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SHORT NOTE

NESTING OF THE YUCATAN VIREO (*VIREO MAGISTER*) IN MAINLAND MEXICO AND ON ISLA COZUMEL, WITH NOTES ON BREEDING PHENOLOGY

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Abstract · The Yucatan Vireo (*Vireo magister*) is a poorly known, range-restricted species with two recognized subspecies: *magister* and *caymanensis*. We report nesting observations of the Yucatan Vireo from continental Mexico and Isla Cozumel, representing the first definitive nesting records for *V. m. magister*. We discovered two nests in July and August 2009 in Sian Ka'an Biosphere Reserve (near Tulum) and one nest on Isla Cozumel in June 2009. All nests were open cups woven onto branches and hung beneath forks, and clutch size was two eggs. Nests and eggs were similar to those of most *Vireo* spp., including sympatric nesting congeners. Breeding activities —including egg-laying, incubation, and nestling and post-fledging provisioning— occurred during June and July in Cozumel and in July and August on the mainland. Incubation and nestling stages lasted c. 15 days and c. 14 days, respectively. We advocate for more work on *V. m. magister* because it might warrant full species recognition.

Resumen · Anidamiento del *Vireo magister* en México continental y en la Isla Cozumel, con notas sobre la fenología reproductiva
El vireo de Yucatán (*Vireo magister*) es una especie poco conocida y de distribución restringida con dos subespecies reconocidas: *magister* y *caymanensis*. Reportamos observaciones de anidación del vireo de Yucatán en México continental y en la Isla Cozumel, los primeros registros inequívocos del anidamiento del *V. m. magister*. Descubrimos dos nidos en julio y agosto de 2009 en la Reserva de Biósfera Sian Ka'an (Tulum) y un nido en Isla Cozumel en junio de 2009. Todos los nidos eran copas abiertas tejidas en ramas debajo de horquetas y el tamaño de la puesta fue de dos huevos. Los nidos y huevos fueron similares a los de la mayoría de otras especies de *Vireo*, incluidas las especies congenéricas simpátricas. Las actividades de reproducción (incluida la puesta de huevos, la incubación y el aprovisionamiento de polluelos posterior al emplumamiento) ocurrieron durante junio y julio en Cozumel, y en julio y agosto en continente. La duración de las etapas de incubación y cría fueron de c. 15 días y c. 14 días, respectivamente. Recomendamos estudios adicionales de V. m. magister porque tal vez deba reconocerse cabalmente como especie.

Key words: Breeding phenology · Cozumel · Nesting · Vireonidae · Yucatan Peninsula

INTRODUCTION

Breeding biology and natural history remain poorly known for many Neotropical members of the Vireonidae. This family comprises 63 species, of which 10 inhabit parts of southern Asia and the remaining 53 range from North to South America (Winkler et al. 2020). For some species, the nests and eggs have only recently been described (e.g., LaPergola et al. 2012), while other species still lack formal nest descriptions (Table 1). The family's largest genus, *Vireo,* contains 33 species with c. 64% mostly or wholly restricted to the Neotropics, including nine species restricted to islands (Winkler et al. 2020, Raffaele et al. 1998).

We focus here on the Yucatan Vireo (*V. magister*), which is among the least known *Vireo* species. Although ambiguity remains around the taxonomic status of the Yucatan Vireo's different populations (see below), its phylogenetic relationship to congeners appears resolved. Recent molecular analyses suggest three recognizable groups within *Vireo* (Slager *et al.* 2014): the 'spectacled' vireos (eight species), the 'eye-ringed' vireos (14 species), and the 'eye-lined' vireos. The 'eye-lined' group, corresponding to the original subgenus *Vireosylva* (Hamilton 1962), comprises two clades allied respectively with *V. gilvus* (four species) and *V. olivaceus* (four species). Following the recent split of *V. chivi* from *V. olivaceus* (Chesser et al. 2018, after Battey & Klicka 2017) and the addition of *V. gracilirostris* (not sampled by Slager et al. 2014), the *Vireo olivaceous* clade now contains six species, including *V. magister*. These 'eye-lined' vireos represent a mix of migratory and sedentary species, including several that breed exclusively in the Neotropics, such as *V. magister* (Table 1).

The disjunct distribution of *V. magister* and the history of species and subspecies descriptions raise questions about the

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Table 1. Knowledge status of breeding biology for "eye-lined" *Vireo* spp. All data derived from Winkler et al. (2020). * A clutch size of two eggs was reported multiple times in the species account, and an average of 3.2 eggs was reported from Ecuador. Most other data were reported as ranges. † Three typical vireo nests were found but were not definitively assigned to *V. gracilirostris*, and a range of 2–5 for clutch size was anecdotally reported by local inhabitants (Olson 1994).

Species	Breeding range	Nest described	Eggs described	Parental care documented	Modal clutch size
V. altiloquus	Neotropical	Yes	Yes	Yes	3
V. chivi	Neotropical	Yes	Yes	No	2 or 3*
V. flavoviridis	Neotropical	Yes	Yes	Yes	3
V. gilvus	Nearctic	Yes	Yes	Yes	4
V. gracilirostris	Neotropical	No†	No	No	Unknown†
V. leucophrys	Neotropical	Yes	No	No	Unknown
V. magister	Neotropical	Yes	Yes	Present study	2
V. olivaceus	Nearctic	Yes	Yes	Yes	3
V. philadelphicus	Nearctic	Yes	Yes	Yes	4
V. sclateri	Neotropical	No	No	No	Unknown

taxonomic status of its populations. The currently recognized range for *V. magister* includes the Caribbean coast of the Yucatan Peninsula, spanning Mexico (especially Quintana Roo state) and parts of Belize, but also many nearby islands including Isla Cozumel, several islands north of Honduras, and the more distant (c. 600 km) Grand Cayman Island (Russell 1964, Cepeda González 2012, Brewer 2020). Despite its somewhat restricted range, the Yucatan Vireo is considered a species of Least Concern (BirdLife International 2021). However, the species inhabits areas heavily impacted by human development that make it highly vulnerable (González-Jaramillo et al. 2016, Ortiz-Pulido 2018), underscoring the need to clarify the taxonomic status of its major populations. Presently, Grand Cayman birds are recognized as *V. magister caymanensis*, while all others are *V. m. magister* (Clements et al. 2021). The species was first described from Belize by Spencer Fullerton Baird as *Vireosylvia* (= *Vireo*) *magister* (Lawrence 1874). The Grand Cayman population was later described as a distinct species (*Vireo caymanensis*; Cory 1887), which later authors continued to recognize (e.g., Nicoll 1904, Ridgway 1904, Lowe 1911). Bangs (1916: 314) subsumed *caymanensis* as a subspecies within *V. magister*, stating that the Grand Cayman population "differs only by its paler coloration." Other researchers maintained the subspecies status of *caymanensis* (Fisher & Wetmore 1931, Bond 1936, 1940). The Cozumel population was similarly first described as a separate species, *Vireosylvia cinerea* (Ridgway 1885a, b), though other authors considered it *V. magister* (Salvin 1885). Ridgway (1904) later subsumed Cozumel's population as a subspecies: *Vireosylva* (= *Vireo*) *magister cinerea*. Phillips (1991:199) also recognized *Vireosylva m. cinerea*, but also erected two new subspecies: (1) *decolorata* for populations on numerous Belizean islands (Turneffe Island "and apparently on islands NW to Ambergris Cay"), and (2) *stilesi* for the populations on Isla de la Bahía, Honduras, and "apparently Glover's Reef, far off (SE) Belize." The subspecies *cinerea*, *decolorata*, and *stilesi* are currently treated as junior subjective synonyms of *V. m. magister* (Clements et al. 2021). However, different subspecies and populations of *V. magister* have never been subjected to rigorous modern analysis. For example, the phylogenetic analysis of Slager et al. (2014) included only one *V. magister* specimen from Isla Cozumel, leaving unresolved whether any of the subspecies should be recognized as distinct species.

We know of no prior breeding data for *V. magister* from mainland Yucatan or Isla Cozumel. The only mainland Yucatan Vireo records concerning reproductive phenology referred to birds in breeding condition collected in April and May in Belize (Russell 1964). The only relevant record we found for Cozumel was that of a male with "apparently regressing" testes on 10 August 1962 (Klaas 1968: 604). The account of Savage English (1916) for Grand Cayman represents the first description of Yucatan Vireo's nesting biology. The most extensive breeding records are also from *V. magister caymanensis* on Grand Cayman (e.g., Bradley 2000).

Here, we report observations of Yucatan Vireo breeding on the mainland Yucatan Peninsula and nearby Isla Cozumel, which represent the species' first definitive nesting records from the continent and for subspecies *V. m. magister*. We discuss our observations in the context of what is known from other breeding populations of the species, including considerations of clutch size and breeding phenology.

METHODS

Study area. Our observations occurred during focal fieldwork on the Black Catbird's (*Melanoptila glabrirostris*) breeding biology (LaPergola 2012, Roldán-Clarà et al. 2013, 2018), conducted in May–July 2009 in Quintana Roo, Mexico, at two mainland sites within the Sian Ka'an Biosphere Reserve (Tulum) and one site on Isla Cozumel.

Our two mainland sites, north and south, were located c. 15 km apart at 20°04'N, 87°29'W and 19°52'N, 87°26'W, respectively, within the Sian Ka'an Biosphere Reserve (SKBR). SKBR is a designated Natural Protected Area comprising 651,000 ha and is managed by the Mexican National Commission for Natural Protected Areas (in Spanish, Comisión Nacional de Areas Naturales Protegidas, CONANP). Each mainland site consisted of one 20 ha plot within a narrow coastal peninsula that extends roughly north to south for c. 45 km. The dominant habitat is coastal dune thicket, dominated by Thatch Palm (*Thrinax radiata*) and various shrubs (especially *Pithecellobium* sp.). Our north site also included the SKBR Visitors' Center, supporting a nearly homogeneous stand of *T. radiata* and located across a dirt road from our 20 ha plot. Our south site was located close to the fishing village San Juan, near the southern tip of the peninsula. For additional site details, see Roldán-Clarà et al. (2013, 2018).

Isla Cozumel, also a UNESCO Biosphere Reserve, is located c. 60 km northeast of our north mainland site. Our work occurred at 20°27'N, 86°57'W in a c. 68 ha site, known locally as Pueblo Fantasma, on the island's west side c. 5 km south of the city of San Miguel de Cozumel. Cozumel is an oceanic island consisting of coralline limestone and located c. 17 km from the Yucatan Peninsula's northeast coast (Cuarón 2009). Most of Cozumel's habitat is semi-deciduous or tropical de-

Figure 1. Nest of Yucatan Vireo (*Vireo magister*) at San Juan, Sian Ka'an Biosphere Reserve, Quintana Roo, México. An adult Yucatan Vireo incubates in this photograph on 26 July 2009 at San Juan (Photograph by JB LaPergola).

ciduous forest, with a relatively low canopy resulting from recent hurricane damage (Perdomo-Velázquez et al. 2017). Dominant vegetation at our site included *Ficus* sp. and *Metopium brownei* and the understory included several Polygonaceae species (Marina Hipolito 2010).

Nest searching and monitoring. We discovered all Yucatan Vireo nests during systematic searches for Black Catbird nests. We inspected nest contents every few days using a mirror attached to a pole (Parker 1972), but we did not standardize the frequency of nest checks across nests. If an adult was incubating or brooding during a visit, we returned later that same day when adults were absent to inspect nest contents. We visually estimated the heights of nests above the ground to the nearest 0.1 m. In Cozumel, we also conducted two nest watches using a cloth blind, binoculars, a wristwatch, and notebook and pencil to record times of adult behaviors (e.g., arrival, departure, food provisioning, etc.) at the nest.

RESULTS

Nesting records on mainland Yucatan. JBL discovered the first Yucatan Vireo nest in the south site (San Juan) at c. 1.6 m above the ground, containing two eggs, at 07:51 h (CST) on 24 July 2009. We observed an adult Yucatan Vireo incubating at this nest at 06:57 h on 26 July 2009 (Figure 1), when the nest still contained two eggs. This nest still held two eggs on the morning of 31 July 2009, but contained two chicks in the morning of 3 August 2009. Unfortunately, we were unable to continue checking this nest.

JBL discovered a second nest in the south site at c. 1.9 m above the ground, containing two chicks about 5–6 days post-hatching, at 08:12 h on 3 August 2009. An adult Yucatan Vireo flew close to the nest with food in its beak while we checked this nest's contents. We were unable to check this nest again.

We did not observe Yucatan Vireos nesting in our north-Sian Ka'an study site despite investing similar effort searching for Black Catbird nests and having observed and mist-netted adult vireos in breeding condition (i.e., exhibiting a cloacal protuberance or brood patch) within the site.

Nesting record on Isla Cozumel and nesting cycle. At 10:09 h on 15 June 2009, JBL discovered an empty *Vireo* nest hanging between a forked branch c. 2.2 m above the ground on Isla Cozumel (Figure 2A). The same nest contained two eggs (Figure 2B) at 09:00 h on 17 June 2009, after which a Yucatan Vireo (unknown sex) arrived and began incubating. The egg-laying period thus lasted two days. We last observed two eggs on 30 June 2009, and then noted one chick and one egg at 07:30 h on 1 July 2009 and two chicks at 07:25 h on 2 July 2009. The length of incubation lasted c. 15 days (range: 14–16 days), if we assume clutch completion on 17 June 2009 and the first chick hatching on 1 July 2009. The nest still contained two chicks at 09:16 h on 8 July 2009. One of the chicks fledged at 07:18 h on 15 July 2009 (Figure 2C), and the nest was empty later the same day. If we assume that both chicks hatched on 1 July 2009, the nestling stage lasted c. 14 days. The total length of the nesting cycle, including egg-laying, incubation, and nestling stages, is c. 30 days.

Nest attendance. Incubation of the chicks over three bouts comprised c. 54% (20 of 39 minutes) of a nest watch on Isla

Figure 2. Yucatan Vireo (*Vireo magister*) nest, eggs, and fledgling from Isla Cozumel, Quintana Roo, México. (A) Side view with slight underside perspective of Yucatan Vireo nest on 26 June 2009. (B) Yucatan Vireo eggs in the nest on 26 June 2009. (C) Juvenile from the same nest, photographed immediately after fledging on 15 July 2009. This nest was located < 10 m from an active Cozumel Vireo (*Vireo bairdi*; LaPergola et al. 2012) nest. (All photographs by JB LaPergola).

Cozumel, starting at 07:30 h on 1 July 2009. Only one bird incubated, but a second individual arrived at the nest once while the first was incubating. At the same nest, at least two adult birds visited the nest and fed insects to the chicks seven times during a 45-min nest watch, starting at 07:25 h on 2 Jul 2009 and yielding a provisioning rate of c. 9.3 visits/hr. During this same watch (2 July 2009), incubation of the chicks over two bouts comprised c. 40% (c. 18 of 45 minutes) of the time.

DISCUSSION

Our observations extend the knowledge of the Yucatan Vireo's breeding biology to nesting observations on the mainland Yucatan Peninsula and nearby Isla Cozumel. We thus provide the first definitive nesting records for *V. m. magister,* because all previous breeding data were restricted to the Grand Cayman Island subspecies. Our observations also provide novel data for the duration of the nesting cycle, albeit only for one nest from Isla Cozumel. The developing picture of the Yucatan Vireo's natural history points to potential differences between the two subspecies and highlights important gaps in our understanding of the species.

Our observations included nesting in July and August on the mainland Peninsula, and June and July on Isla Cozumel. However, on Grand Cayman Island, the nesting season lasts at least five months (March–July) (Bradley 2000). Nest building on Grand Cayman Island has been reported in mid-March and can presumably occur in late February or early March, as Bradley (2000) reported a nest with two chicks on 29 March 1993, while fledging occurs as late as July. Bradley also reported nest building as late as mid-August, which extends the nesting season on Grand Cayman by two months, assuming that such a nesting attempt would result in nestlings that fledged in mid- to late September. Whether the Yucatan Vireo's nesting season begins earlier than July and extends beyond August on the Yucatan Peninsula, or earlier than June and beyond mid-July on Cozumel, remain open and important questions.

On Cozumel, Yucatan Vireo breeds syntopically with Cozumel Vireo, *Vireo bairdi* (LaPergola et al. 2012). Perhaps one distinguishing feature of the one Yucatan Vireo nest on Cozumel was that it occurred along the forest edge, whereas all known Cozumel Vireo nests were within the forest, although not far from edges. However, this possible distinction might be an artifact of our search efforts, because we found all nests opportunistically while searching for nests of Black Catbird, a species that tends to favor edges (LaPergola 2012; Roldán-Clarà et al. 2013, 2018); we seldom made deep forays into the forest during nest-searching. Additionally, in 2009, mainland and Cozumel forests were recovering from recent intense hurricanes such as Wilma (2005), that had physically altered the vegetation by shearing off much of the upper canopy and creating gaps (Perdomo-Velázquez et al. 2017). We do not know the extent to which this habitat disturbance impacted locally nesting vireo species. More fieldwork is clearly required to determine the extent of syntopy of these two vireo species on Cozumel.

We recorded clutch size (i.e., maximum clutch size stable across two or more nest checks) of two eggs in two nests, one each from the mainland and Cozumel. These observations suggest a small clutch size for the species. On Grand

Cayman Island, clutch size was usually two eggs, although Bradley (2000) observed one brood of three nestlings. More data are needed to determine whether undetected clutch size variation exists on mainland Yucatan, Cozumel, and other nearshore islands.

While we require more information to better delineate the breeding season of both mainland and Cozumel populations of the Yucatan Vireo, general natural history aspects additionally lack extensive sampling. In particular, hatching and fledgling success, as well as the characterization of the social breeding and mating systems, are sorely needed. Our observations suggest the possibility of biparental care, but nest watches involving color-banded attendants are needed to test this hypothesis. More data on nesting success and inter-annual survival of adults are also needed, especially for mainland populations occupying habitat along Quintana Roo's east coast that are experiencing substantial loss and fragmentation caused by development for the region's bourgeoning tourist industry. The extent to which such modification impacts Yucatan Vireos is unknown. Additionally, many Yucatan Vireo populations occupy low-lying islands, which are threatened by rising sea levels (Bellard et al. 2014). We hope that our reported observations will provide valuable data for land managers and help to stimulate further research into this and other poorly known Neotropical species.

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