

The Citreoline Trogon as an Ecosystem Engineer¹

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ABSTRACT

The western Mexican endemic Citreoline Trogon (*Trogon citreolus*) builds its nest cavities in arboreal termitaria. We studied the reuse of these holes by other organisms after the trogons abandoned them in the tropical dry forest of western Mexico. Of the 24 cavities examined, 19 were occupied (5 by mammals and 14 by arthropods). We found two western Mexico endemic mammals (*Marmosa canescens* and *Xenomys nelsoni*) using these spaces. Our results suggest that the *T. citreolus* provides a critical role in creating necessary cavities for many organisms in tropical dry forests.

RESUMEN

La especie *Trogon citreolus* es un ave endémico de la región occidental de México, construye sus cavidades para anidar adentro de termiteros arbóreos. Investigamos la reutilización de estas cavidades por otros organismos después de ser abandonadas por los trogones en el bosque tropical caducifolio en el occidente de México. De 24 cavidades examinadas, 19 estaban ocupadas (5 por mamíferos y 14 por artrópodos). Encontramos dos especies endémicas de mamíferos (*Marmosa canescens* y *Xenomys nelsoni*) utilizando las cavidades. Nuestros resultados sugieren que *T. citreolus* tiene una función muy importante en la creación de cavidades necesarias para muchos otros organismos en el bosque tropical caducifolio.

Key words: arboreal termitaria; Chamela-Cuixmala; Citreoline Trogon; ecosystem engineer; Grayish-mouse Opossum; Magdalena Rat; *Marmosa canescens*; *Trogon citreolus*; tropical dry forest; *Xenomys nelsoni*.

ECOSYSTEM ENGINEERS ARE SPECIES THAT PERFORM ACTIVITIES that directly, or indirectly, have a major influence on other organisms by creating or modifying the habitat, thereby controlling the availability of resources for other species (Jones *et al.* 1997). For example, the North American beaver (*Castor canadensis*) creates ponds, which in turn provide habitat and resources for a wide array of aquatic and subaquatic species (Pollock *et al.* 1995). Among birds, primary cavity-nesters perform essential roles in ecosystems by creating holes, which are later used by other organisms that are not able to create their own (Dennis 1971, Loeb 1993). A special case in the Neotropics is the use of arboreal termitaria for nest sites. It has been documented that at least 32 percent of all New World trogon species (Trogonidae), 11 percent of parrots (Psittacidae), and 45 percent of kingfishers (Alcedinidae) use arboreal termitaria for nesting (Fry *et al.* 1992, Juniper & Parr 1998, Johnsgard 2000). After the cavity is abandoned, it has been observed that they can be occupied by other birds (Jullien & Cariveau 2001) or bat species (Kalko *et al.* 1999).

The current study was designed to evaluate the role of the western Mexico endemic Citreoline Trogon (*Trogon citreolus*) as an ecosystem engineer in the tropical dry forest in the coastal region of Jalisco. The main objectives were to (1) identify the species that

utilized abandoned trogon nests; (2) quantify the frequency of use; and (3) determine the characteristics of the cavities reused by various species.

The research was conducted in the relatively pristine tropical deciduous forest of the Estación de Biología Chamela, which is part of the 13,200 ha Reserva de la Biosfera de Chamela-Cuixmala on the coast of Jalisco, México (19°22' to 19°35' N and 104°56' to 105°03' W). This region has a pronounced dry season (November–mid June); annual rainfall averages 798 mm (1977–2000) and is concentrated from the end of June to October (García-Oliva *et al.* 2002). The mean annual temperature is 24°C with an average daily minimum temperature of 16°C (1978–2000, García-Oliva *et al.* 2002). The Reserve has a rough topography with lowlands and rolling hills ranging from sea level to 584 m elevation. Streams are intermittent and do not contain surface water during the dry season.

A previous study (2001–2003) found that the *Trogon citreolus* was observed to nest only in active termite nests that were created by *Nasutitermes nigriceps* (T. Valdivia-Hoeflich and J. H. Vega Rivera, pers. obs.), the one termite species that builds arboreal termitaria in the region (Nickle & Collins 1988). After the trogon nesting period (June–October, 2001–2003), termites remained active in 11 of 30 of the termitaria closing the cavities. However, the rest were abandoned by the termites and the holes originally created by trogons remained open.

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To document the use by other organisms in abandoned trogon nests that remained open, in November 2003 we examined 17 cavities in arboreal termite nests that were built by trogons during the breeding seasons of 2001–2003. Additionally, in November 2003, we found seven other holes which could have been created by either trogons or parakeets, but most likely were created by trogons because they showed some signs of recent use. The Orange-fronted Parakeet (*Aratinga canicularis*) is the only additional species in the region that has been reported to use arboreal termitaria for nesting (Juniper & Parr 1998); however, parakeets nest during the dry season (Ornelas *et al.* 1993).

Of the 24 cavities examined in November 2003, 19 were occupied and 5 were empty. Of the 19 occupied holes, five were used by mammals: two by the Grayish-mouse Opossum (*Marmosa canescens*), one by the Magdalena Rat (*Xenomys nelsoni*), and two by unknown small mammals that escaped before being identified. Additionally, 14 cavities were occupied by arthropods, including tailless whip scorpions (Amblypygi), katydids (Tettigoniidae), bees (Apidae), and wasps (Sphecidae).

T-tests comparing occupied and unoccupied termitaria showed no significant differences between parameters such as tree height (7.1 m \pm 1.9 SD *vs* 6.9 \pm 1.9 m, respectively, $P = 0.9$), tree DBH (27.5 \pm 23.6 cm *vs* 23.6 \pm 13.4 cm, $P = 1.0$), termitaria length (58.6 \pm 15.2 cm *vs* 67.0 \pm 9.6 cm, $P = 0.2$), termitaria width (35.1 \pm 8.3 cm *vs* 33.4 \pm 6.0 cm, $P = 0.6$), diameter of cavity entrance (6.7 \pm 0.7 cm *vs* 6.8 \pm 0.3 cm, $P = 1.0$), or height of termitaria from the ground (3.2 \pm 1.9 m *vs* 3.3 \pm 1.4 m, $P = 0.81$).

Our data suggest that the contribution of trogons in making cavities available for other organisms is important. Seventy-nine percent of the holes examined were occupied. In particular, these cavities may be especially important for two endemic mammals, for which little ecological information exists (Ceballos & Miranda 2000). The Magdalena Rat has one of the most restricted geographic ranges of all Mexican mammals; it has been recorded from only three localities, and one of them is the region of Chamela where it is considered rare (Ceballos *et al.* 1998, Ceballos & Miranda 2000). This species is considered endangered by the Mexican Government (SEMARNAT 2002) and at lower risk/near threatened by the IUCN (Baillie 1996). The Grayish-mouse Opossum is common in the region and has been observed using old nests of the White-bellied Wren, *Uropsila leucogastra* (Marquez-Valdelamar & Navarrijo 2002). One of the two adults we observed was carrying seven small offspring, indicating that at least some individuals of this species use these cavities during their reproductive period.

Of the 24 examined cavities, 8 (33%) were occupied by bees and 2 (8%) were occupied by wasps. In this same area, Vega Rivera *et al.* (2003) reported that a female nesting Ivory-billed Woodcreeper (*Xiphorhynchus flavigaster*) was expelled from its tree hole by Africanized honeybees (*Apis mellifera scutellata*). Thus, these observations suggest that there may be competition for cavities posed by these stinging insects.

Most obligate cavity-nesting organisms are considered to be nest-site limited (Kunz 1982, Brawn & Balda 1988, O'Donnell & Sedgeley 1999, Taulman 1999). Unfortunately, we do not have information on the availability of natural cavities in the study region,

which may help confirm the importance of secondary use of nesting holes created by trogons. Nevertheless, the high frequency of reuse of abandoned trogon nests (79%) strongly suggests that the *T. citreolus* provides a critical role in creating necessary cavities for many organisms in tropical dry forests.

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