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SOME ASPECTS OF THE REPRODUCTIVE BIOLOGY OF THE MEXICAN SHEARTAIL (*DORICHA ELIZA*) IN CENTRAL VERACRUZ

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Abstract. The Mexican Sheartail (*Doricha eliza*) is a hummingbird endemic to Mexico, where it occurs in disjunct populations in the states of Yucatan and Veracruz. In neither area has the species' reproductive biology been studied. On the basis of observations in Veracruz we characterize the species' eggs (the first description for the genus), fledging success, nestling growth, causes of mortality, nest-site selection, and courtship behavior. We located 11 active nests at various stages (8 eggs and 12 chicks, so not all nests contributed to all data sets). Nests were placed on four species of plants (three of them with spines), and some were aggregated. The species nested in natural grasslands and cattle pastures dominated by *Acacia*. Males formed leks. Chicks fledged from 4 of 11 nests, yielding 8 juveniles from 22 possible. Causes of mortality were predation, weather, human disturbance, and failure to hatch. Conservation of nesting sites in Veracruz is necessary for maintaining a healthy population.

Key words: Doricha eliza, *hummingbirds, Mexican Sheartail, nests, reproductive biology, Veracruz.*

Algunos Aspectos sobre la Biología Reproductiva de *Doricha eliza* en el Centro de Veracruz

Resumen. El colibrí *Doricha eliza* es endémico de México y se distribuye en dos poblaciones alopátricas en Yucatán y Veracruz. Su biología reproductiva es desconocida. Presentamos información sobre los sitios de anidación, la descripción del huevo (primera descripción para el género), el crecimiento de polluelos, el éxito de volantones, las causas de mortalidad y la conducta de cortejo para la población de Veracruz. Localizamos 11 nidos activos en diferentes fases (con 8 huevos y 12 polluelos; por lo que no todos los nidos contribuyeron a determinar todos los estimados). Los nidos estuvieron sobre cuatro especies de plantas (tres de ellas con espinas) en pastizales naturales y ganaderos dominados por *Acacia*. Observamos agregación de nidos y los machos formaron asambleas de cortejo. Sólo ocho polluelos de 22 posibles tuvieron éxito en dejar el nido. Las causas de mortalidad fueron depredación, factores climáticos, perturbación humana y fracaso en la eclosión. La conservación de los sitios de anidación en Veracruz es necesaria para mantener saludable a esta población.

INTRODUCTION

The hummingbird genus *Doricha* is confined to northern Middle America, from southern Mexico to Honduras and El Salvador. Neither of the two species in the genus has been studied in detail, so almost nothing is known about their ecology, behavior, or systematics. Information on breeding displays, for example, may clarify relationships of this genus to similar and apparently closely related genera such as *Calothorax* and *Calliphlox*. One of the two species of *Doricha*, the Mexican Sheartail (*D. eliza*), is endemic to Mexico, where there are two allopatric populations separated by 650 km (Howell and Webb 1995, Johnsgard 1997, AOU 1998, Stattersfield et al. 1998). One population occurs along the northern coast of the Yucatan peninsula, the other in central Veracruz (Peterson et al. 2000, Ortiz-Pulido et al. 2002). The Veracruz population has been recorded from 110 to 1480 m above sea level and for some time was believed extirpated (Ortiz-Pulido et al. 1998, 2002, Ortiz-Pulido 2000, Ortiz-Pulido and Díaz 2001).

Because the two populations are allopatric, threats to them differ (Stattersfield et al. 1998, Ortiz-Pulido et al. 2002), although the entire species is considered "near threatened" by the International Union for the Conservation of Nature (IUCN 2009). Three reserves protect the sheartail in Yucatan (Stattersfield et al. 1998, Ortiz-Pulido et al. 2002), but none protect it in Veracruz (Peterson et al. 2000, Ortiz-Pulido et al. 2002). The species is relatively common in Veracruz, although it is restricted to a range of 20 × 40 km, where Ortiz-Pulido and

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Díaz (2001) estimated the population density at 0.033 individuals ha^{-1} and the population size at 2500 individuals. Ortiz-Pulido et al. (2002) suggested that threats to this species include intensive habitat modification from agriculture, resort construction, livestock grazing, and other human activities. Determining management needed to prevent extinction of the Mexican Sheartail requires an understanding of the species' biology and ecology. Yet little field data have been obtained about the species' biology in Veracruz, making any conservation action infeasible or mere guesswork. We remedy that lack of information by presenting the first description for Veracruz of fundamental aspects of the Mexican Sheartail's breeding biology—such as hatching rate, fledging success, nestling mortality, and nest-site selection—as well as a description of the eggs and of the species' courtship behavior.

METHODS

Nests we studied in central Veracruz were active between 4 July and 19 September 2003, falling within the species' known breeding season (Ortiz-Pulido et al. 1998, Peterson 1999). We searched in 14 localities within the species' recent range (Fig. 1; Ortiz-Pulido et al. 1998, 2002, Ortiz-Pulido and Díaz 2001). At each locality two observers searched a 40- × 2000-m transect for 4 hr. When we found a Mexican Sheartail, we searched for a nest for at least 3 hr. When we found a nest, we systematically surveyed and watched, every 3 days for 3 months, for individuals engaged in courtship behavior or calling. If we detected a displaying bird we followed it until it perched and searched adjacent shrubs and groups of plants for other nests.

For each active nest we recorded the following: contents (eggs or chicks), composition (basic construction materials), height above ground (cm), internal and external diameter (mm), depth (mm), orientation with respect to the center of the plant were the nest was found (°), and number and diameter (mm) of supporting branches. Except for nest contents, we measured all variables after the nest failed or the nestlings departed. For the nest plant, we recorded its height (m), main trunk diameter (mm), canopy projection on the ground (cm^2), and geographic coordinates. We recorded whether the female was incubating or brooding (Ralph et al. 1994) and assessed climate at each nest site (García 1973).

We monitored each nest until it succeeded or failed. To obtain data on egg development, chick rearing, and mortality, we visited nest sites every 3 days. We measured the weight (g), length (mm), and diameter (mm) of eggs and the total length (bill to tail, in mm), weight (g), and bill length (mm) of chicks. In weighing eggs and chicks (±0.05 g accuracy), we used a small cardboard box filled with cotton. We did not detect any effects (success or failure) of our measuring nests, eggs, or chicks (see Results).

We estimated nest building (n = 1 nest), incubation period (n = 1), and feeding rate (n = 4) by monitoring nests from 08:00 to 11:00. Observations were made through a 10–40× telescope from a blind set up 10 m away. All work was performed under official governmental permits issued by the Secretaría de Medio Ambiente y Recursos Naturales. Unless otherwise indicated, we report values as means ± 1 SE.

STATISTICAL ANALYSIS

We estimated probability of individual success (of egg, juvenile, and total) by the Mayfield method (1961, 1975, Johnson 1979), standard error by the method of Murphy et al. (1999). To develop Mayfield equations, we assumed an incubation period of 15 days and a nestling period of 23 days (see Results). Mayfield estimates must be taken with caution because it is not clear if it overestimates apparent nest success (1–24% relative to some other methods) or if its deviations increase at sample sizes <20 (Hensler and Nichols 1981, Jehle et al. 2004).

Because we found that nests were apparently placed near roads and water bodies, we tested the hypothesis that nests were located randomly by comparing 30 randomly selected points versus 11 points where we found nests. We determined the location of each randomly selected point by randomly selecting two geographic coordinates, one for latitude and one for longitude, inside the 800 km^2 where the Veracruz population has been reported (Ortiz-Pulido and Díaz 2001). We visited each randomly selected point in 2009 and recorded its distances to roads and water bodies. As the data were normally distributed according to a Shapiro–Wilk test, we compared the points' distance in meters to roads and water bodies with a t test, considering a difference significant when $P < 0.05$.

RESULTS

NESTS

We located 11 active Mexican Sheartail nests at an altitudinal range of 900 to 1114 m above sea level (Fig. 1). All nests were close to an old, unoccupied hummingbird nest in the same or adjacent bush. Climate at 7 of 11 nests was semi-warm humid. Ten of the 11 nests were found in natural grasslands surrounded by cultivation (sugar cane and tomato) and pastures and one was found in a *huizachal*, a habitat dominated by subtropical trees of the genus *Acacia*.

We found active nests in four species of shrubs: five nests were in *Solanum tridynamum* (Solanaceae), three were in *Mimosa albida* (Fabaceae), two were in *Calea urticifolia* (Asteraceae), and one was in *Acacia farnesiana* (Fabaceae). The *Solanum*, *Mimosa*, and *Acacia* carry spines. Nests were aggregated: at one locality we found four active nests in a 40-m radius, separated by ~20 m; at another two nests were only 15 m apart; at another two nests were 30 m apart. Nests were close to bodies of water (to 80.2 ± 11.9 m, n = 11) and to roads (13.6 ± 4.9 m). Nests were significantly closer to water bodies ($t = 2.8$, df = 38, $P = 0.008$) and roads ($t = 2.5$, df = 38, $P = 0.016$) than were random points established within the distribution of the Veracruz population.

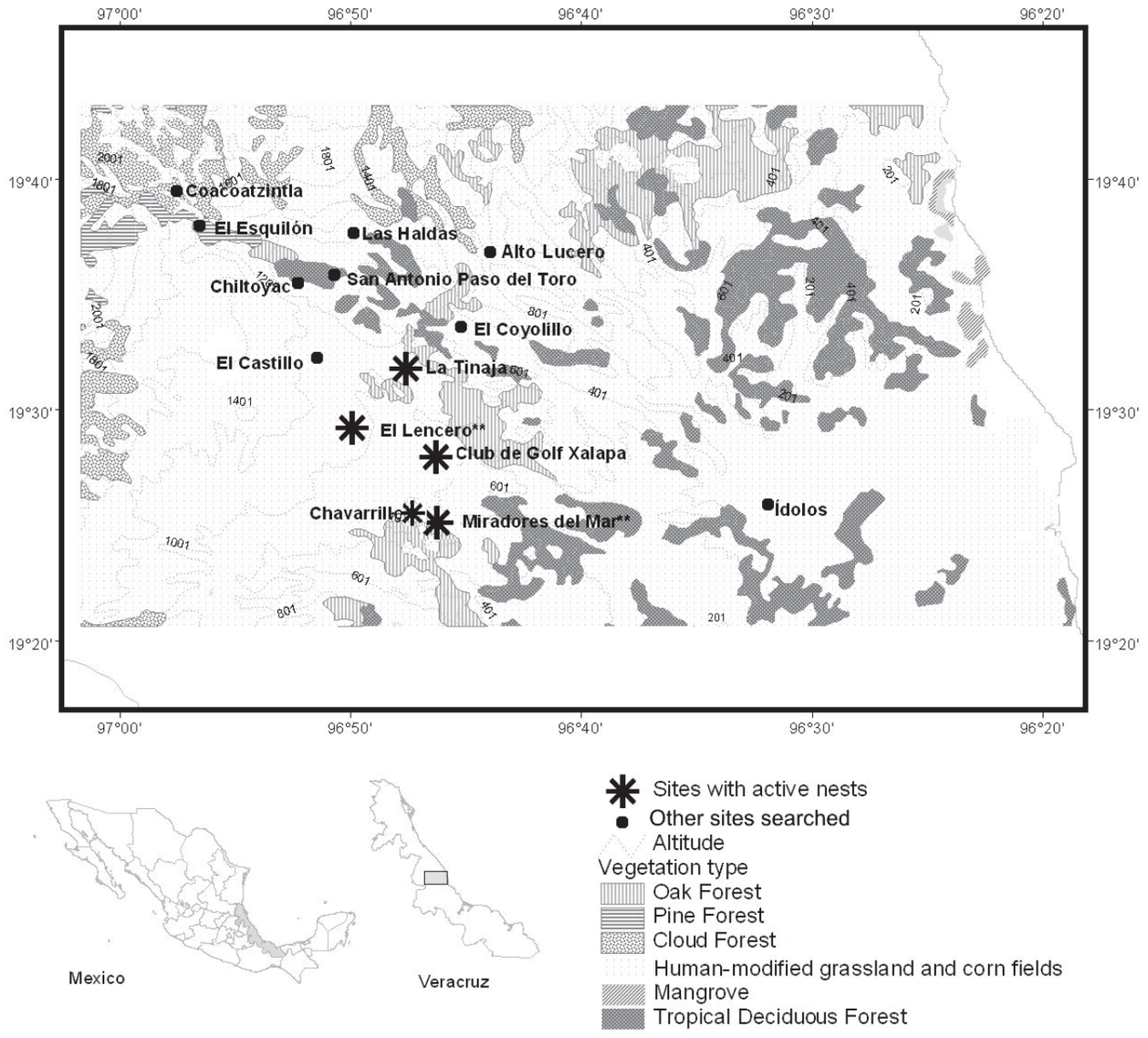

FIGURE 1. Sites in central Veracruz where the Mexican Sheartail has been observed since 1997, including those where we found nests in 2003.

Most materials used for nest building were of vegetable origin, including leaves, thin sticks, lichens, seeds of the grasses *Rhynchelytrum repens* and *Andropogon glomeratus* (Poaceae), white fibers of *Cephalocereus palmeri* (Cactaceae) and *Senecio* sp. (Asteraceae), and wind-dispersed seeds of herbaceous plants. Cobwebs were used to bind these materials together.

Most nests ($n = 10$) were cup-shaped and built in a crotch, but one nest appeared similar to a tea cup balanced on a horizontal branch. The 11 active nests were at 73.1 ± 21.5 cm above the ground and had an internal diameter of 24.2 ± 2.3 mm, an external diameter of 35.2 ± 1.8 mm, height of 36.5 ± 7.3 mm, and depth of 19.5 ± 5.1 mm.

EGGS

We observed a total of eight eggs from five nests. Recently laid eggs were rosy white, but they darkened after few days of incubation. Eggs are oval, slightly oblong, and small: 12.0 ± 0.1 × 8.0 ± 0.1 mm ($n = 7$) and 0.55 ± 0.11 g ($n = 6$). We estimated an egg's survival probability at 0.254 ± 0.037 per day through incubation, and probability of hatching was 0.429.

CHICKS

We followed 12 chicks from 6 nests (all nests had two chicks); 10 chicks had hatched recently, whereas 2 were located a few days after they fledged. Chicks 1–6 days old (n = 10) were nearly black except for the ventrum, which was brown. They were featherless with the exception of two lines (pterylae) of fine yellowish down feathers on the dorsum. The bill was short and broad; the mandible was yellow-orange. They were silent and remained nearly motionless. Chicks 7–10 days old (n = 8) began to open their eyes, and feathers became visible, including on the tail and wings, but black skin remained visible except on the ventrum, which was brown and without feathers. At this stage the tail feathers were white, and the bill was notably longer and thinner at the tip. Chicks 14–20 days old (n = 6) began to preen and were generally more active. The body was covered with grayish-brown feathers and the bill was straight and short but thinner still. At 17 days old the chicks were entirely feathered, with dorsal feathers of iridescent green and throat, breast, and ventral feathers similar to those of an adult female; wing and tail feathers were nearly full grown. At 20 days old chicks were active constantly and flapped their wings frequently.

Chicks fledged at 23 days old. At this point the bill measured ~70% of an adult female's and was straight and completely black. Fledglings flew short distances to perch at a medium height on shrubs. Each chick occupied different feeding perches (most of the time in different shrubs) that they used consistently. Fledglings uttered a repeated "beep-beep" associated with begging from their perch. When juveniles were 46 days old their bill was curved and nearly as long as an adult female's. As in many species of hummingbird, the female alone tended and fed the chicks, including to ~35 days after they had fledged.

Weight and body length increased steadily with age (Fig. 2; n = 10 chicks from 5 nests). Chicks fledged from 4 of 11 nests, yielding 8 juveniles from 22 possible (36%). Nest failures were the result of predation (n = 1 of eggs, 2 of chicks), eggs not hatching (n = 1), human disturbance (n = 1, destruction by a tractor), and adverse weather (n = 2, intense rain during incubation). We estimated juveniles' survival at 0.501 ± 0.014 from hatching to fledging and an individual's total probability of survival, from laying to fledging, at 0.044.

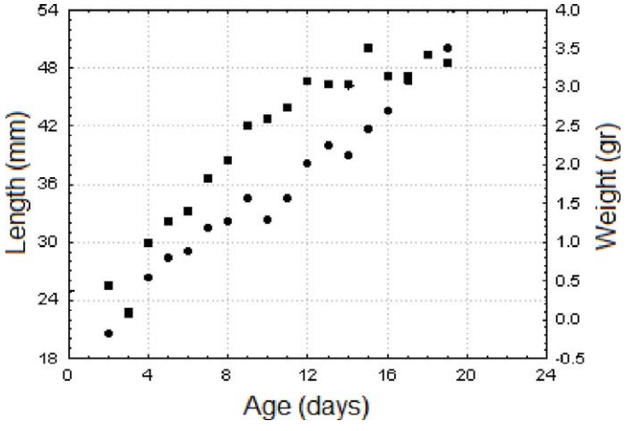

FIGURE 2. Relationship between the age of Mexican Sheartail chicks and their length (circles) and weight (squares).

GENERAL INFORMATION

One of the two juveniles in a nest was always one day ahead in its development. After fledging the young were fed by the female and fed themselves on nectar of *Helicteres guazumifolia* (Sterculiaceae) and insects. Older juveniles fed on insects and four plant species: *Solanum tridynamum, Salvia purpurea* (Lamiaceae), *Mimosa albida*, and *H. guazumifolia*. Adults fed on *Salvia coccinea* (Lamiaceae), *Opuntia dejecta* (Cactaceae), *Cnidoscolus multilobus* (Euphorbiaceae), *Tillandsia limbata*, *Tillandsia* sp. (Bromeliaceae), and *Erythrina americana* (Fabaceae). The species gleans and hawks insects.

Males displayed (Fig. 3) under various circumstances, such as in front of an incubating female, an active nest (in

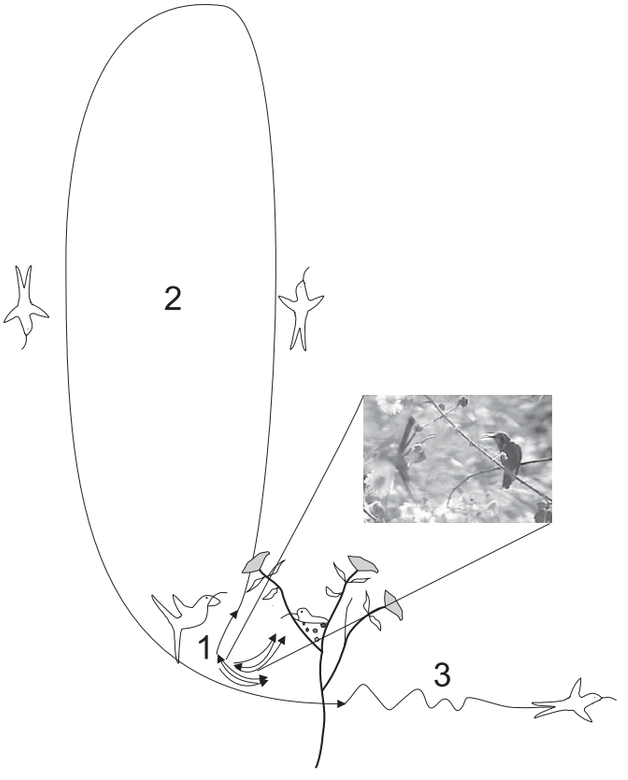

FIGURE 3. Display of males of the Mexican Sheartail in Veracruz. The number indicates the sequence of movements. The inset is a photograph of step 1, where the male displays its gorget and tail feathers.

all stages of development), even when the female was absent, juveniles, and other males. Males formed open groups (exploded leks) of up to five individuals in small patches of vegetation or when two males were in the same bush. In these patches we observed several displays directed to other males and females. Males used much of their time to pursue each other and to perform step 1 of the display (Fig. 3). They vocalized repeatedly, although no calls were long or complex. The males did not seem to prefer special perches on which to vocalize. Males foraged in the areas of their displays and visited nests frequently, sometimes flushing an incubating female to then pursue her in flight. We also saw individuals with adult female plumage visit a female sitting on her nest ($n = 3$). In one case the visit lasted only a few seconds, but the visitor perched close to the occupied nest. In the other two cases the visitors perched just above the nest, and the incubating females never attempted to chase them away.

On five occasions Azure-crowned Hummingbirds (*Amazilia cyanocephala*), whose nest differs markedly, built nests close to a aggregation of Mexican Sheartail nests. In other places we found active nests of these two species within short distance of each other. We detected no other species of hummingbird breeding at the survey sites.

DISCUSSION

We drew seven primary conclusions about the reproductive biology of the Mexican Sheartail in Veracruz. Nests tend to be placed (1) in plants with spines, (2) near water and roads, and (3) in natural grasslands. A study designed to compare nest sites with habitat availability is needed to elucidate nest-site selection fully. We further observed (4) nests clustered spatially (Collias and Collias 1984) and (5) low probability of survival of young (<0.05). (6) Steady growth in length and weight (Fig. 2) suggests that an equation may be derived to infer the age of chicks accurately. Last (7), we noted that Mexican Sheartail eggs, the first described in the genus *Doricha* (Johnsgard 1997, Peterson 1999, Ortiz-Pulido et al. 2002), are among the smallest ever reported in hummingbirds (Johnsgard 1997, Schuchmann 1999). The eggs of the smallest hummingbird, the Bee Hummingbird (*Mellisuga helenae*) of Cuba, measure 11 × 8 mm (Schuchmann 1999), barely smaller than dimensions we obtained for Mexican Sheartail eggs.

If natural grassland proves to be essential to nesting Mexican Sheartails then habitat may be the most important aspect to be considered for the species' conservation. Native grassland is endangered in the central Veracruz. Grasslands have been converted to cultivation or are grazed by livestock. Those close to the city of Xalapa, where we found the species nesting, are highly threatened as a result of expansion of sugar cane, tomato, and chili fields, as well as by urban sprawl (Geissert and Campos 1993). We recommend preservation of remaining natural grasslands in Veracruz, particularly those around El Lencero and La Tinaja, where most of our nests were located. During our study new "country" housing estates were being developed, unpaved roads were being built, and land was up for sale or already sold.

The Mexican Sheartail may tolerate, in some way, human building in its habitat, but when that building affects the nests directly (e.g., by physical destruction of shrubs), the species' population viability can be affected adversely, in part because of the naturally high failure rate of eggs and hatchlings. We call for specific study of the potential negative effects of urban development on the Mexican Sheartail and its habitat in order that urban growth in the species' tiny range in central Veracruz be properly controlled and managed.

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LITERATURE CITED

AOU (American Ornithologists' Union). 1998. Check-list of North American birds, 7th ed. American Ornithologists' Union, Washington, DC.

Collias, N. E., and E. C. Collias. 1984. Nest building and bird behavior. Princeton University Press, Princeton, NJ.

Garcia, E. 1973. Modificaciones al sistema de clasificación climática de Köppen. Instituto de Geografía, Universidad Nacional Autónoma de México, México, D.F.

Geissert, D., and A. Campos. 1993. Los paisajes morfoedafológicos del área de influencia de la ciudad de Xalapa, p. 65–79. *In* I. R. López-Moreno [ed.], Ecología urbana aplicada a la ciudad de Xalapa. Instituto de Ecología, A. C., Xalapa, Veracruz.

Hensler, G. L., and J. D. Nichols. 1981. The Mayfield method of estimating nesting success—a model, estimators and simulation results. Wilson Bulletin 93:42–53.

Howell, S. N. G., and S. Webb. 1995. A guide to the birds of Mexico and northern Central America. Oxford University Press, New York.

IUCN (International Union for Conservation of Nature) [online]. 2009. The IUCN red list of threatened species, version 2009.2. <www.iucnredlist.org> (17 November 2009).

Jehle, G., A. A. Yackel Adams, J. A, Savidge, and S. A. Skagen. 2004. Nest survival estimation: a review of alternatives to the Mayfield estimator. Condor 106:472–484.

Johnsgard, P. A. 1997. The hummingbirds of North America, 2nd ed. Smithsonian Institution Press, Washington, DC.

Johnson, D. H. 1979. Estimating nest success: the Mayfield method and an alternative. Auk 96:651–661.

Mayfield, H. F. 1961. Nesting success calculated from exposure. Wilson Bulletin 73:255–261.

Mayfield, H. F. 1975. Suggestion for calculating nest success. Wilson Bulletin 87:456–466.

MURPHY, R. K., B. G. ROOT, P. M. MAYER, J. P. GOOSSEN, AND K. A. SMITH. 1999. A draft protocol for assessing Piping Plover reproductive success on Great Plains alkali lakes, p. 90–107. *In* K. F. Higgins, M. R. Brashier, and C. D. Kruse [EDS.], Proceedings, Piping Plovers and Least Terns of the Great Plains and nearby. South Dakota State University, Brookings. Northern Prairie Wildlife Research Center Online, Jamestown, ND. <http://www.npwrc.usgs.gov/resource/birds/pplover/index.htm> (21 September 2009).

ORTIZ-PULIDO, R. 2000. La autopista Cardel–Perote puede extinguir una especie de colibrí en Veracruz. Diario de Xalapa, 23 Janaury 2000, , p. A12, Xalapa, Veracruz, México.

ORTIZ-PULIDO, R., E. FLORES, AND R. ORTIZ. 1998. Descripción del nido de *Doricha eliza* y ampliación de su rango. Ornitología Neotropical 9:223–224.

ORTIZ-PULIDO, R., AND R. DÍAZ. 2001. Distribución y densidad de colibríes en la zona baja del centro de Veracruz, México. Ornitología Neotropical 12:297–317.

ORTIZ-PULIDO, R., A. T. PETERSON, M. B. ROBBINS, R. DÍAZ, A. G. NAVARRO, AND G. ESCALONA-SEGURA. 2002. The Mexican Sheartail (*Doricha eliza*): morphology, behavior, distribution, and endangered status. Wilson Bulletin 114:153–160.

PETERSON, A. T. 1999. Mexican Sheartail (*Doricha eliza*), p. 667. *In* J. del Hoyo, A. Elliott, and J. Sargatal [EDS.], Handbook of the birds of the world, vol. 5. Lynx Edicions, Barcelona.

PETERSON, A. T., S. L. EGBERT, V. SÁNCHEZ-CORDERO, AND K. O. PRICE. 2000. Geographic analysis of conservation priority: endemic birds and mammals in Veracruz, Mexico. Biological Conservation 93:85–94.

RALPH, C. J., G. R. GEUPEL, P. PYLE, T. E. MARTÍN, D.F. DESANTE, AND B. MILÁ. 1994. Manual de métodos de campo para el monitoreo de aves terrestres. USDA Forest Service General Technical Report PSW-GTR-159-Web.1996.

SCHUCHMANN, K. L. 1999. Family Trochilidae (hummingbirds), p. 468–680. *In* J. del Hoyo, A. Elliott, and J. Sargatal [EDS.], Handbook of the birds of the world, vol. 5. Lynx Edicions, Barcelona.

STATTERSFIELD, A. J., M. J. CROSBY., A. J. LONG, AND D. C. WEGE. 1998. Endemic bird areas of the world. BirdLife International, Cambridge, UK.