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Palmchat (*Dulus dominicus*) activity at nests in the non-breeding season

André A. Dhondt^{1,2}, Jeremy L. Collison^{1,3}, Matthew H. Lam^{1,4}, Matthew J. D'Ambrosio^{1,5}, and Taylor L. Crisologo^{1,6}

Abstract The Palmchat (*Dulus dominicus*), endemic to Hispaniola, is one of the few passerine species that build large, complex nests containing multiple chambers defended by different pairs. Although the breeding season is March–June, Palmchats occupy and maintain nests year-round. We report detailed observations of Palmchat nests and nest-related behavior made during two January visits in the eastern Dominican Republic. Throughout the day the average number of Palmchat visits to a nest varied between 21 and 85 per hr. Groups were larger in larger nests. In one larger nest, birds arrived with a twig in 5.2% of the visits, while in a smaller nest, birds arrived with a twig during 18.8% of visits. The twig-related activities per individual were more frequent in two smaller nests than in two larger nests, suggesting that each individual in the smaller nests invested more in nest growth and nest maintenance. Twig length varied between 1.0 cm and 58.9 cm (mean = 21.03, SD = 9.01) and twigs were usually curved. In flight, birds often held twigs lopsided (not in the center), then inserted the shorter end into the nest. After a twig was placed in the nest, it was frequently manipulated and sometimes moved to a different location, or even to a different nest. We observed aggressive behavior at one nest; it may have resulted from the nest's occupancy by two different groups of birds.

Keywords Dominican Republic, *Dulus dominicus*, nest building, Palmchats, Punta Cana

Resumen Actividad de Cigua Palmera (*Dulus dominicus*) en nidos en la temporada no reproductiva—La Cigua Palmera (*Dulus dominicus*), endémico de la Española, es una de las pocas especies de paseriformes que construyen nidos grandes y complejos que contienen múltiples cámaras defendidas por diferentes parejas. Aunque la temporada de reproducción es de marzo a junio, esta especie ocupa y mantiene nidos durante todo el año. Reportamos observaciones detalladas de los nidos de Cigua Palmera y del comportamiento relacionado con los mismos durante dos visitas realizadas en enero en el este de República Dominicana. A lo largo del día, el número promedio de visitas de individuos de esta especie a un nido varió entre 21 y 85 por hr. Los grupos eran más grandes en nidos más grandes. En un nido más grande, las aves llegaron con una rama en el 5,2% de las visitas, mientras que en uno más pequeño, llegaron con una en el 18,8% de las visitas. Las actividades relacionadas con ramas por individuo fueron más frecuentes en dos nidos más pequeños que en dos nidos más grandes, lo que sugiere que cada individuo en los nidos más pequeños invirtió más en la construcción y mantenimiento de los nidos. La longitud de las ramas varió entre 1,0 cm y 58,9 cm (media = 21,03, DE = 9,01) y generalmente eran curvas. En vuelo, las aves a menudo sostenían ramas torcidas (no en el centro) y luego insertaban el extremo más corto en el nido. Después de colocar una rama en el nido, con frecuencia se manipulaba y a veces se movía a otro lugar, o incluso a un nido diferente. Observamos un comportamiento agresivo en un nido que pudo haber sido por la ocupación del mismo por dos grupos diferentes de aves.

Palabras clave Cigua Palmera, construcción de nidos, *Dulus dominicus*, Punta Cana, República Dominicana

Résumé Activités des Esclaves palmistes (*Dulus dominicus*) dans les nids en dehors de la saison de reproduction—L'Esclave palmiste (*Dulus dominicus*), endémique d'Hispaniola, est l'une des rares espèces de passereaux à construire de grands nids complexes contenant plusieurs cavités défendues par des couples différents. Bien que la saison de reproduction se situe entre mars et juin, les Esclaves palmistes occupent et entretiennent leurs nids toute l'année. Nous présentons ici des observations détaillées de nids d'Esclave palmiste et de comportements associés aux nids, réalisées lors de deux séjours en janvier dans l'est de la République dominicaine. Au cours de la journée, le nombre moyen de visites des Esclaves palmistes par nid variait entre 21 et 85 par heure. Les groupes étaient plus importants dans les plus grands nids. Dans un grand nid, les oiseaux apportaient une branche dans 5,2% des visites, alors que dans un nid plus petit, ils apportaient une branche dans 18,8% des visites. Les activités relatives aux branches pour chaque individu étaient plus fréquentes dans deux nids de petite taille que dans deux nids plus grands, ce qui suggère que dans les petits nids chaque individu s'investissait davantage dans l'augmentation du volume du nid et dans son entretien. Les branches étaient généralement incurvées et d'une longueur variant entre 1,0 cm et 58,9 cm (moyenne = 21,03, ET = 9,01). En vol, les oiseaux tenaient souvent les branches en déséquilibre (pas par le centre), puis inséraient l'extrémité la plus courte dans le nid. Lorsqu'une branche était déposée dans le nid, elle était ensuite fréquemment manipulée et parfois déplacée vers un

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autre endroit, ou même dans un autre nid. Nous avons observé un comportement agressif qui était peut-être dû à l'occupation du nid par deux groupes d'oiseaux différents.

Mots clés construction des nids, *Dulus dominicus*, Esclave palmiste, Punta Cana, République dominicaine

The Palmchat (*Dulus dominicus*) is a ubiquitous, monotypic species endemic to the island of Hispaniola (Wetmore and Swales 1931, Dzielski 2014). Together with the Monk Parakeet (*Myiopsitta monachus*) and two weaver species (the White-billed Buffalo-Weaver [*Bubalornis albirostris*] and the Sociable Weaver [*Philetaurus socius*]), the Palmchat is one of the few species that have large, complex nests containing multiple chambers that are defended by different pairs or individuals but built, at least in part, by all occupants collaboratively (Collias and Collias 1984). While the nest-related behavior of the two weavers (Collias and Collias 1977) and the parakeet (Eberhard 1998) has been studied in some detail, no detailed study on the nest-related behavior of the Palmchat has been published. Palmchat nests are very conspicuous and can be up to 2 m wide. They are usually built in royal palms (*Roystonea borinquena*) using intertwined twigs 25–75 cm long (Keys 1991, Keith et al. 2003). Palmchats appear to add and remove twigs throughout the year, although they breed only between March and June (Keith et al. 2003). The only detailed information on twig sizes is from Wetmore and Swales (1931) who reported that twigs ranged in length from 25 cm to 45 cm, and occasionally reached 75 cm. When no palms are available, Palmchats may build nests in any tree with a long trunk and high branches (Dod 1992). Nests are occasionally built on poles and in exceptional cases may be built on the ground; for example, Fernandez and Keith (2003) reported a nest on a rock in the ocean just off the edge of the shoreline.

Despite basic descriptive information on Palmchat nests, knowledge of the species' behavior is very limited (Temple 2019), with only a single detailed (but unpublished) behavioral study of color-banded birds during the breeding season (Keys 1991). No studies describe Palmchat nest-related behavior during the non-breeding season, although Mauersberger (1992) reported twig-carrying behavior during a visit in late February and early March, and again in late August. Because Keys' (1991) study is unpublished and often not concordant with earlier observations, we will summarize those of his observations that are relevant to this paper. He defined a group as all birds that were regularly observed in the core of a single nest. However, he did observe that while in most cases a single group of birds occupied a single nest, some groups occupied nests in two different trees, while in other trees a single nest was occupied by two different groups that interacted aggressively (Keys 1991). While Temple (2019) and Wetmore and Swales (1931) noted that a typical group consists of 4–10 pairs, Keys (1991) reported an average group size of only 2.79 pairs (range 1–5 pairs). He confirmed Wetmore and Swales's (1931) observation that Palmchats are gregarious at their nest and that they maintain their nest year-round.

During two visits to Punta Cana, Dominican Republic, in January 2015 and 2018, we studied Palmchat behavior around nests. In 2015, we observed general behavior and twig-carrying activity

of Palmchats at a series of nests, paying particular attention to birds moving twigs between nests. In 2018, we made detailed observations throughout the day at two larger and two smaller nests, and compared Palmchat activity among them. We hypothesized that more birds would be associated with the larger nests, and that the individuals at the smaller nests would bring more twigs in order to increase nest size while individuals at the larger nests would perform relatively more nest maintenance behavior. We also analyzed structural variation of 996 twigs from two partial nests.

Methods

Our study area was located in lowland coastal dry forests in Punta Cana, Dominican Republic, at the eastern end of Hispaniola. We conducted fieldwork during the month of January in two non-consecutive years, at two sites on the property of Punta Cana Resort & Club.

In 2015, we studied Palmchat activity on a plot approximately 5,000 m² on the Old Hotel grounds (18°30'49"N, 68°22'20"W) that was surrounded by hotel buildings and contained 30 royal palms, 14 of which held a Palmchat nest. We sketched a map of the study site and named each of the 14 nests (A–N). During six periods, between 0730 and 1100, two observers recorded Palmchat activity at each nest during a 10-min period. The sequence in which nests were observed was randomized. We recorded the number of birds bringing twigs to or removing twigs from nests, as well as the arrivals and departures of birds that were not carrying twigs. Results are reported as total activity, defined as the total number of birds arriving at or departing from a nest during a 10-min period. Twig-carrying activity represents the number of twigs brought to or removed from the nest per 10-min period. Although birds were not color-banded, we were able to follow some individuals as they moved between two nests carrying twigs. We measured the distances between nest trees to determine if exchanges between nests were related to distance between the trees.

In 2018, we selected two larger nests from a group of 30 nests on the Old Hotel grounds, and named them H1 and H2. We chose these two nests because they could easily be observed at eye level from the top of a nearby three-story building. Additionally, we selected two smaller nests (F1 and F2) from seven nests located at the edge of the Fundación Punta Cana's Fruit Garden (18°31'00"N, 68°22'35"W), along the road from Punta Cana airport to Fundación Punta Cana and about 650 m inland from the Old Hotel site. We conducted observations of individual nests at standardized time intervals between 15 and 18 January 2018. At nests H1 and F1, we recorded observations every minute during one complete day that we split into four 2-hr intervals: "Morning" (0630–0830), "Late Morning" (0930–1130), "Afternoon" (1330–1530), and "Evening" (1630–1830). Each 2-hr interval was further divided into four 25-min blocks separated

by 5-min rest periods. To increase sample size, we made similar observations at nests H2 and F2 during the “Afternoon” period only. We observed the nests at a distance of about 20 m. One person observed and reported the birds’ activities around the nests using binoculars, while another logged the observations minute-by-minute. A third person tallied when a Palmchat entered or left the nest (movements within the nest were not recorded). The vicinity of the nest was defined as the inside and outside of the nest structure, as well as the fronds of the palm tree in which the nest was constructed. Although the distance from which we observed the birds was only 20 m, we believe that the Palmchats rapidly became habituated to our presence. Palmchats give a distinct ground predator alarm call when people are walking around their nest tree (Dod 1992), and we noted that once our observers had settled in, the birds resumed their normal activities. We recorded the following twig-associated behaviors at nests: “bringing” (a bird flies into the tree or nest with a twig), “relocating” (a bird moves a twig to a different location in the same nest), “adjusting” (a bird manipulates a twig without removing it), and “removing” (a bird removes a twig and flies away with it). We also recorded aggressive interactions between two or more birds. Every 15 min we counted the total number of birds simultaneously visible around the nest and used the median number of all counts as a crude but repeatable measure of group size.

In 2018, we found two partial nests on the ground under two different palm trees. We carefully deconstructed the nests and counted, measured, and categorized the twigs in each nest. We measured twig length as the linear distance from endpoint to endpoint. All twigs were categorized into one of three groups: straight, curved, or hooked. Twigs in the latter category had a curvature that exceeded 270 degrees towards one end, forming a hook. Given that the length distribution was very asymmetric, we calculated mean, standard deviation, and skewness. We also compared frequencies using contingency tables.

Results

Nest Composition and Twig Characteristics

We recorded twig characteristics (length and shape) of 996 twigs from the two partial nests we found under palm trees in 2018. Linear twig length varied between 1.0 cm and 58.9 cm (mean = 21.03, SD = 9.01) and most twigs were curved, with only a small proportion that were straight (Table 1). The distribution

Table 1. Characteristics of twigs used in two partial Palmchat nests found in Punta Cana, Dominican Republic.

| | Nest 1 | Nest 2 | All |
|------------------------------|--------|--------|-------|
| <i>n</i> | 193 | 803 | 996 |
| Mean Length (cm) | 23.11 | 20.53 | 21.03 |
| Standard Deviation | 10.75 | 8.47 | 9.01 |
| Skewness | 0.69 | 0.77 | 0.82 |
| Minimum Straight Length (cm) | 4.4 | 1.0 | 1.0 |
| Maximum Straight Length (cm) | 58.9 | 54.4 | 58.9 |
| Proportion Straight | 0.08 | 0.02 | 0.03 |
| Proportion Curved | 0.87 | 0.95 | 0.92 |
| Proportion Hooked | 0.05 | 0.04 | 0.04 |

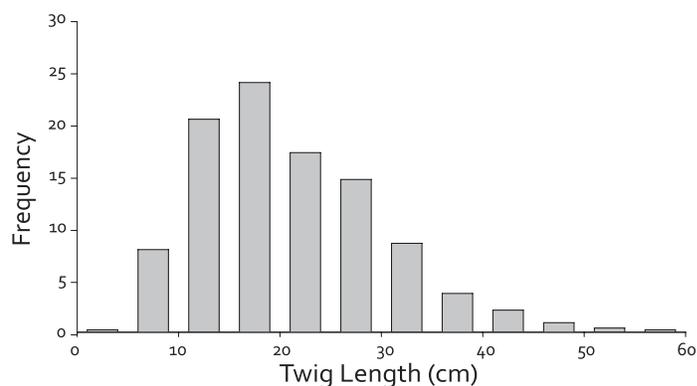


Fig. 1. Distribution of length (cm) of twigs ($n = 996$) in two Palmchat nests. Lengths were binned in 5-cm intervals.

of twig length was right-skewed, meaning nests contained a relatively small number of long twigs (Fig. 1). In addition to their curvature, a few twigs had special features like thorns and fungus growth. Notably, many twigs had forks in them. Several, in particular, had end growth that suggested them to be from bushes rather than trees.

Diurnal Activity at Colony Nests

At the four nests we observed in 2018, group sizes were markedly different: the median number of Palmchats simultaneously present at a nest was smaller at the smaller nests near Fundación Punta Cana (1 at F1 and 1.5 at F2) than at the larger Old Hotel nests (5 at H1 and 5.5 at H2). Activity was relatively constant throughout the day and was much higher at the larger Old Hotel nests than at the smaller Fundación nests (Fig. 2). At the second nest for each site (H2 and F2), we recorded activity only during the “Afternoon” period. As illustrated by Fig. 2, activity levels between the two nests at a single site were similar: more birds were active at the larger Old Hotel nests than at the smaller Fundación nests.

Activity at nests started before civil twilight (0645) and well before sunrise (0708), as we observed on two mornings when we arrived at the study site before Palmchats were active. On 13 January 2018, at the Old Hotel site, we first noted isolated calls at 0634; 12 min later, we heard calls from all around the Old Hotel site. At 0650, the first Palmchats flew out of their nests. Birds from a series of nests joined one another to form large and very noisy aggregations in a couple of low neighboring trees, with one tree holding over 100 individuals. We did not observe such behavior at other times of the day.

Activity Involving Twigs

Total activity varied considerably among the four nests we observed in 2018 (Fig. 2). We compared the proportions of different activities among times of day and between nests, calculated as a percentage of the total number of birds arriving at a nest during a given time period. Because the proportions of different twig-related activities did not vary significantly during the day for nests H1 and F1 (Table 2; contingency table analysis: H1, all four twig-related activities: $\chi^2 = 5.25$, $df = 9$, $p = 0.81$; F1 comparison excluding the very infrequent “removing” behavior: $\chi^2 = 8.22$,

df = 6, $p = 0.22$), we summed the number of observations during the entire day to compare the relative contribution of different twig-related activities between the nests. In the smaller F1 nest, twig-related activity (41.3%) was significantly more frequent than in the larger H1 nest (18.3%) ($\chi^2 = 33.55$, df = 1, $p < 0.0001$). This difference was caused by the much higher proportion of visits in which a Palmchat brought a twig (18.8% for F1 versus 5.2% for H1; $\chi^2 = 28.88$, df = 1, $p < 0.0001$) and the much higher proportion of birds seen to adjust a twig in the nest (18.1% for F1 versus 8.8% for H1; $\chi^2 = 10.19$, df = 1, $p = 0.001$). Neither of the other two twig-related activities differed significantly in their relative proportion between the two nests (both $p > 0.46$) (Table 2).

To determine if twig-related activity per bird varied with nest size, in 2018 we compared the number of twig-related activities among all four nests during the “Afternoon” period. We tested

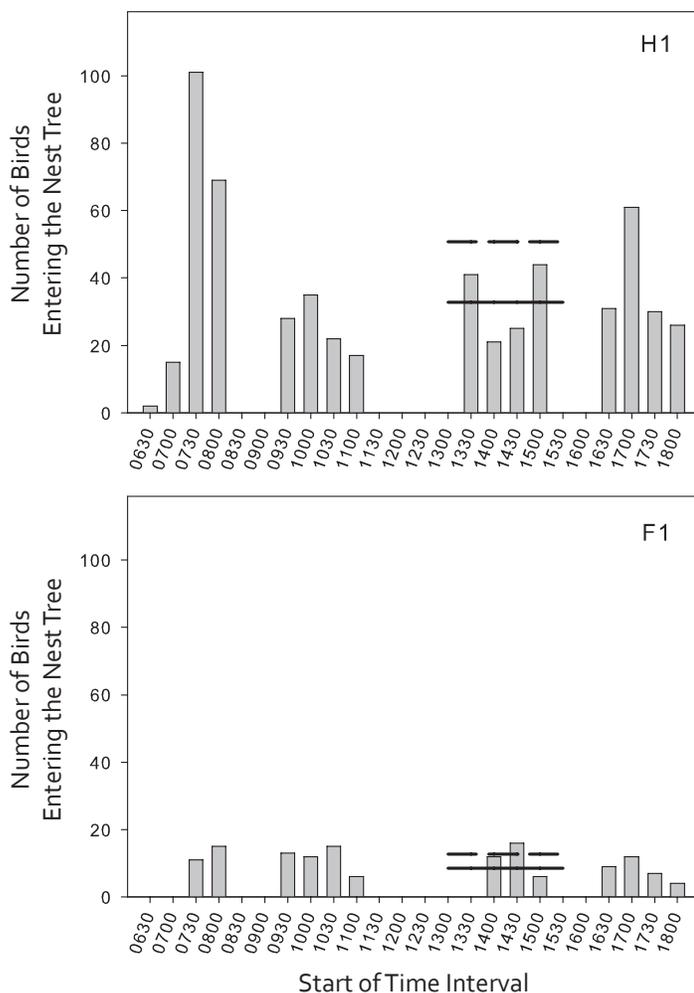


Fig. 2. Diurnal variation in number of birds entering the nest tree per 25-min period throughout the day for the larger nest H1 (top) and the smaller nest F1 (bottom) in 2018. In the “Afternoon” interval (1330–1530), the continuous lines represent the average values for nests H1 (top) and F1 (bottom); the dashed lines represent the average values for nests H2 (top) and F2 (bottom), which were observed only during that time interval. More visits occurred at larger nests (H1, H2) than at smaller nests (F1, F2), which reflects the larger group size.

the hypotheses that in the smaller nests each individual bird would bring twigs more often than in the larger nests, and that in the larger nests birds would invest more in nest maintenance. To estimate individual effort at a nest, we divided the total number of observations of each activity by the estimated group size. The data summarized in Fig. 3 emphasize the differences between the two larger and the two smaller nests—not in total number of visits to the nests (i.e., the height of the columns in Fig. 3), but in the relative frequency of different behaviors. Although our sample size was exceedingly small, it is interesting that the data suggest that in larger nests more birds arrive without participating in twig-related activities. Only in larger nests did we observe twigs being removed during the “Afternoon” observation session. As hypothesized, more individuals arrived at the nest with a twig (“bringing”) at the two smaller nests compared to the larger nests, but individuals in larger nests did not spend more time on maintenance activities (Fig. 3). Throughout the day the average number of Palmchat visits to a nest varied between 21 and 85 per hr.

Although we did not know the origin of most twigs, we observed in both 2015 and 2018 that some were picked up from the ground and others were broken off from bushes, as was also reported by Dod (1992). Palmchats often held twigs lopsided in their bills during flight, grasping the twig not at the middle of its length but off-center, such that there was a short end and a long end. Upon arriving at the nest, the bird would insert the twig short-end first by tilting its head and pushing the twig into the nest, then wiggling the twig back and forth, sometimes for several minutes. The short end was often the straighter, less forked part of the twig. If a bird flew to a nest holding a twig approximately in the middle, it would often shift to a lopsided grip before inserting the twig into the nest. Once a twig had been placed into the nest it was frequently manipulated further, apparently to adjust its location in the nest or even to move it to a different location in the nest (see Table 2). On one occasion we observed two birds tugging on a twig in opposite directions. In regard to twig removal, it was surprising to see that when a bird removed a twig, other Palmchats seemed not to intervene, although more observations are needed to confirm this. Some twigs received considerably more attention than others; at nest H1 in 2018, we observed one particular flowering branch being moved and adjusted several times over the course of an afternoon.

Twig Flow

Twig flow varied greatly among the 14 nests we observed in 2015, both in regard to the total number of twigs brought in or removed per 10 min (minimum = 0.33, maximum = 4.50), and to the net twig flow (minimum = -1.33, maximum = 2.50). While on average more twigs were brought to the nests than were removed, in some nests more twigs were removed than added (Table 3). Twig movements were not usually to the closest tree; although most nests at the Old Hotel site had another nest tree within 10 m, most twig movements were between trees further than 15 m apart (Fig. 4). Twig activity represented on average 18.3% (SE \pm 1.6) of total activity and was higher in nests in which overall activity was higher. Our 2015 data thus showed that (1) the activity at some nests was much higher than at other nests; (2) the net twig flow at some nests was positive, while at

Table 2. Frequency of twig-related activity in 2-hr periods throughout the day in two Palmchat nests (H1 and F1) in 2018. The four twig-associated behaviors are described in the Methods; “% Twig Activity” is calculated as a percentage of total activity (Birds Arriving) in each time period.

| | Birds Arriving | Bringing | Adjusting | Relocating | Removing | Sum Twig Behaviors | % Twig Activity |
|-----------------------|----------------|-------------|-------------|------------|------------|--------------------|-----------------|
| <i>H1</i> | | | | | | | |
| Early Morning | 187 | 3 | 7 | 3 | 1 | 14 | 7.5 |
| Late Morning | 113 | 8 | 10 | 2 | 3 | 23 | 20.4 |
| Afternoon | 131 | 13 | 16 | 5 | 2 | 36 | 27.5 |
| Evening | 148 | 6 | 18 | 6 | 3 | 33 | 22.3 |
| Daily Sum | 579 | 30 | 51 | 16 | 9 | 106 | 18.3 |
| % of Daily Sum | | 5.2 | 8.8 | 2.8 | 1.6 | | |
| <i>F1</i> | | | | | | | |
| Early Morning | 26 | 2 | 1 | 0 | 1 | 4 | 15.4 |
| Late Morning | 46 | 6 | 13 | 4 | 0 | 23 | 50.0 |
| Afternoon | 34 | 10 | 6 | 1 | 0 | 17 | 50.0 |
| Evening | 32 | 8 | 5 | 0 | 0 | 13 | 40.6 |
| Daily Sum | 138 | 26 | 25 | 5 | 1 | 57 | 41.3 |
| % of Daily Sum | | 18.8 | 18.1 | 3.6 | 0.7 | | |

other nests it was negative; and (3) birds did not normally carry twigs to the closest neighboring nest, but between nests that were sometimes quite far apart.

Social Interactions

Our detailed observations of the four nests in 2018 showed that birds frequently preened, and in the case of nest H1, they also interacted aggressively. We observed a total of 44 such

aggressive interactions in H1 throughout the day; these interactions included one-on-one, two-on-one, and two-on-two skirmishes. Fights typically involved two individuals locking on to each other with beaks or feet and subsequently falling or rolling off the tree and spiraling towards the ground. Just before or upon impact they would split apart and fly away.

At nest H1, we also observed attempted copulation behavior on 17 January 2018. At 0808, one bird (presumably male) attempted to mount another bird (presumably female) and stretched to try to get his cloacal region underneath the female's tail. The female, however, kept her tail angled down; we did not observe any copulation. The male then grabbed the female's back and they rolled over on the palm frond, with the female facing up and the male trying to stretch his cloaca around and under the female's tail. They then rolled off the frond and fell, breaking apart before hitting the ground and flying away in separate directions. At 1344, we saw one bird pecking at another bird's tail and chasing it around, and at 1423 one bird tried to jump onto another bird in another attempt at copulation.

Discussion

Our observations confirm that even outside the breeding season, the nest remains the center of activity for Palmchats (Wetmore and Swales 1931, Keys 1991, Dod 1992). Even several months before they start breeding, Palmchats spend the night in the nest. They emerge well before sunrise, and return to the nest throughout the day. Larger nests are occupied by more individuals and are visited more frequently during the day, although the average visit rate per individual does not seem to vary with group size. On average, Palmchats bring a twig to the nest in 5.2–18.8% of the visits, depending on nest size. Individuals in small groups that occupy smaller nests invest more in twig-related activities; specifically, they are more likely to bring a twig during visits, and perform more twig adjustments

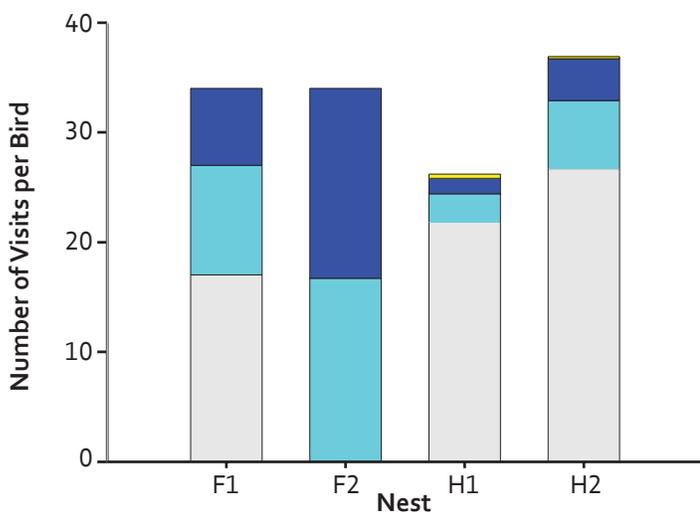


Fig. 3. Number of visits per bird during the 100 min of the “Afternoon” period for nests F1, F2, H1, and H2 in 2018. From bottom to top: visits without a twig (light gray), visits with a twig (light blue), maintenance (twig adjustment and relocation) activity (dark blue), and twig removed (yellow). Note that in nest F2 no birds arrived without a twig, and that in nests F1 and F2 no twigs were removed.

Table 3. Number of birds arriving at a nest carrying a twig (Twig Added) or flying away with a twig taken from a nest (Twig Removed) during a 10-min observation period. The values reported are the average from observations made during six 10-min periods on different days in 2015. The total twig-related activity is the sum of “Twig Added” and “Twig Removed” and the net difference is the algebraic difference of the two.

| Nest | Twig Added | Twig Removed | Net | Total |
|-------------|-------------|--------------|-------------|-------------|
| A | 3.50 | 1.00 | 2.50 | 4.50 |
| B | 0.33 | 1.67 | -1.33 | 2.00 |
| C | 0.17 | 0.17 | 0.00 | 0.33 |
| D | 1.00 | 0.17 | 0.83 | 1.17 |
| E | 0.33 | 0.17 | 0.17 | 0.50 |
| F | 0.50 | 1.00 | -0.50 | 1.50 |
| G | 1.50 | 0.17 | 1.33 | 1.67 |
| H | 1.00 | 0.00 | 1.00 | 1.00 |
| I | 2.00 | 0.00 | 2.00 | 2.00 |
| J | 1.17 | 0.17 | 1.00 | 1.33 |
| K | 0.50 | 0.00 | 0.50 | 0.50 |
| L | 1.50 | 0.00 | 1.50 | 1.50 |
| M | 1.00 | 0.33 | 0.67 | 1.33 |
| N | 0.50 | 0.83 | -0.33 | 1.33 |
| Mean | 1.07 | 0.40 | 0.67 | 1.48 |

and twig relocations within the nest. Palmchats sometimes pick twigs up from the ground, but also actively break twigs from bushes. A surprising number of twigs are removed from existing nests and transported to a distant nest; this suggests these twigs are “stolen” by individual Palmchats from a different social group.

The nest structure is remarkable. Nests are built entirely of twigs, yet the bulky nest fragments we found on the ground remained intact when we moved them. The placement of twigs clearly ensures structural integrity, which may explain why Palmchats readjust twigs so often. Our data also suggest that Palmchats may prefer curved twigs for nest construction, and showed that twig length varied 1.0–58.9 cm ($n = 996$ twigs). Note that all other publications that report twig sizes are based on Wetmore and Swales (1931), who reported 25 cm as the minimum twig length; in the nests we deconstructed, however, 38% of the twigs measured less than 20 cm long. The maximum length we recorded was 58.9 cm. Since we report straight-line distances between the two ends of each twig, including curved twigs, and since Wetmore and Swales (1931) do not report how they measured twig length, this could be consistent with their statement that birds occasionally bring twigs that are 60–75 cm long.

Although we frequently observed aggressive interactions at one of the nests in our study, the lack of aggression at the other three nests suggests that this nest may have been occupied by two different groups, as was observed by Keys (1991) during the breeding season. Future behavioral studies would benefit from the use of color bands to determine the identity of individual Palmchats that remove twigs from one nest and carry them to a different one.

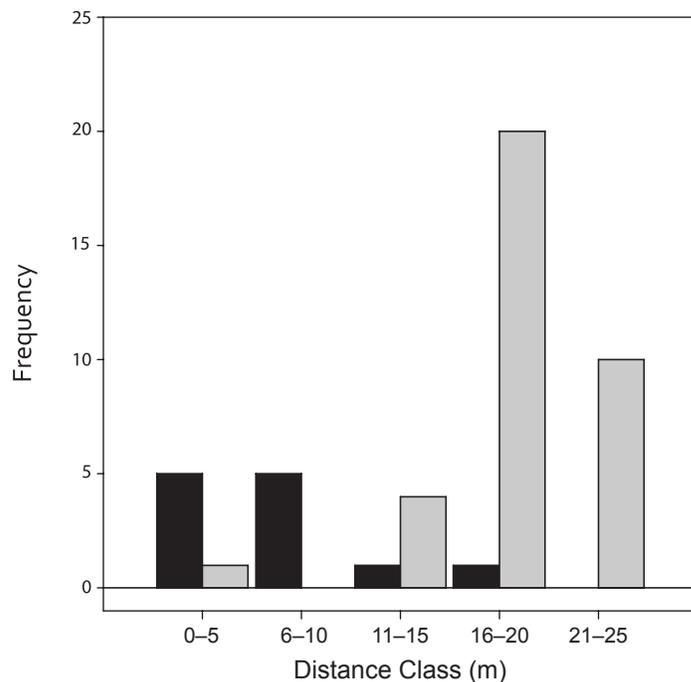


Fig. 4. Distribution of distance to the closest nest (black) and distance to the nest to which twigs were taken (gray), based on observations of nests A–N in 2015. Palmchats did not normally transport twigs to the closest nest.

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