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OBSERVATIONS ON THE BREEDING BIOLOGY OF THE MEXICAN WOODNYMPH HUMMINGBIRD *EUPHERUSA RIDGWAYI* IN NAYARIT, MEXICO

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Abstract · Many Neotropical birds, like the threatened, endemic Mexican Woodnymph *Eupherusa ridgwayi*, lack fundamental information on their breeding biology. Between 2021 and 2024, in March, July, and November, we discovered four nests of the Mexican Woodnymph in shade-coffee plantations and cloud forests in Nayarit, Mexico. These cup-shaped nests, mainly made of moss and fern, were built on understory branches, 1 m above the ground, on shady banks near roads or streams. Courtship involved males performing side-to-side and forward-backward flight. Three nests had two eggs (12.8 x 7.7 mm, N = 6 eggs) each. Two nests hatched two chicks each, but only one chick per nest survived. Nestling plumage became sexually dimorphic 17–20 days after hatching —an unusual trait for nestling hummingbirds. Chicks fledged on days 25–26 and remained nearby for 2 weeks. Our study quadruples the number of known nests and expands knowledge of nestling development, post-fledging care, and breeding season for the Mexican Woodnymph.

Resumen · Observaciones sobre la biología reproductiva del colibrí Ninfa Mexicana *Eupherusa ridgwayi* en Nayarit, México
Muchas aves neotropicales, como el endémico y amenazado colibrí Ninfa Mexicana *Eupherusa ridgwayi*, carecen de información fundamental sobre su biología reproductiva. Entre 2021 y 2024, en marzo, julio y noviembre, encontramos cuatro nidos de *E. ridgwayi* en cafetales de sombra y en bosques de niebla en Nayarit, México. Los nidos, con forma de copa y hechos principalmente de musgo y helechos, fueron construidos en ramas del sotobosque, a 1 m del suelo, en taludes sombreados cerca de caminos o arroyos. El cortejo implicó que los machos hicieran vuelos laterales y hacia adelante y hacia atrás. Tres nidos tenían dos huevos (12.8 x 7.7 mm, N = 6 eggs) cada uno. Dos nidos eclosionaron dos polluelos, pero solo uno sobrevivió en cada nido. Entre los días 17 y 20 después de la eclosión, el plumaje de los polluelos adquirió dimorfismo sexual —un rasgo inusual en los polluelos de colibríes. Los polluelos abandonaron el nido alrededor del día 25–26 y permanecieron cerca durante dos semanas. Nuestro estudio cuadruplica el número de nidos descritos y amplía el conocimiento sobre el desarrollo de los polluelos, el cuidado posvolanton y la temporada reproductiva de *E. ridgwayi*.

Keywords: *breeding season · hummingbird reproduction · Mexican endemic hummingbirds · nest description · nesting behavior · nestling development*

INTRODUCTION

For most Neotropical bird species, a significant gap remains in basic natural history knowledge, and fundamental information on nest descriptions, clutch size, incubation period, and nestling period is lacking for many species (Xiao et al. 2017, Lees et al. 2020). Nesting is essential for maintaining bird populations and species fitness (Martin 1993, Clark and Shutler 1999, Tadey 2019). Conservation efforts rely heavily on understanding breeding biology and identifying and protecting habitat features that influence breeding success and survival (Martin 1992). Studying nests also provides valuable life-history data, such as clutch size, brood numbers, nesting attempts, and success rates, which are crucial for assessing a species' vulnerability to decline or disturbance (Martin and Geupel 1993). Conservation planning is nearly impossible without more accurate knowledge of ecological needs. For many hummingbird species living in tropical habitats, details about nest characteristics, reproductive seasonality, and nesting-site preferences are still unknown. These gaps emphasize the importance of gathering more information on tropical hummingbirds (Nuñez-Rosas et al. 2021).

Five *Eupherusa* hummingbird species are native to Mexico and Central America, ranging from western Mexico to Panama, and are mostly restricted to specific regions. These mountain-dwelling birds inhabit cloud forests, humid pine-oak forests, and evergreen tropical forests (Arizmendi et al. 2020a, 2020b, 2020c, Schulenberg and Sedgwick 2020, Peterson and Boesman 2021). Three Mexican endemic *Eupherusa* face significant risks as they are closely associated with humid environments that are threatened by habitat loss from agricultural expansion and illegal logging (BirdLife International 2018, Arizmendi et al. 2020a, 2020b, Peterson and Boesman 2021).

The northernmost species in the genus is the Mexican Woodnymph *Eupherusa ridgwayi*, an endemic hummingbird confined to a small range in the states of Nayarit, Jalisco, and Colima in western Mexico (Berlanga et al. 2008, Peterson and Boesman 2021, Rosas-

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Espinoza et al. 2022). It is listed as vulnerable by the IUCN (BirdLife International 2018), included in CITES appendix II (CITES 2025), and classified as "threatened" under Mexican law (SEMARNAT 2019). Biological data on the Mexican Woodnymph, including aspects of its breeding biology such as courtship behavior, nest construction, incubation, nestling development, and maternal behavior, remain very limited. Aside from breeding birds collected in February and March (Peterson and Boesman 2021), there is little additional information about its reproductive behavior. More recently, Rosas-Espinoza et al. (2022) described a cup-shaped nest found in cloud forest in Jalisco, Mexico. Therefore, further research into the Mexican Woodnymph's life history, including its breeding ecology, is critically needed (Peterson and Boesman 2021). We aimed to (1) describe nest architecture and materials, (2) document nestling development and maternal behavior, (3) characterize nest-site habitat, and (4) offer conservation recommendations based on observed habitat requirements. We also compare our findings with the only previously described Mexican Woodnymph nest (Rosas-Espinoza et al. 2022) and with available information for the *Eupherusa* genus.

METHODS

Study species. The Mexican Woodnymph is a medium-sized hummingbird that inhabits cloud forests, tropical lowland evergreen forests, canyons, and the foothills of humid forests and coffee plantations (BirdLife International 2018, Peterson and Boesman 2021). Males are primarily green, with a dark green belly, bluish-black tail, iridescent blue-violet front, blue crown, and green gorget. Females are green on the back and sides but have clear grey underparts (Arizmendi and Berlanga 2014). Both sexes have slightly forked tails and black, short, straight bills (Arizmendi and Berlanga 2014). The only Mexican Woodnymph nest described to date was placed 1.32 m above the ground on a secondary branch of a tree sapling (4.2 m tall, 5 cm DBH), located 1 m away from a permanent stream in a cloud forest (Rosas-Espinoza et al. 2022). The nest was built in early July and occupied for most of August (Rosas-Espinoza et al. 2022).

Study site. We conducted the study at El Cuarenteño (105°01'44.545" W, 21°27'29.232" N), an *ejido* (community-owned land) located on the western slope of the Sierra de San Juan and part of the Sierra de San Juan State Biosphere Reserve. El Cuarenteño is situated at an average elevation of 1013 m a.s.l., in the municipality of Xalisco, Nayarit, Mexico. Vegetation includes pine-oak forests, cloud forests, and secondary growth associated with coffee, banana, and avocado plantations. The mean annual temperature is 22°C, and the average total annual rainfall is 1500 mm (INEGI 2010).

Nest search and monitoring. From August 2021 to July 2022, and October 2023 to September 2024, while monitoring hummingbird habitat and floral resources through point counts with associated floral counts (Hutto et al. 1986, Ralph et al. 1995, Díaz Infante et al. 2020a, 2020b, López-Segoviano et al. 2025) in El Cuarenteño, we also searched for hummingbird nests along transects. Point-count transects were located along secondary roads and covered an altitudinal range of 890–1465 m a.s.l., primarily in disturbed cloud forests that had been transformed into shade-coffee, avocado, and banana plantations.

We located nests by observing female hummingbird behavior, such as long, straight flights to or from dense vegetation (without flowers), collecting or carrying construction materials, territoriality away from floral patches, aggressive behavior, or a female remaining in an area without actively feeding (Martin and Geupel 1993). Whenever possible, we observed the nests from the date when they were found until the chicks fledged. When nests were abandoned or destroyed, we gathered as much information as possible. We observed nesting behavior and chick development at approximately 10 m using binoculars for 1 to 1.5 hours per day to minimize disturbance and prevent females from abandoning their nests.

We found four Mexican Woodnymph nests, locating Nest 1 in 2021, Nest 2 in 2022, and Nests 3 and 4 in 2024. We obtained data on Nest 1 over 20 non-consecutive days, totaling 30.3 h of observation. Nest 2 was located a few centimeters from the location of Nest 1, therefore we presumed this was made by the same female as Nest 1 (based on proximity). For logistical reasons, this nest was not visited as frequently, and we do not have the exact number of observation days. Finally, Nests 3 and 4 could not be monitored further as they were abandoned after being located: in Nest 3, the female did not return, and Nest 4 was destroyed during a storm.

We measured nests following Hansell (2000), including shape (cup, dome, or semi-dome), average depth (exterior top-to-bottom measurement), nest diameter (distance across the widest part of the nest), cup depth (interior top-to-bottom distance), cup diameter (interior distance across the widest part of the nest), and nest wall thickness. We measured eggs along their longest and widest axes (Biggins et al. 2018). We only took measurements of nestlings from Nest 1, and only once, on the day the second egg hatched. We measured nestling body length from bill tip to the end of the pygostyle, and bill length from the nares to the tip. All nest, egg, and chick measurements were taken with a Vernier (Spi 150mm/0.1mm). Once nests were abandoned, we collected the nests to analyze their construction materials. Nests were dried, and the materials were separated, weighed (Citizen CX301, Max: 310 g, d = 0.1 mg), and identified with the help of a stereo microscope (Velab Stereo VE-S7) and consultation with a botany expert (A.M. Hanan-Alipi).

RESULTS

Breeding season. We located Nest 1 with eggs on 6 November 2021, when we observed a female foraging in *Malvaviscus arboreus* flowers, just before she perched on her nest (Figure 1A). Nests 2 and 3 were located on 12 March 2022 and 16 March 2024, respectively, both with eggs. Finally, we located Nest 4 under construction, with no eggs, on 23 July 2024.

Courtship. On 12 September 2021, we observed a female perched about 2.5 m high, with a male above her who, upon arriving, hovered in front of her, moving side to side and front to back, then flew away. A few seconds later, the male returned and repeated the display. The female flew off, and the male pursued her. A second male joined in and chased them, vocalizing constantly within a 25 m radius. A few seconds later, the female returned to her perch and copulated with the first male. The site was a shade-coffee plantation in a steep, shady gully, with *Inga* and other native trees, and the courtship display lasted a couple of minutes.

Nest site. All four nests were placed on shaded banks near dirt roads, close (1 to 10 m) to shade-grown coffee, avocado, or banana plantations, with dense native cloud forest surrounding and interspersed among them. The forest included trees such as *Carpinus tropicalis*, *Ficus* spp., and *Quercus* spp., as well as bushes and herbs. Nests 1, 2, and 3 were on steep slopes facing north, while Nest 4 was on a south-facing slope. The average nest height was 1.24 ± 0.12 m (range: 1.08–1.35 m) above the ground. Nest 1 was positioned between two *Passiflora jorullensis* (Passifloroideae) vines intertwined at the base of the nest; one vine measured 4.9 mm in diameter, and the other 4.5 mm. Nest 2 was on a dry twig 43 cm long and 5.5 mm in diameter, supported by a *Piper hispidium* shrub branch, which provided shade for both nests. Nest 3 was on a *Chusquea cortesii* (Bambusoideae) stem measuring 5.7 mm in diameter and located 70 cm from the outer bamboo foliage. Finally, Nest 4 was located 63 cm from a moss-covered rock wall, on a coffee shrub *Coffea*

Figure 1. Mexican Woodnymph *Eupherusa ridgwayi* nests at El Cuarenteño, Nayarit, Mexico. A) Female on Nest 1. B) Clutch in Nest 1. C) Female feeding a 3-day-old nestling in Nest 1. D) Female feeding a 10-day-old nestling in Nest 2. E) 19-day-old female nestling at Nest 1. F) 22-day-old male nestling at Nest 2. Photos of Nest 1 taken from November to December 2021; photos of Nest 2 taken from March to April 2022 (All photos taken by EM Figueroa-Esquivel, except photo C by Mark Stackhouse).

arabica 2.4 m tall, positioned at the intersection of two twigs: one measuring 45 cm in length and 6.5 mm in diameter, and the other 13 cm long and 3.9 mm in diameter. The nest was 16 cm from the trunk of the shrub. Some lianas growing over the rock wall extended above the coffee shrub. Nests 1 and 2 were above an ephemeral creek, Nest 3 was not near any creek, and Nest 4 was about 8 m from an ephemeral creek.

Nest description. Nests (N = 3) were cup-shaped with an average depth of 5.1 ± 0.87 cm, a nest diameter of 5.3 ± 1.70 cm, a cup depth of 2.02 ± 0.8 cm, a cup diameter of 2.62 ± 0.59 cm, and nest wall thickness of 0.98 ± 0.38 cm. Nest 3 was larger and with a thicker wall than the other nests (Table 1). Nests were mainly built with moss and fern scales attached with spider silk, and green lichens (possibly *Parmotrema* sp.) on the outside (Figure 1, Table 1). The inner cup of the nests was lined

Table 1. Dimensions and materials used in Mexican Woodnymph *Eupherusa ridgwayi* nests. The main components for each nest are highlighted in bold. For Nest 4 and the nest reported by Rosas-Espinoza et al. (2022), we only list (x) the main observed materials.

Measurements (mm)	Nest 1	Nest 2	Nest 3	Nest 4	Rosas-Espinoza et al. 2022
nest depth	47.6	46.1	61.8	–	50
nest diameter	44.5	42.2	71.8	–	50
cup depth	21	20.1	19.5	–	22
cup diameter	30.5	28.6	19.5	–	-
wall thickness	7.8	7.4	14.1	–	6
Materials g (%)					
Moss	0.61 **(46.6)**	0.73 **(51.0)**	1.61 **(75.9)**	x	x
Fern scales	0.36 **(27.5)**	0.38 **(26.6)**	0.01 (0.5)		
Plant-down	0.00 (0.0)	0.08 (5.6)	0.40 **(18.9)**	x	x
Lichen	0.12 (9.2)	0.11 (7.7)	0.02 (0.9)	x	x
Exuvia	0.16 **(12.2)**	0.03 (2.1)	0.00 (0.0)		
Leaves	0.01 (0.8)	0.07 (4.9)	0.08 (3.8)		x
Bark	0.04 (3.1)	0.02 (1.4)	–		
Fern rhizomes	0.01 (0.8)	0.01 (0.7)	–		
Total weight (g)	1.31	1.43	2.12		

with unidentified plant-down (Figure 1B), likely from *Asteraceae pappus*. The average weight of nests was 1.5 ± 0.43 g (N = 3). Moss was the primary material by weight in all nests (Table 1) and comprised a mean of 57.9 ± 15.8% of nest weight. Fern scales were the second-most common material in Nests 1 and 2 (Table 1), averaging 18.2 ± 15.3% (N = 3) of nest weight. In Nest 3, plant down was the second-most abundant material, comprising 18.9% of the nest weight (mean 8.2 ± 9.7%, N = 3 nests; Table 1). Other materials, such as lichens, caterpillar *exuvia*, leaves, bark, and fern rhizomes, average less than 6% of nest weight (Table 1). Nest 4 was destroyed during a storm before it could be analyzed, but some moss with attached lichens on the outside, and white plant-down inside, were still observed.

Materials were also used to conceal nests. Nest 1 was concealed during incubation by a live fern, *Thelypteris oligocarpa,* with a frond attached to the nest by the female using spider silk. Towards the end of incubation, a *Piper hispidium* leaf (220 x 80.7 mm) nearly covered the northeastern side of the nest. Nest 2 was concealed by a ball of leaf-litter bound with spider silk. Bamboo foliage concealed Nest 3, except for one side. Finally, Nest 4 was the most exposed, lacking leaf cover, but the color and texture of the nest provided camouflage against the moss-covered wall.

Eggs. Nests 1 to 3 each contained two white, non-glossy, elliptical-oval eggs (Figure 1B). The average egg measurements were 12.78 ± 0.71 x 7.74 ± 0.84 mm (Table 2). Both eggs from Nest 1 hatched by November 2021, which was 13 days after the first nest was located. Eggs from Nest 2 hatched between 14 and 16 March 2022, three to four days after being found. We did not observe the start of nest construction or egg-laying in any nests with eggs, nor the exact hatching date for Nest 2. Therefore, we cannot determine the actual incubation period with our current data. Eggs from Nest 3 did not hatch because the nest was abandoned, and Nest 4 was destroyed before egg-laying.

Nestling development. Two chicks hatched in both Nest 1 and Nest 2, but only one chick from each nest survived. The smallest nestling from Nest 1, which died for an unknown reason, measured 15 mm in length on the day of hatching. It was pinkish, with a yellow belly, and almost entirely featherless except for two lines of brown down on the dorsal part, which ran from the base of the neck to the pelvic region. The 2.5 mm-long beak was yellowish-pink at the base, with a barely visible white egg tooth. By day 4 after hatching, the surviving nestling had grown considerably, and more down appeared on the dorsal part, although it was still absent on the head. In the following days, between hatching and fledging, we mainly observed changes in plumage, including the down on the head and the emergence of all feathers, including wing feathers. Both mandibles had a striking yellow-orange color, and only before fledging did the upper mandible turn dark; the lower mandible remained yellow-orange except for the tip, which also turned black. Between days 17 (Nest 1) and 20 (Nest 2) after hatching, the plumage of the nestlings was differentiated by sex: the female chick from Nest 1 had a clear gray throat and belly; the head and back were dull green with brown tips (Figure 1E). The male chick in Nest 2 had a slightly shiny green body and a grayish-green throat (Figure 1F). Before fledging, both chicks preened, stretched, and hovered over their nests.

Female nesting behavior. Once the eggs hatched, the female remained on the nest an average of 8.8 ± 3.12 mins, ranging from 5 to 16 mins (N = 5 observations). The female perched on the edge of the nest and fed the nestlings for two to five seconds (Figure 1C,D). Most of the time, after feeding the nestlings, the female foraged in nearby flowers (5–20 m from the nest), and only once did she brood the nestlings. During November and December, the nesting female mainly fed on nectar from *Malvaviscus arboreus* and *Barleria oenotheroides* flowers, and during March and April, on nectar from *Inga eriocarpa* flowers.

One day before fledging, the female from Nests 1 and 2 perched about 4 m away and vocalized constantly. The female chick from Nest 1 left on day 26 after hatching, while the male chick from Nest 2 left around day 25 after hatching. Both chicks stayed 10 to 20 m from the nest. The female fledgling flew uphill

Table 2. Measurements (length x width) of six eggs of the Mexican Woodnymph *Eupherusa ridgwayi*. Each nest contained two eggs.

Nest ID	Egg 1 (mm)	Egg 2 (mm)
Nest 1	13.4 x 6.1	12.8 x 7.8
Nest 2	12.2 x 8.3	11.8 x 8.4
Nest 3	12.8 x 7.9	13.7 x 8.0

and stayed nearby for 13 days, moving from one branch to another at a height of 1 to 1.5 m, where the female fed the fledgling several times daily. In contrast, the male fledgling flew downhill, and we were unable to observe him. However, one month later (7 May 2022), an adult female was seen feeding a juvenile male at the same location, with a range of 5 to 11 min per feeding event, mean 7.56 ± 1.6 min (N = 20 feeding events).

DISCUSSION

In this study, we present observations on key aspects of the breeding biology of the Mexican Woodnymph, including courtship and time of nesting, female nesting behavior, nest-site and nest characteristics, clutch size, egg descriptions, brood size, and nestling development. Previous information on Mexican Woodnymph reproduction consisted only of records of birds in breeding condition captured in February and March (Howell and Webb 1995, Peterson and Boesman 2021), as well as one nest description detailing nesting activity and nestling development during July and August (Rosas-Espinoza et al. 2022). Therefore, our observations expand the understanding of the species' natural history, enable comparison with other *Eupherusa* spp., and provide valuable information for the conservation of the Mexican Woodnymph.

Breeding season. Our observation of nesting in March 2022 and 2024 supports the breeding activity reported by Howell and Webb (1995) and Peterson and Boesman (2021). However, our additional observations of active nests in July 2024 and November 2021, along with courtship behavior in September 2021, suggest that breeding season of the Mexican Woodnymph spans at least seven months (July–December, March). Whether breeding occurs year-round at El Cuarenteño requires confirmation through ongoing monitoring. Our observation also coincides with the previously documented nest in Jalisco, Mexico, that was active from July through August (Rosas-Espinoza et al. 2022), and Villar (2021) provides photographic records of a fledgling in mid-September. Collectively, these records indicate that the Mexican Woodnymph maintains an extended breeding season, a trait likely shared with other *Eupherusa* hummingbirds. Notably, the other two endemic *Eupherusa* species from southwestern Mexico also have nest reports during the dry and wet seasons: Feb–May, Nov for the White-tailed Hummingbird *E. poliocerca*, and May, Oct–Nov for the Oaxaca Hummingbird *E. cyanophris* (Hartert and Hartert 1894, Rowley 1966, Collar et al. 1992). Moreover, the more southernly distributed *Eupherusa* species seem to have broader breeding seasons: the Stripe-tailed Hummingbird *E. eximia* breeds from April to August in Mexico but from September to April in Costa Rica, while nest reports of the Black-bellied Hummingbird *E. nigriventis* span October to March and also July (Rowley 1984, Binford 1989, Stiles and Skutch 1989, Howell and Webb 1995).

Courtship. Our observations of back-and-forth flight and the male closely following the receptive female, who sits motionless on an exposed branch, are similar to the courtship description from Jalisco (Rosas-Espinoza et al. 2022). We did not observe paired flight here, as only the male performed; however, we added side-to-side movement. Display flights are common among hummingbirds and are often performed at male feeding grounds (Schuchmann 1999). Still, more courtship descriptions are needed for generalization.

Nest site. In line with the nest described by Rosas-Espinoza et al. (2022), we found that Mexican Woodnymph nests occurred at low heights on shady, steep banks near roads or streams, within dense forest understory. Nests were built under a sheltering branch covered with leaves, as noted for *Eupherusa* spp. (Stiles and Skutch 1989, Fogden et al. 2014, Arizmendi et al. 2020a, 2020b, 2020c, Peterson and Boesman 2021, Rosas-Espinoza et al. 2022). Additionally, the concealment of nests with a live fern frond or a ball of dead leaves that we reported suggests an active effort to hide nests. This covering helps to protect nestlings from direct sunlight and rain (Schuchmann 1999) and conceals the nest from predators (Winkler 2016).

Three out of four nests we found confirmed that *Eupherusa* females place their nests near streams in the understory of humid tropical forests (Stiles and Skutch 1989, Fogden et al. 2014, Arizmendi et al. 2020a, 2020b, 2020c, Peterson and Boesman 2021, Rosas-Espinoza et al. 2022). Many hummingbird species build their nests around streams (Skutch 1958, Hayes et al. 2000, Greeney et al. 2006, Nuñez-Rosas et al. 2021), and they also bathe, drink, and forage for arthropods that are crucial for nestling development, along watercourses (Wagner 1946, Stiles 1995). Additionally, three out of four nests were oriented northeast, providing humid and shady microclimatic conditions (Schuchmann 1999).

Nest description. Similar to most Trochilinae (Schuchmann 1999), all Mexican Woodnymph nests were cup-shaped, and two of the nests we found were similar in size to that reported by Rosas-Espinoza et al. (2022) in Jalisco, while the third nest was larger and with a thicker wall than the others. Mexican Woodnymph nests were slightly larger than nests of *E. cyanophris* and *E. eximia* (Rowley 1966, 1984). However, since these measurements come from only four nests, there may be greater variation.

Moss was the main material in the four nests found at El Cuarenteño, and is also reported for *E. nigriventris*, *E. eximia*, and *E. ridgwayi* in Jalisco (Rowley 1966, 1984; Rosas-Espinoza et al. 2022). Hummingbirds commonly use moss for nesting because it retains moisture longer, preventing eggs from drying out (Breil and Moyle 1976, Blem and Blem 1994). Moss may also have antimicrobial properties that could improve nestling survival (Basile et al. 1999, Alabrudzińska et al. 2003, Fontúrbel et al. 2020). Fern scales were the second-most abundant material in the nests we examined. Fern scales are recorded as structural materials in nests of four out of 30 (13%) hummingbird species analyzed by Hansell (2000). They are also reported in nests of *E. nigriventris* nests and other hummingbirds (Skutch 1946, 1967, Osorio-Zúñiga et al. 2014). Plant down, the third-most abundant component in Mexican Woodnymph nests, was used as a lining material. Plant down is also noted in *E. eximia* and *E. cyanophris* nests (Rowley 1966, 1984, Stiles and Skutch 1989), as well as in more distant hummingbird species in Ecuador (Greeney and Juiña 2020). The choice of nest materials may be associated with availability (Greeney and Zyskowski 2008, Nuñez-Rosas et al. 2021) or their specific properties (Fontúrbel et al. 2020).

Eggs and nestlings. Mexican Woodnymph nests each contained two white eggs, similar to other hummingbirds (Schuchmann 1999). Egg size was slightly smaller than that reported for *E. cyanophris* (Rowley 1966) but comparable to *E. eximia* (Rowley 1984). Nestling traits such as size, color, and feather development were similar to those previously described by Rosas-Espinoza et al. (2022). The only difference was our measurement of the 2.5 mm nestling bill length, which varied from the 14 mm nestling bill length reported by Rosas-Espinoza et al. (2022). This discrepancy may be due to an error in their measurement, which was not directly measured, but estimated from photographs of nestlings (Rosas-Espinoza et al. 2022). Adult *Eupherusa* bills range from 16 to 21 mm length (Tobias et al. 2022), therefore it is unlikely that 1-day post-hatching nestlings (Rosas-Espinoza et al. 2022) would have almost adult-sized bills.

Our description of feather development in Mexican Woodnymph nestlings also aligns with that generally reported for hummingbirds (Schuchmann 1999). Our record of nestlings fledging at 25 and 26 days after hatching is slightly longer than the 23 days reported by Rosas-Espinoza et al. (2022), but it falls within the normal variation in hummingbirds (Schuchmann

1999), as fledging timing can be influenced by weather, resources, and individual differences. In the final days before fledging, Mexican Woodnymph nestlings showed sex differences in plumage, a finding also reported by Rosas-Espinoza et al. (2022), although this is uncommon among hummingbirds of that age (Schuchmann 1999).

Although Mexican Woodnymph nests contained two eggs and hatched two nestlings, successful nests produced only one young each, with the second nestling dying soon after hatching. We are unaware of the causes of chick mortality, but early in the nestling phase, weather conditions may impact nest success (Schuchmann 1999), chicks may be lost to predation, or brood reduction may be an adaptive strategy during periods of food scarcity (Węgrzyn et al. 2023). All of this underscores the species' vulnerability.

Conservation. Since only one nest had been described (Rosas-Espinoza et al. 2022), we increased the sample fourfold and provided the first quantitative data on nestling development, post-fledging care, and an extended breeding season. One of the most critical limiting factors for bird population growth is reproduction (Newton 1998), which cannot be fully understood without considering the nest (Hansell 2000). Our observations, therefore, provide valuable information for designing population recovery actions for the Mexican Woodnymph.

All the nests we located were near dirt roads and close to plantations. Nests near roads are highly vulnerable to human disturbance and predation because of increased visibility and the removal of understory vegetation during road and orchard maintenance. Edge habitats have been associated with higher nest predation (Paton 1994, Weldon and Haddad 2005), which significantly contributes to hummingbird nest failure (Baltosser 1986, Fierro-Calderon and Martin 2007, Smith et al. 2009). However, the effect of edge habitats on reproductive success appears to depend heavily on the habitat preferences of the area's primary predators (Angkaew et al. 2019). Unfortunately, research on hummingbird reproduction and survival in human-altered habitats remains limited (Leimberger et al. 2022; but see Gleffe et al. 2006, Smith et al. 2009). Consequently, more studies are needed to examine fitness metrics across different habitat quality gradients (Hadley and Betts 2009, Leimberger et al. 2022, Falk et al. 2025).

Almost all Mexican Woodnymph nests were located on native plants, and we observed nesting females foraging on the flowers of three native plants. Therefore, maintaining understory vegetation with floral resources and native species used by nesting hummingbirds in steep, shady areas near roads and streams could be beneficial (Camprodon and Brotons 2006, Heyman 2010) and help protect potential nesting sites. However, the small number of nests analyzed in our study prevents more detailed analyses and broader conclusions about nesting requirements. Range-wide comparisons of nesting success and habitat use are needed to understand how local environments affect population recruitment and distribution (Martin and Geupel 1993). Therefore, it is essential to continue studying the breeding biology of this species to better target conservation efforts for this endemic and threatened species.

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