the extensive range and large populations of the Micronesian Myzomela, no captive breeding and translocation programs have been developed. However, U.S. Department of Defense is funding efforts directed at restoring native forest on Tinian for the benefit of native wildlife (Readiness and Environmental Protection Integration Program 2025). On Sarigan, feral goats and pigs have been eradicated, which is permitting native vegetation to recover (Martin et al. 2008).

To prevent the spread of the brown tree snake from Guam to other islands, the U.S. Dept. of Agriculture has a snake interdiction program. Similarly, the CNMI Dept. of Lands and Natural Resources conducts a snake interdiction program. The Pacific

Island Ecosystem Research Center also has a rapid response and research program aimed at preventing snake establishment (Pacific Island Times 2023). 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 escaping 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 concerning 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 islands.
2. As the highest densities of the Micronesian Myzomela are usually attained in secondary forest, particularly forest in which *Cocos nucifera* is a major component, a second priority is the preservation of this habitat by setting it aside from any encroachment by residential or commercial development.
3. Little attention has been paid to understanding the behavior of this species. Studies of inter- and intraspecific interactions, territoriality and foraging ecology would greatly expand our knowledge of its ecology.

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