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Article *in* Journal of Field Ornithology · March 2008

DOI: 10.1111/j.1557-9263.2008.00141.x

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Journal of Field Ornithology

J. Field Ornithol. 79(1):20–23, 2008 DOI: 10.1111/j.1557-9263.2008.00141.x

Breeding biology of Eared Quetzals in the Sierra Madre Occidental, Mexico

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Received 13 July 2007; accepted 6 November 2007

ABSTRACT. Eared Quetzals (*Euptilotis neoxenus*), a threatened species, are one of the least studied trogons in Mexico. We monitored 29 Eared Quetzal nests in the Chihuahuan portion of the Sierra Madre Occidental from 1998 to 2003. All nests were in tree cavities, and the mean tree and nest cavity heights ($N = 14$) were 16.9 ± 7.8 m and 11.4 ± 4.1 m, respectively. The mean clutch size was 2.8 ± 0.9 eggs ($N = 28$), the incubation period lasted 22 d ($N = 1$), and nestling periods ranged from 29 to 31 d ($N = 5$). Both adults incubated eggs and fed nestlings. Of 80 eggs, 70 hatched (87.5%) and 67 of 70 young fledged (95.7%). Twenty-five of 29 nests (86.2%) produced at least one fledgling. One nest was predated, and two failed when nest trees fell. Higher rates of nest predation have been reported for other species of trogons. However, fewer potential predators, such as snakes and mammals, are present in the Sierra Madre than in tropical zones where most trogon species occur. In addition, antipredator behaviors, including nestlings with calls resembling a snake and nests with an unpleasant odor, may contribute to the high nesting success. The main limiting factors for Eared Quetzals in the northern Chihuahua may be competition for cavities with other secondary cavity-nesters, and the failure of nests when snags fall.

SINOPSIS. **Biología reproductiva de *Euptilotis neoxenus* en la Sierra Madre Occidental, México**

Euptilotis neoxenus es un ave amenazada y uno de los trogones menos estudiados de México. Monitoreamos 29 nidos en la Sierra Madre Occidental de Chihuahua durante seis años (1998–2003). Todos los nidos se encontraron en cavidades de árboles, 11 de los 14 nidos caracterizados fueron localizados en álamos (*Populus tremuloides*). La altura promedio de los árboles y los nidos fue de 16.9 ± 7.8 m y 11.38 ± 4.05 m, respectivamente. El tamaño de puesta fue de 2.8 ± 0.9 huevos ($N = 28$), el periodo de incubación duró 22 días ($N = 1$) y el de anidamiento 28–31 días ($N = 5$). Ambos adultos incubaron y alimentaron a los pollos. De 80 huevos, 70 eclosionaron (87.5%) y 67 fueron volantones (95.7%). Veinticinco de los 29 nidos (86.2%) produjeron al menos un volantón. Un nido fue depredado y dos se perdieron debido a la caída del árbol que los albergaba. Para otras especies de trogones han sido reportadas tasas de depredación más altas. Sin embargo, en la Sierra Madre Occidental existen una menor cantidad de depredadores potenciales, como serpientes y mamíferos, que en las zonas tropicales donde la mayoría de las especies de trogones está presentes. Además, comportamientos anti-depredación, incluyendo polluelos con llamados que asemejan una serpiente y nidos con un olor desagradable, podrían contribuir a un éxito reproductivo alto. Los principales factores limitantes para la productividad de esta especie son la competencia por cavidades con otras especies y la pérdida de nidos cuando los árboles en decadencia caen.

Key words: Chihuahua, Eared Quetzal, incubation, nestling period, reproductive success, Sierra Madre Occidental

Eared Quetzals (*Euptilotis neoxenus*), endemic to Mexico, are considered globally near-threatened in the Red List of Endangered Species (IUCN 2006), and protected under Mexican laws as threatened (NOM-059-SEMARNAT-2001; DOF 2002). These quetzals are found in pine and pine-oak forests at elevations ranging from 1800 to 3000 m asl, especially along rivers in canyons of the Sierra Madre Occidental and western part of the Transvolcanic axis, and are present in lower numbers in xeric vegetation in southern Arizona and New Mexico (Marshall 1957, Miller et al. 1957, Zimmerman 1978, Williamson 1992a, Lammertink et al. 1996, AOU 1998). During the early 1990s, Eared Quetzals were considered rare and thought to be impacted by logging and removal of nest sites (Collar et al. 1992). However, a survey in Sierra Madre Occidental in 1995 suggested that populations of Eared Quetzals were stable;

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they were common in appropriate habitat, and little affected by logging (Lammertink et al. 1996). Eared Quetzals are one of the least studied trogons in Mexico and little is known about their reproductive biology (Williamson 1992a,b, Baicich and Harrison 1997). In addition, no information is available concerning their reproductive success and the duration of incubation or fledging periods. Our objective was to obtain such information and to examine variation in reproductive success over several breeding seasons.

METHODS

Our study area was in the Chihuahuan portion of the Sierra Madre Occidental (2300–2820 m asl). We studied quetzals at three locations: Mesa de las Guacamayas in Janos municipality (128 km south of the Arizona border; 30°33′N, 108°36′W), Cinco Millas (Madera municipality, 70 km from Tutuaca municipality; 29°19′N, 108°11′W), and Tutuaca (Temosachi municipality, 280 km south of Mesa de las Guacamayas; 108°11′N, 28°28′W). These sites are characterized by pine, pine-oak (*Pinus* and *Quercus*), and fir forests (*Pseudotsuga* and *Abies*), and canyon vegetation, where pines and quaking aspens (*Populus tremuloides*) are present. From 1998 to 2003, we searched for and monitored nest cavities from early August to early October. On 7 d each year from 1998 to 2000, 12 d per year in 2001–2002, and 25 d in 2003, we looked for nests beginning 20 min before dawn and used the location of singing individuals and the response of quetzals when we knocked on trunks as cues. Once located, we used climbing gear to reach nests.

For as many nests as possible, we determined clutch size, number of nestlings, and number of fledglings, and determined nest fate. We also monitored the development of two nestlings in 2003, measuring their mass and wing chord about every 5 d.

We characterized 14 nest sites (11 in 2003 and 3 in 2002), noting the tree species, whether the tree was dead or alive, and whether the cavity was natural or created by a woodpecker. We also measured tree height, diameter at breast height (dbh), nest height, and dimensions of the cavity (length, height, depth, and external–internal diameter). Values are presented as means ± 1 SD.

RESULTS

We monitored 29 nests in 21 different nest cavities during our 6-yr study. Three nests were reused for 6, 4, and 2 yrs, respectively. For the 14 nest sites characterized in 2002 and 2003, 11 were in quaking aspens, two in Durango pines (*Pinus durangensis*), and one in a Mexican white pine (*P. ayacahuite*). Eight nests were in dead trees with at least portion of the trunk remaining, and the rest ($N = 6$) were in live trees with no signs of decay. The mean height of nest trees was 16.9 ± 7.8 m, and the mean dbh was 0.52 ± 0.20 m. The mean height of nest cavities was 11.4 ± 4.1 m ($N = 14$). The altitudinal range of nest sites was 2330–2600 m asl. Nine nests were in woodpecker cavities (64.3%) and five in natural cavities (35.7%). The mean dimensions of nest cavity entrances were 9.0 ± 1.6 cm high and 9.0 ± 1.8 cm wide ($N = 10$). Mean depth and internal and external diameter ($N = 3$) were 25 ± 18 cm, 20 ± 8 cm, and 34 ± 23 cm, respectively.

Eggs were light blue to greenish-blue and oval-shaped (32.5 × 26.3 mm, $N = 1$), and the mean clutch size was 2.8 ± 0.9 eggs ($N = 28$; 13 with two eggs, seven with three, and eight with four). The incubation period lasted 22 d ($N = 1$), and nestling periods ranged from 29 to 31 d ($N = 5$). Of 80 eggs, 70 hatched (87.5%) and 67 of 70 young fledged (95.7%). Of the 10 eggs lost during incubation, one did not hatch, two were predated (by a squirrel), and seven (in two nests) were lost when nest trees fell. We observed only two cases of nestling mortality; two nestlings died when their nest cavity flooded, and one nestling was found dead, possibly due to starvation or disease. Twenty-five of 29 nests (86.2%) produced at least one fledgling. Apparent nest success was high during the 6 yrs of study: 100% for 1998 ($N = 1$), 1999 ($N = 2$), 2000 ($N = 2$), and 2001 ($N = 6$), 66.6% for 2002 ($N = 6$), and 83.3% for 2003 ($N = 12$).

At hatching, Eared Quetzal young were blind, naked, and pink-skinned. Feathers started to erupt from shafts by day 5 posthatching, and nestlings were completely covered between 10 and 16 d of age. During the nestling period, the mean body mass of two siblings from a nest in 2003 was 18.3 gm on day 3 posthatching, 26.1 gm on day 5, 45.7 gm on day 10, 81.5 gm on day 16, 92.9 gm on day 19, and 96 gm on day 28. For these same nestlings, the mean wing chord was 12.8 mm on day 3 post-hatching, 15.2 mm on day 5, 29.4 mm on day 10, 62.2 mm on day 16, 86.7 mm on day 19, and 111.7 mm on day 25.

Females spent more time incubating than males. Based on observations at six nests, males arrived at nests between 06:30 and 07:00 and left by 13:10–13:45 (7 h), females then arrived and incubated for the rest of the day and night (17 h).

We made no systematic effort to identify food items delivered to nestlings. However, we did observe adults (males and females) provisioning the young with larvae, butterflies, and lizards (*Sceloporus* sp.). In addition, adults and juveniles were commonly observed in areas near nest sites feeding on blackberries (*Rubus* sp.), *Arbutus* berries, insects, and larvae.

From egg laying through the end of incubation, the floor of nest cavities was covered by pieces of wood and feathers. However, once nestlings hatched, feces and food remains began to accumulate, with a layer of excrement about 5–6-cm deep ($N = 3$) present by the time young fledged.

DISCUSSION

Eared Quetzals in our study had relatively long incubation and nestling periods (22 and 28–31 d, respectively). Several related species have shorter incubation periods, including sympatric Mountain (*Trogon montanus*; 19 d; Skutch 1942) and Elegant (*T. elegans*; 17–21 d; Hall and Karubian 1996) trogons and, a closer relative (Espinosa-de los Monteros 1998), Resplendent Quetzals (*Pharomachrus mocinno*; 17–19 d, Skutch 1944). The nestling period of Eared Quetzals was longer than reported for Mountain and Elegant trogons (both 15–16 d; Skutch 1942, Hall and Karubian 1996), but similar to the upper range reported for Resplendent Quetzals (23–30 d; Skutch 1944) despite being smaller. Similarly, Baird's Trogons (*T. bairdii*) have a longer nestling period (25 d; Skutch 1945) than similar-sized trogons. Because Baird's Trogons nest in a chamber at the end of an ascending tunnel in decaying trees, Collar (2001) suggested a relationship between the relatively long nestling period and the use of secure, enclosed nests, that is, reduced predation pressure may select for longer nestling periods

For nestlings of trogons that nest at higher altitudes, such as Eared and Resplendent quetzals and Mexican Trogons, feathers begin erupting at 5–7-d posthatching and young are completely covered by when 12–16-d old (Skutch 1942, 1944). In contrast, nestlings of lowland species, like Baird's and Black-headed trogons, still have pin-feathers 12–14 d after hatching and are fully feathered by day 16 (Skutch 1944, 1959). Skutch (1944) suggested that the earlier development of feathers in highland species represented an adaptation for colder temperatures, and the pattern exhibited by Eared Quetzals in our study seems to support this hypothesis.

Eared Quetzals have been observed eating madrone berries (*Arbutus arizonica*) and caterpillars in Arizona (Williamson 1992b), and arthropods and larvae in México (Taylor 1994). Such observations are consistent with ours. However, we also observed nestlings being fed lizards. Similarly, Hall and Karubian (1996) reported that young Elegant Trogons were fed insects in Arizona, and Skutch (1942, 1944, 1948, 1956, 1959, 1962) reported that the young of various *Trogon* species were fed insects and fruits, and nestling Resplendent Quetzals were fed lizards and frogs.

Low volume, hissing, begging calls have been reported for nestling Citreoline Trogons (*T. citreolus*; Skutch 1948), Mountain Trogons, (Skutch 1942), and Eared Quetzals (Williamson 1992b). Skutch (1942) reported nestling Mountain Trogons disturbed by a human observer uttered a quavering hiss. Harcus (1976) suggested that certain calls of nestling Narina Trogons (*Apaloderma narina*) served an antipredatory function because hissing calls produced by nestlings when "stressed" were more similar to the sounds produced by two snake species than were calls uttered when nestlings were hungry. Eared Quetzal chicks in our study also uttered hissing calls that, to our ears, resembled a snake when disturbed. However, a further study is needed to confirm Harcus' (1976) the hypothesis.

As reported for other trogon species (Skutch 1942, 1948, 1956, 1959, 1962), the feces of nestling Eared Quetzals accumulated in nest cavities in our study. The unpleasant odor that develops may deter potential predators (Collar 2001).

The rate of nest failure for Eared Quetzals in our study was low (19.2%). In contrast, 67–78% of the nests of Resplendent Quetzals failed (Wheelwright 1983). Only one nest was lost to predation in our study, but high rates of nest predation have been reported for other species of trogons (Collar 2001). However, Monterrubio et al. (2002) noted that no arboreal snakes are found in the high-elevation pine forest of the Sierra Madre Occidental, and there are fewer potential mammalian predators in the Sierra Madre than in tropical zones where most trogon species occur (Collar 2001). In addition, the antipredator behaviors of Eared Quetzals, including nestlings with calls that resemble a rattlesnake and nests with an unpleasant odor, may contribute to their high nesting success. For Resplendent Quetzals, nests failed due to flooding of cavities, snags with active nests falling, and human disturbance (LaBastille-Bowes and Allen 1969). Although no nests in our study failed due to human disturbance, Williamson (1992a, b) suggested that Eared Quetzals breeding in Arizona were susceptible to disturbance and less tolerant of human presence than Elegant Trogons. The main limiting factors for Eared Quetzals during the nesting stage in northern Chihuahua are probably competition for cavities with other secondary cavity-nesters (von Haartman 1957, Taylor 1994), and the failure of nests when snags fall.

ACKNOWLEDGMENTS

We thank A. Panjabi for his comments and suggestions on the article and the Peregrine Fund Library for assistance with our literature review. We appreciate the improvements in our use of English made by D. Brooks through the Association of Field Ornithologists' program of editorial assistance.

LITERATURE CITED

AMERICAN ORNITHOLOGISTS' UNION. 1998. Check-list of North American birds, 6th ed. American Ornithologists' Union, Washington, DC

BAICICH, P. J., AND C. J. O. HARRISON. 1997. A guide to the nests, eggs, and nestlings of North American birds, 2nd ed. Academic Press, New York.

COLLAR, N. J. 2001. Family Trogonidae (trogons). In: Handbook of the birds of the world, volume 6: mousebirds to hornbills (J. Del Hoyo, A. Elliot, and J. Sargatal, eds.), pp. 80–129. Lynx Edicions, Barcelona, Spain.

———, L. P. GONZAGA, N. KRABBE, A. MADROÑO, L. G. NARANJO, T. A. PARKER, AND D. C. WEGE. 1992. Threatened birds of the Americas: the ICBP/IUCN Red Data Book, part 2, 3rd ed. ICBP, Cambridge, UK.

DIARIO OFICIAL DELA FEDERACIÓN (DOF). 2002. Norma Oficial Mexicana NOM-O59- SEMARNAT-2001. Protección ambiental-especies nativas de México de flora y fauna silvestres-Categorías de riesgo y especificaciones para su inclusión, exclusión o cambio-Lista de especies en riesgo. Secretaría de Gobernación, México, D. F.

ESPINOSA-DE LOS MONTEROS, A. 1998. Phylogenetic relationships among trogons. Auk 115: 937–954.

HALL, L. S., AND J. O. KARUBIAN. 1996. Breeding behavior of Elegant Trogons in southeastern Arizona. Auk 113: 143–150.

HARCUS, J. L. 1976. Presumed anti-predator behaviour of the Narina Trogon. Ostrich 47: 129–130.

INTERNATIONAL UNION FOR CONSERVATION OF NATURE AND NATURAL RESOURCES (IUCN) [ONLINE]. 2006. 2006 IUCN Red List of Threatened Species. Available at: <www.iucnredlist.org> (1 June 2007).

LABASTILLE-BOWES, A., AND D. G. ALLEN. 1969. Biology and conservation of the quetzal. Biological Conservation 1: 297–306.

LAMMERTINK, M., J. A. ROJAS, F. M. CASILLAS, AND R. L. OTTO. 1996. Status and conservation of old-growth forests and endemic birds in the pine-oak zone of the Sierra Madre Occidental, Mexico Verslagen en Technische Gegevens No.69. Institute for Systematics and Population Biology Zoological Museum, University of Amsterdam, Amsterdam, The Netherlands.

MARSHALL, J. T. 1957. Birds of pine-oak woodland in southern Arizona and adjacent Mexico. Pacific Coast Avifauna 32: 82–83.

MILLER, A. H., H. FRIEDMANN, L. GRISCOM, AND R. T. MOORE. 1957. Distributional check-list of the birds of Mexico, Part II. Pacific Coast Avifauna, Cooper Ornithological Club 33: 1–436.

MONTERRUBIO, T., E. ENKERLIN-HOEFLICH, AND R. B. HAMILTON. 2002. Productivity and nesting success of Thick-billed Parrots. Condor 104: 788–794.

SKUTCH, A. F. 1942. Life history of the Mexican Trogon. Auk 59: 341–363.

———. 1944. Life history of the Quetzal. Condor 46: 213–235.

———. 1945. Incubation and nestling periods of Central American birds. Auk 62:8–37.

———. 1948. Life history of the Citreoline Trogon. Auk 50: 137–147.

———. 1956. A nesting of the Collared Trogon. Auk 73: 354–356.

———. 1959. Life history of the Black-throated Trogon. Wilson Bulletin 71: 5–18.

———. 1962. Life history of the White-tailed Trogon *Trogon viridis*. Ibis 104: 301–313.

TAYLOR, R. C. 1994. Trogons of the Arizona borderlands. Treasure Chest Publications, Tucson, AZ.

VON HAARTMAN, L. 1957. Adaptation in hole-nesting birds. Evolution 11: 339–347.

WHEELWRIGHT, N. T. 1983. Fruits and the ecology of Resplendent Quetzal. Auk 100: 286–301.

WILLIAMSON, S. 1992a. First nesting of Eared Trogon in the United States. Winging It 4: 1–4.

———. 1992b. The Eared Trogon in Arizona: behavior, ecology, and management of the "Northern Quetzal." In: Proceedings of the Chiricahua Mountains Research Symposium (M. S. Barton and S. A. Sloane, eds.), pp. 98–101. Southwest Parks and Monuments Association, Tucson, AZ.

ZIMMERMAN, D. A. 1978. Eared Trogon—immigrant or visitor? American Birds 32: 135–139.