ORNITOLOGIA NEOTROPICAL 25, 397–406, 2014

NESTING BIOLOGY OF THE FLAME-FACED TANAGER (*TANGARA PARZUDAKII*) IN NORTHEASTERN ECUADOR

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Resumen. – Biología de anidación del Tangara Cariflama (*Tangara parzudakii*) en el noreste del Ecuador. – La Tangara Cariflama (*Tangara parzudakii*) incluye tres subespecies reconocidas, *urubambae*, *lunigera* y la nominal *parzudakii*, que se reconocen sobre la base de las diferencias de plumaje y aspectos de distribución. Información general falta en la biología reproductiva básica para esta especie, con sólo un puñado de los registros de la especie en su conjunto, y sólo una pequeña nota sobre la cría de la subespecie nominal *parzudakii*. Con el fin de añadir los datos fundamentales de la historia de vida de la especie, se estudió la biología reproductiva de *Tangara parzudakii parzudakii* en el noreste de Ecuador entre 2001–2009 usando observaciones de carácter general y por grabar en vídeo los comportamientos en el nido con cámaras de vídeo. En total, encontramos 22 nidos. Recogimos información más detallada de 10 nidos, componentes de nidos analizados de un nido, y observaciones de comportamiento en video en un nido. La Tangara Cariflama en la vertiente oriental de Ecuador parece reproducirse en los meses más lluviosos de enero–julio. La mayoría de los nidos se encontraron en los pastos, sin embargo, dos nidos fueron encontrados en hábitat boscoso, uno fue encontrado en el borde del bosque, y uno fue encontrado debajo del techo de una cabina. Sobre la base de cópulas durante la fase de construcción, la hembra parece construir el nido solo, mientras el macho espera cerca. El tamaño de puesta fue de dos en todos los nidos. Los huevos eran de color blanco con moteado de color marrón claro que fue más fuerte hacia el extremo más grande. La media (± DE) de duración del encuentro inquietante fue de 8.4 ± 5.6 min y varió desde 0.33–24.3 min de duración. Tanto los adultos jóvenes y aprovisionan, a diferencia de algunas especies de *Tangara*, no observamos ayudantes en el nido. Reportamos 4.9 alimentaciones por pichón-hora durante el período de cría. No se encontró pulgas en el material de la jerarquización de un nido se recogieron inmediatamente después de emplumar, que puede ser debido a la alta tasa de sondas afiladas y rápidos realizados por los adultos en el período enclavado temprana y las sondas afiladas realizados hasta la mañana de volantones.

Abstract. – The Flame-faced Tanager (*Tangara parzudakii*) includes three recognized subspecies, *urubambae*, *lunigera*, and the nominate *parzudakii,* that are distinguished based on plumage differences and distribution aspects. Information is generally lacking on basic breeding biology for this species, with only a handful of records for the species as a whole, and only one small note on breeding of the nominate subspecies *parzudakii*. In order to add fundamental data to the species' life history, we studied the breeding biology of *Tangara parzudakii parzudakii* in northeastern Ecuador from 2001–2009 using general observations and by videotaping behaviors at the nest with camcorders. In total, we made 22 direct observations of reproduction. We collected detailed information from 10 nests, analyzed nest components of one nest, and videotaped behavior at one nest. Flame-faced Tanager on the eastern slope in Ecuador appears to breed during the rainier months of January–July. The majority of nests were found in pastures, however, two nests were found in forested habitat, one was found at the forest edge, and one was found below the roof of a cabin. Based on copulations during the building phase, the female appears

to build the nest alone while the male waits nearby. Clutch size was two in all nests. Eggs were white in color with pale brown flecking that was heaviest toward the larger end. Mean (± SD) brooding bout duration was 8.4 ± 5.6 min and ranged from 0.33–24.3 min. Both adults provisioned young and, unlike some *Tangara* species, we did not observe helpers at the nest. We recorded 4.9 feeds per nestling-hour during the brooding period. We did not find fleas in the nesting material of a nest we collected immediately after fledging, which may a result of the high rate of sharp and rapid probes performed by adults in the early nestling period and the sharp probes performed up to the morning of fledging. *Accepted 13 November 2014.*

Key words: Flame-faced Tanager, *Tangara parzudakii*, Andes, breeding biology, feeding rates, life history, nestlings, Thraupidae.

INTRODUCTION

The genus *Tangara* is among the most speciose of South American bird genera (Isler & Isler 1999, Sedano & Burns 2010, Hilty 2011). Members of the genus have been described as "feathered jewels" due to their brilliant color patterns (Isler & Isler 1999). Despite their bold plumage, *Tangara* species are rather inconspicuous while nesting because they are not especially vocal, do not call from exposed perches, and rarely demonstrate territorial behaviors (Skutch 1976, Isler & Isler 1999, Hilty 2011). As a result, we lack breeding information for many species in this large, widespread genus.

The Flame-faced Tanager (*Tangara parzudakii*) inhabits humid forests on the western slope of the Andes from southwestern Venezuela to northern Ecuador and on the eastern slope from Venezuela to southern Peru. It is most common at elevations ranging from 1000–2600 m a.s.l. and rarely found as low as 700 m a.s.l. (Isler & Isler 1999, Hilty 2011). Despite its extensive range, published breeding data on the Flame-faced Tanager are limited. In Colombia, observations of the nominate subspecies of the Flame-faced Tanager, *Tangara parzudakii parzudakii*, include courtship feeding in February (Ridgely & Gaulin 1980), large gonads in March, and nest-building in June (Fjeldså & Krabbe 1990). Fledglings were observed in March, June and October, and a juvenile was recorded in July (Fjeldså & Krabbe 1990). A juvenile was also recorded in May in Peru (Fjeldså & Krabbe 1990).

In Ecuador, breeding records from the western slope (ssp. *lunigera*) include nest-building in August, October and December (Greeney & Nunnery 2006) and nesting in February (see Arcos-Torres & Solano-Ugalde 2007 for first nest description for ssp. *lunigera*). A juvenile was observed in September (Fjeldså & Krabbe 1990). Breeding records for the nominate subspecies of the Flame-faced Tanager (ssp. *parzudakii*), which occurs on the eastern slope of the Andes in Ecuador, are sparse, with notes on one pair in southern Ecuador nesting in May (Greeney *et al.* 2010). Here we present the first detailed data on the nest, eggs, nestlings, and breeding biology of the nominate subspecies of the Flame-faced Tanager (ssp. *parzudakii*) from northeastern Ecuador.

METHODS

We opportunistically gathered information from 2001 to 2009 on the nest, eggs, nestlings, and breeding behaviors of the Flame-faced Tanager (ssp. *parzudakii*) on the eastern slope of the Andes in northeastern Ecuador. We collected data at Yanayacu Biological Station and Center for Creative Studies (00°35.95S, 77°53.40W, 2100 m a.s.l.) and the adjacent land of Cabañas San Isidro in Napo Province. Detailed descriptions of the study area can be found in Greeney *et al.* (2006) and Guayasamin *et al.* (2006).

In total, we located 22 nests. We estimated nest height based on the consensus of two observers if the nest was unreachable; otherwise we used a measuring tape to record nest height. We used a tripod-mounted video camera (Sony video Hi8) at one nest to quantify parental behaviors during the final 10 days of the nestling period (3, 5–7, 9, 10 and 12–15 May, 2006). Because the length of the nestling period is (or had been) unknown for the Flame-faced Tanager, and we did not know the day of hatching, we noted nestling age as the days before fledging rather than days after hatching. We filmed for an average of 7.5 h each day between 06:00 and 18:30 h and recorded a total of 76.3 h of behavior. We quantified feeding and fecal sac removal rates, nest maintenance behaviors, time spent brooding, and time of fledging. To compare daily activity from the videotaped nest, we corrected data for the number of hours filmed each day. We collected the nest we filmed one hour after fledging and held the nest in a sealed bag for two weeks to determine the presence of nest parasites (i.e., fleas).

RESULTS

Nest sites and habitat. We found and recorded location information for 10 nests. Six nests were located in pasture, three of which measured 1.75 m high and were located in the same old, mossy tree stumps and three of which averaged 19 m (1.7 SD) high in isolated pasture trees. Two nests were found in forested habitats at an average height of 23.5 m (0.7 SD), including one nest located in primary forest and a second nest located at the edge of a forest gap in the crook of a large *Cecropia* tree. Another nest was located in a mossy branch 25 m high and 8 m from the main trunk of an isolated tree at the forest edge. We also noted a nest being built under the roof of a cabin at the San Isidro bird lodge. Despite the variety of nest placements, all nests were completely concealed from above and typically well concealed on the sides by epiphytes or other vegetation.

Nest construction and nest architecture. During the building phase, we made several observations of adult behavior. In a 90-min observation at one nest, we recorded 17 total trips to the nest, 13 with material. A single adult built exclusively while a second adult routinely perched 10–20 cm from the nest. Because sexes are similar, we could not determine the identity of the bird that was building. During the observation period we noted 2 copulations separated by approximately 5 min. In both cases, the female perched 20 cm from the nest with material in her bill while the male copulated with her. She then took the material to the nest. At a second nest we noted the presence of three adults, but only one adult appeared to be building.

Nests were bulky, open cups composed externally of stiff dark fibers and fern pieces (42%) used to loosely bind together moss and other soft organic material (37%) (Fig. 1). Internally the cups were neatly lined with tightly compacted layers of dead, pale, dry *Chusquea* bamboo leaves mixed with a few flexible fibers (mostly pale-colored). Despite the variability in nest placement, all nests were well supported, with most of the lower portion of the nest resting upon a support. Mean measurements (cm ± SD) for three nests were: outer diameter 12.3 ± 0.9; outer height 9.8 ± 1.8; inner diameter 6.0 ± 0.8; inner depth 4.5 ± 0.6.

Eggs. Eggs were white with pale brown flecking throughout, though flecking was heaviest toward the larger end near the air cell (Fig. 2). At one nest, the first egg was laid sometime before 14:30 h and the second egg was laid the following day before 09:00 h. Five eggs from three nests measured 22.0 (± 0.6 SD)

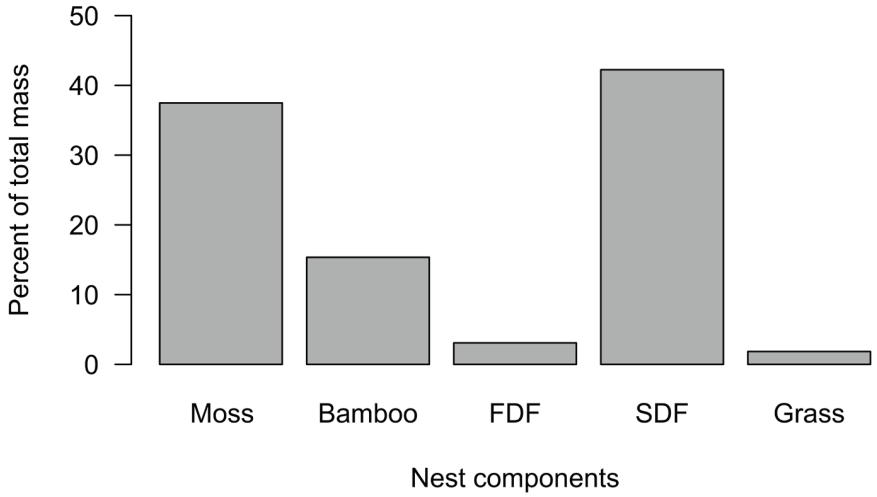

FIG. 1. Nest components by percent of total nest mass for the Flame-faced Tanager (*Tangara parzudakii*). Components include moss and other soft organic material (Moss), *Chusquea scandens* leaves (Bamboo), Flexible dark fibers (FDF), stiff dark fibers and fern pieces (SDF), and dead grass and pale fibers (Grass). Data are from one nest collected at Yanayacu Biological Station in northeastern Ecuador (00°35.95S, 77°53.40W, 2100 m a.s.l.).

mm x 16.7 (± 0.3) mm. Average fresh mass of six eggs from three nests was 3.2 (± 0.2) g.

Brooding. Based on videotaped observations, we never saw a brooding adult being replaced by another adult, suggesting that only one sex brooded. In addition, observations of color-banded (but unsexed) adults at another nest revealed that only one individual assumed all brooding duties (unpubl. data). We thus infer that, as in other *Tangara* spp. (Hilty 2011), only female Flame-faced Tanagers brood the young (Fig. 3). In the videotaped observations, the brooding adult generally sat low in the nest after fluffing breast and belly feathers, and almost always faced the same direction during each bout (32 of 36 brooding bouts). Brooding bouts ranged from 0.33–24.3 min in length, with a mean duration (± SD) of 8.4 ± 5.6 min. Twelve days before fledging, adults spent 57% of daylight hours brooding. Ten days before fledging, the percent of time spent brooding dropped to 20%. Between five and nine days before fledging, adults spent ≤ 2% of daylight hours brooding. Diurnal brooding ceased four days prior to fledging. During the nestling stage, an adult would return to the nest no later than 18:22 h and appeared to leave the nest in the morning around 06:00 h. Nocturnal brooding ceased 5 days before fledging.

Nestling provisioning and growth. Based on videotaped observations, adults provisioned two nestlings 752 times during 76.3 h of filming for a rate of 4.9 feeds per nestling-hour. Nestling provisioning was lowest on the day when percent of time spent brooding was highest (3.1 feeds per nestling-hour). Provisioning was highest one day before fledging (6.0 feeds per nestling-hour). The earliest recorded feeding occurred at 06:10 h and the latest feeding occurred at 18:14 h. Adults provisioned nestlings with mashed up fruits, but more commonly single arthropod items, though we did

FIG. 2. Eggs from a nest of the Flame-faced Tanager (*Tangara parzudakii*) in northeastern Ecuador (photo H. F. Greeney).

FIG. 3. Brooding adult of the Flame-faced Tanager (*Tangara parzudakii*) hunkered down in the nest in northeastern Ecuador. The adult is facing right and its head is turned toward the camera (photo H. F. Greeney).

witness some prey-loading of small arthropods. We were able to identified several arthropod prey items brought to the nest including Tettigoniidae (n = 1), Lepidoptera (n = 2), and Araneae (n = 1). We also observed adults bringing red berries to nestlings, which could be *Miconia* sp. (Melastomataceae), a favored fruit of the Flame-faced Tanager

(Naoki 2003, Hilty 2011) and other *Tangara* species (Ridgely & Gaulin 1980, Sheldon & Greeney 2007).

Based on data from the nest we videotaped, mean body mass (± SD) of two nestlings 15 days prior to fledging was 5.7 ± 0.1 g and 11 days prior to fledging was 11.6 ± 0.5 g (Fig. 4). On the day of fledging, one nestling that had yet to fledge had a body mass of 21.2 g (Fig. 5).

Nest maintenance and sanitation. While at the nest, usually after food delivery or while brooding, adults frequently probed into the nest lining with a sharp, pecking movement (sharp probe) or in a rapidly repeated, sewing-machine-like manner (rapid probe), behaviors which have been interpreted as forms of parasite removal or nest sanitation (Halftorn 1994, Greeney 2004). Based on videotaped observations, twelve days before fledging, adults performed sharp probes 32.8 times/h (n = 167) and rapid probes 8.5 times/h (n = 42). Eight days before fledging, the sharp probes had fallen to 1.5 times/h and we observed no rapid probing. Among all observation days, sharp and rapid probes occurred an average of 5.5 and 1.4 times/h, respectively. After collecting the nest we filmed one hour after fledging and holding it in a sealed bag for two weeks, we saw no sign of a single flea. This supports the hypothesis that probing behaviors remove parasites (Haftorn 1994, Greeney 2004).

The two nestlings we videotaped produced a total of 264 fecal sacs during 76.3 h of observation for a rate of 1.7 fecal sacs per nestling-hour. We found no trend in the number of fecal sacs produced over the nestling period (Pearson correlation = -0.13, n = 10, P = 0.72). The nestlings produced all fecal sacs in the presence of adults up until six days before fledging. By the morning of fledging, 60% of fecal sacs were being produced when adults were absent. Of the fecal sacs that were produced in the presence of adults, the vast majority (84%) were carried away rather than eaten and those produced in the absence of adults were deposited over or on the side of the nest.

Fledging. Nestlings fledged in quick succession on 15 May 2006, with the first leaving the nest at 07:22 h and the second following at 07:28 h. On the morning of fledging, adults provisioned the nestlings 25 times in the 1.4 h from sunrise to time of fledging for a rate of 8.9 feeds per nestling-hour. The adults provisioned nestlings right up to fledging, with the last feed coming only 2 min before the first nestling fledged.

General observations. While provisioning young, adults visited nests in quick succession, suggesting that, like other *Tangara* species, the Flame-faced Tanager forages in pairs and is rarely alone (Isler & Isler 1999, Willis & Oniki 2003). *Tangara* species often show cooperative breeding with helpers at the nest (Skutch 1961, Snow & Collins 1962, Sick 1985, Long & Heath 1994, Gelis *et al.* 2006, Eisermann *et al.* 2011). We saw a third adult present during the building phase at only one nest, and we never observed more than two adults feeding nestlings at one time. Clutch size was two at all of the nests we found that contained eggs or nestlings (n = 6).

At most nests, adults avoided visiting the nest in our presence, generally staying 5–10 m above the ground and 10–15 m away, hopping between well-hidden perches, and chipping loudly. At one nest, however, older nestlings (three days prior to fledging) gave harsh, high-pitched alarm calls in response to being handled. Both adults responded by swooping at our heads, chipping, and hopping rapidly in low vegetation 1–3 m away. Their movements shook surrounding foliage and they fluttered their wings loudly, which we interpreted as distraction displays.

FIG. 4. Nestlings of the Flame-faced Tanager (*Tangara parzudakii*) 15 days (A) and 11 days (B) prior to fledging from a nest in northeastern Ecuador (photo H. F. Greeney).

Seasonality of breeding. We made several observations of the Flame-faced Tanager breeding activity including: five nests being built in January (2002, 2003, 2004, 2009, 2011), and one each in February (2003), March (2007) and April (2001); a nest with eggs in April (2012); two nests with nestlings in February (2002) and May (2001, 2002) and one nest with nestlings in April (2006); two adults foraging with one juvenile in a mixed species flock in March (2002); a courtship feed while two adults foraged together in February (2003); one adult carrying nesting material that looked like moss while a second adult foraged nearby, both with a mixed species flock in February (2003); one adult collecting nesting material while traveling with a mixed species flock in February (2005); and, an adult carrying nesting material in February (2005).

DISCUSSION

We discovered the nest we filmed 15 days before the nestlings fledged. Many *Tangara*

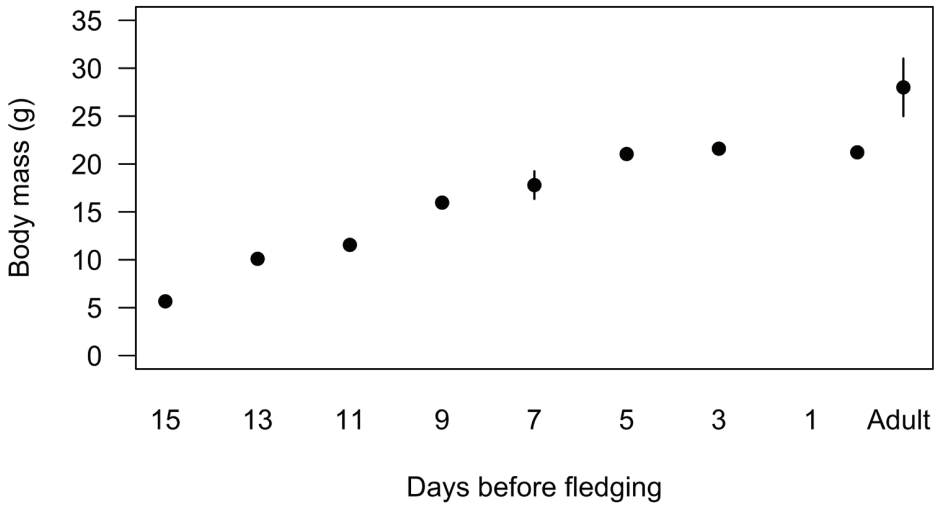

FIG. 5. Mean body mass (± SD) of Flame-faced Tanager nestlings (n = 2) beginning 15 days prior to fledging. Day of fledging data (Day 0) is from only one nestling that had yet to leave the nest. Adult body mass data are from Isler & Isler (1987).

species have nestling periods that fall within 13–17 days, including Azure-rumped (*T. cabanisi*) (Eisermann *et al.* 2011), Black-capped (Freeman & Greeney 2009), Bay-headed (*T. gyrola*), Golden-hooded (*T. larvata*), Speckled (*T. guttata*) (Skutch 1954), and Paradise Tanager (*T. chilensis*) (Wood *et al.* 1992).

Both diurnal and nocturnal brooding appeared to cease between 4 and 5 days before fledging. This is consistent with previous reports that show diurnal brooding in *Tangara* species ceases around 6 days prior to fledging and nocturnal brooding ceases 2–4 days prior to fledging (Skutch 1954, 1981; but see Sheldon & Greeney 2007 for exception). Average brooding bout length for the Flame-faced Tanager was also similar to other *Tangara* species, which tend to brood in 10–14 minute bouts (Skutch 1954, 1981, Van Houtan & Alvarez-Loayza 2006, Freeman & Greeney 2009).

Nestlings were provisioned at an average rate of 4.9 feeds per nestling-hour, which is in line with feeding rates observed in other *Tangara* species, including Speckled (5 feeds h^{-1}; Skutch 1954), Beryl-spangled (7.2 feeds h^{-1}; Sheldon & Greeney 2007), and Black-capped Tanager (6 feeds h^{-1}; Freeman & Greeney 2009). Consistent with other *Tangara* species, we found that adults primarily provisioned nestlings with small arthropods and fruits (Ridgely & Gaulin 1980, Van Houtan & Alvarez-Loayza 2006, Freeman & Greeney 2009, Hilty 2011), however, *T. parzudakii* tends to be less frugivorous than other *Tangara* species (Ridgely & Gaulin 1980), and we observed adults provisioning nestlings with more arthropod prey items than fruits.

Based on the nest we filmed, we found a relatively high rate of sharp and rapid probing in the very early stages of the nestling period. Among all observations days of the nestling period, sharp probing of 5.5 times/h for the Flame-faced Tanager was greater than for the Black-capped Tanager (1.1 times/h), however, rapid probing was similar in Flame-faced (1.4 times/h) and Black-capped Tanager (1.7 times/h) (Freeman & Greeney 2009).

Because rapid probing has been linked to the nestling stage in the Black-capped Tanager, Freeman & Greeney (2009) suggest this behavior is associated with the removal of parasites or detritus from the nest. Though we did not find a single flea in the nest of the Flame-faced Tanager we collected directly after fledging, we never observed rapid probing in the eight days before fledging. We did, however, observe sharp probing all the way to the morning of fledging. Thus, even though rapid probing has been associated with the nestling stage in other *Tangara* species, it appears sharp probing may be as important as rapid probing in protecting nestlings from parasites. Additional parasite sampling from nests where probing has been quantified is needed to better understand the function of these behaviors.

Based on our breeding observations, the Flame-faced Tanager on the eastern slope in Ecuador appears to breed at the beginning of the rainy season in January through the rainier months of February–July, which coincides with breeding of other Thraupidae species in the area (Greeney & Gelis 2007, Greeney *et al.* 2008). Seasonality of breeding for the Flame-faced Tanager occurs during a different time in other parts of Ecuador. Records from the Tandayapa Valley, Pinchincha Province, Ecuador, include adults building nests in August and October and carrying nesting material in December (Greeney & Nunnery 2006). The Tandayapa Valley is located on the western slope of the Andes where weather patterns are different from the eastern slope of the Andes. On both slopes, seasonality in breeding of *T. parzudakii* appears to coincide with the rainy season.

The only other detailed description of the nest for the Flame-faced Tanager is from the subspecies *lunigera* on the western slope of the Andes in Ecuador (Arcos-Torres & Solano-Ugalde 2007). We found no substantial differences in nest site, nest composition, or adult building behavior of ssp. *lunigera* compared with ssp. *parzudakii*.

The information presented here on the breeding biology of the Flame-faced Tanager greatly adds to our understanding of this beautiful species. However, many aspects of its life history remain undocumented, such as incubation period, age at first reproduction, nesting success, lifespan, and population regulation (O'Malley & Burns 2012). We encourage others to continue with research aimed at documenting the natural history of this and other tropical species.

ACKNOWLEDGMENTS

We are grateful to Dana Drumm and Melanie Schriber for help transcribing videos. KSS was funded by NSF (GRF and Postdoctoral Research Fellowship no. 1306883). HFG was supported by the Population Biology Foundation, John V. Moore, Matt Kaplan, and Field Guides Inc. We thank Cabañas San Isidro for access to their reserve. This is a publication of the Yanayacu Natural History Research Group.

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