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NEST BUILDING AND NESTING BEHAVIOR OF THE BROWN CACHOLOTE

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ABSTRACT.—We studied nesting behavior of the Brown Cacholote (*Pseudoseisura lophotes*) in Córdoba, Argentina from April 1989 to March 1993. Brown Cacholotes build many elaborate stick nests throughout the year and use each of them during the breeding period or for a short time in the non-breeding period. Nest building requires 15 to 37 days. Nests were usually built with thorny twigs, but the nature of the materials depends on availability. Usually each pair had several nests or part of them in their territory (range = 1–10). Nest building requires much of the birds' time and energy, but Brown Cacholotes generally use the material of old nests to minimize energy expenditure in nest construction. Both sexes shared all nesting activities. The birds copulate inside the nest, which is apparently unknown among birds. Egg laying occurred from last September to late February. Mean clutch size was 2.6 eggs (range = 2–4). The incubation period lasted 18–20 days and the nestling period 18–23 days. Nesting success was 59.3%, and an average of 1.5 nestlings were reared per clutch. Parental breeding experience, rather than age, would be more important influence on clutch-size and nesting success. Juveniles remained in the parental territories for 4–13 months. They contributed to nest building and defense of their territory, but their help was minimal. *Received 7 Dec. 1992, accepted 1 Sept. 1993.*

Although nest has been defined as a structure that aids the development of the eggs and the survival of young (Collias 1964), some birds build similar or different structures for use as dormitories throughout the year and have a close relation with them (Skutch 1961, Collias 1964, Welty 1979). This implies that nest-building behavior and nest structures are potentially under intense selective pressure. Because of this, detailed study of nest-building behavior can provide interesting clues to the evolutionary history and ecology of a species (Collias 1986).

The Brown Cacholote (*Pseudoseisura lophotes*) is a large bird (25 cm), with large feet, a strong bill, and a conspicuous crest. Its food consists mainly of insects and includes also seeds and eggs of various birds. This species inhabits savannas and woodlands in the Chaco region of northern and central Argentina, western Paraguay, and southern Bolivia (Short 1975). Its habitat also includes urban parks, squares, and gardens. It is a common bird with a conspicuous nest, but little has been published regarding its nest (see Masramón 1971, Vaurie 1980, Narosky et al. 1983, de la Peña 1987) and nothing about nest building and breeding behavior. We give here detailed information about nest characteristics, nest materials, nest sites, and construction. We report aspects of the breeding

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FIG. 1. Geographical location of the study areas: (1) Monte Cristo, (2) Córdoba Zoological Garden, (3) Santa Isabel.

behavior such as pair bonding, courtship, copulation, clutch size, incubation, development of nestlings, and nesting success.

STUDY AREA AND METHODS

We studied Brown Cacholotes for four years, from April 1989 to March 1993, at three sites in Córdoba province, Argentina. The main study site was located near the town of Monte Cristo (31°23'S, 63°53'W). This area (800 ha) is composed of cultivated land interspersed with remnant patches of xerophytic woodlands. Dominant tree species include *Prosopis nigra, Prosopis alba, Celtis spinosa, Geoffroea decorticans, Acacia* spp., *Capparis atamisquea,* etc. Additional observations were made at the Córdoba Zoological Garden (1 ha), where the Centro de Zoología Aplicada is located, and at sites (Santa Isabel, 25 ha) within Córdoba city (Fig. 1).

We studied 368 nests, 67 of which were breeding nests and 210 roosting nests, and there were 91 nests at the beginning of this study.

We used mist nets and a funnel trap (Martella et al. 1987) to catch the birds. We marked 211 individuals with leg bands of colored plastic and observed marked birds building 46 nests. We distinguished the sexes of individuals by observing copulation and egg-laying of

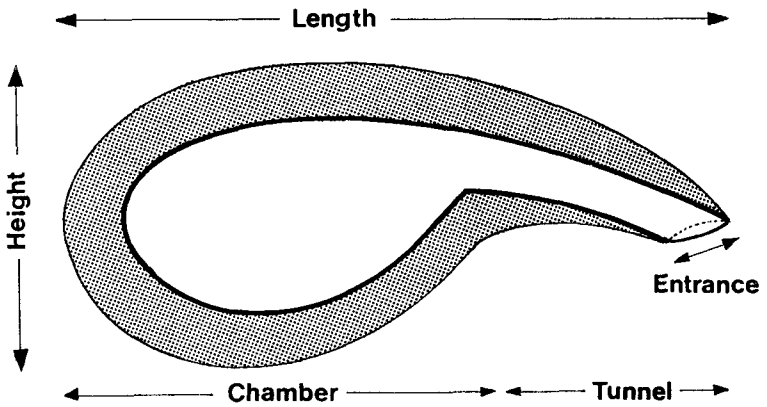

FIG. 2. Diagram of a longitudinal section through a Brown Cacholote's nest showing its components.

two and six banded birds, respectively. All nests built at 6 m or less above the ground were examined. To look into the nest, we opened a round hole in the brood chamber. After each examination, the hole was closed with oversized pieces of sponge following the procedure of Fraga (1980) and Mason (1985). Eggs were marked with waterproof ink, and the nestlings were marked with small, temporary rings from hatching until they were 10 days old. We visited the main study site every seven days during the non-breeding period and daily in the breeding period. We watched building daily in the Córdoba Zoological garden.

RESULTS

Nest sites.—Brown Cacholotes are strictly territorial. Usually, the territory of a cacholote pair contained several nests or remains of them ($\bar{x}$ = 4.4 ± [SD] 2.1 nests, range = 1–10). Nests were most frequently built in isolated trees, in trees in small clumps, or in those at the edges of cleared woodlands. Nests rarely were placed in dense woods (N = 7, 1.9% of total observed nests). The average height of the nests was 3.1 m above the ground (range = 1.60–17 m). In the study area, most nests were located among the lower branches of mesquites (*Prosopis* spp.), with twigs and branches of the trees incorporated in them. At the Córdoba Zoological Garden, the birds used various species of cultivated trees. The study areas contained many suitable nesting sites in trees. Nevertheless, in 92 cases (25%) cacholotes built a new structure upon an old nest.

Nest shape and size.—Brown Cacholotes build bulky nests consisting of two parts, a large oval chamber and a slightly down-curved entrance tunnel (Fig. 2). The average tunnel length is 30.1 cm ± 3.2 (range = 7–63) and its average inner diameter is 9.2 cm ± 1.1 (range = 9–10). At its inner end, it opens into a large chamber (inner diameter $\bar{x}$ = 22 cm ± 1.5, range = 19–24). The whole nest averages 90 cm in length (range =

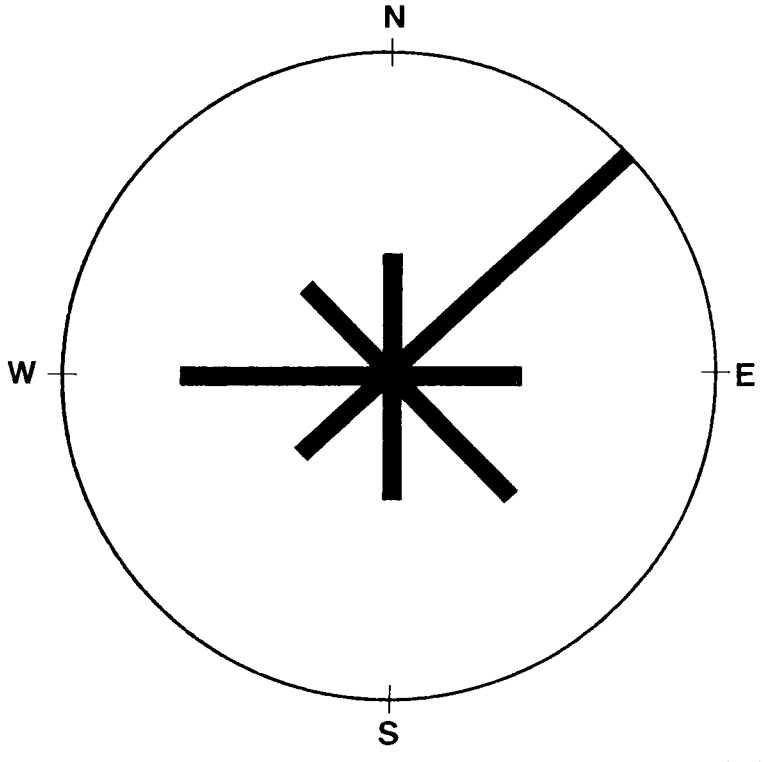

FIG. 3. Nest orientation of Brown Cacholote in trees (N = 120) Length of bars indicates number of nests that were found with an orientation toward each cardinal point: N (11), NE (29), E (12), SE (16), S (12), SW (11), W (18), NW (11).

60–125) and 43.3 cm (range = 32–55) in height. Nests weighed 2–5 kg. We counted 962 twigs in one small nest (2.5 kg) and estimate that large nests may contain as many as 2000 items. In general, the breeding nests ($\bar{x}$ = 100 cm ± 13.44) were larger than the roosting nests ($\bar{x}$ = 88 cm ± 10) (F = 46.05, df = 1,221, $P < 0.001$), and contained more twigs.

Cacholotes usually do not line the bottom of their nest chamber, and the eggs are laid directly on the twigs. Of 368 nests, only 11 (2.9%) were lined with a few fine sticks. The birds cut the thorns from sticks inside the chamber and tunnel. Although most nests were very compact, in some the cacholotes and their eggs could be seen through the wall.

The nests are oriented most commonly with their long axis facing NE (24%)(Chi square test χ^2 = 18.133, df = 6, $P < 0.01$)(Fig. 3).

Nest materials.—Most nests were composed of thorny twigs (twig length $\bar{x}$ = 15.6 cm ± 3.5, range = 9–75; twig diameter $\bar{x}$ = 5 mm ± 1.7, range

= 3–10). Where thorny twigs were unavailable, as in gardens and parks, the nest was built with thornless sticks. The kind of sticks in a nest usually varied. Those in the chamber were smaller and less often thorny, while the tunnel was made of larger, thornier pieces. The birds sometimes added other materials to their nests, including bits of wire (one nest contained 40% of them), small pieces of paper, plastic materials, and scraps of nylon. Nest material was collected, within 200 m of the nest, from trees, other nests, or the ground. After completion, breeding nests were often "adorned" with some long quill feathers of other birds, usually from Guira Cuckoos (*Guira guira*) and Chimango Caracaras (*Milvago chimango*).

Nest building.—Cacholotes require 15–37 days ($\bar{x} = 23 \pm 5.6$) to build their nests, but they continue to add sticks and repair them as long as they are in use.

Nests are built in the following sequence. First, both members of the pair carry sticks and twigs to a chosen branch until they form a small platform (Fig. 4A, B). This often takes a long time because the first sticks usually fall off the branch and wind often destroys the rudimentary structure. As soon as the platform is adequate, the birds begin to build up the nest wall to form a cup about 20 cm deep (Fig. 4C). Then, they begin the roof. When the chamber is partly covered, they start the entrance tunnel (Fig. 4D). When the tunnel is partly completed, they finish the chamber roof (Fig. 4E), and then they finish the tunnel (Fig. 4F).

Nests are built from the beginning, but often upon an old nest as foundation. Old nests are never reused for breeding or roosting. Birds build a roosting nest after they rear their young. In several cases, during the non-reproductive period, a pair finished building one nest and immediately began another. In two cases, birds destroyed a partly completed nest, using its materials to build another. Commonly, materials from old nests are used in new ones, especially those intended for breeding. Although some of the old nests are wholly demolished, a lot of them survive the years intact or partly demolished.

The birds spend much more time building a nest when they collect materials from trees or from the ground than from other nests ($F = 8.64$, df = 1,10, $P < 0.001$).

A Brown Cacholote pair sleeps in their nests throughout the year, but only for a short period in any one of them; ($\bar{x} = 42$, range = 5–55 days). During the pre-laying period, both members of the pair sleep together in the breeding nest. During egg-laying the female passes the night with the eggs, apparently incubating. The male usually roosts near the nest amid the foliage or in the penultimate nest, occasionally in the breeding nest. Juveniles remain in the parental territory, at first roosting in the nest where they were reared, later in their parent's new dormitory nest.

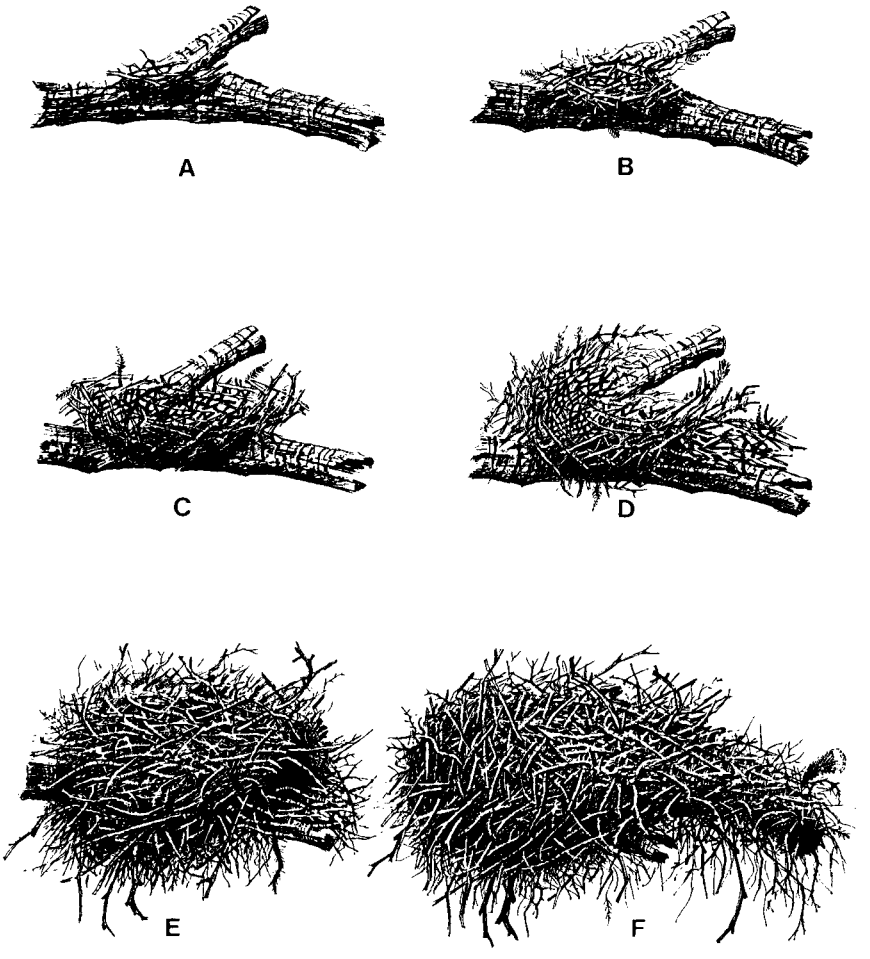

FIG. 4. Different stages in the construction of a Brown Cacholote's nest.

Cacholotes built 277 new nests over the four-year study period. A single pair built 17 nests in 36 months at the Córdoba Zoological Garden. The mean interval between the building of two nests was 62 days (range = 0–184). The birds built most actively just before the breeding season (Fig. 5). Morning and afternoon activity duration averaged 46% and 44.8% of the time (N = 86 h), respectively, and did not differ through the nest building period (ANOVA; $P > 0.05$). They interrupted their work at midday for approximately two hours. They relaxed their efforts by late afternoon, and stopped before sunset. Nest maintenance continued during

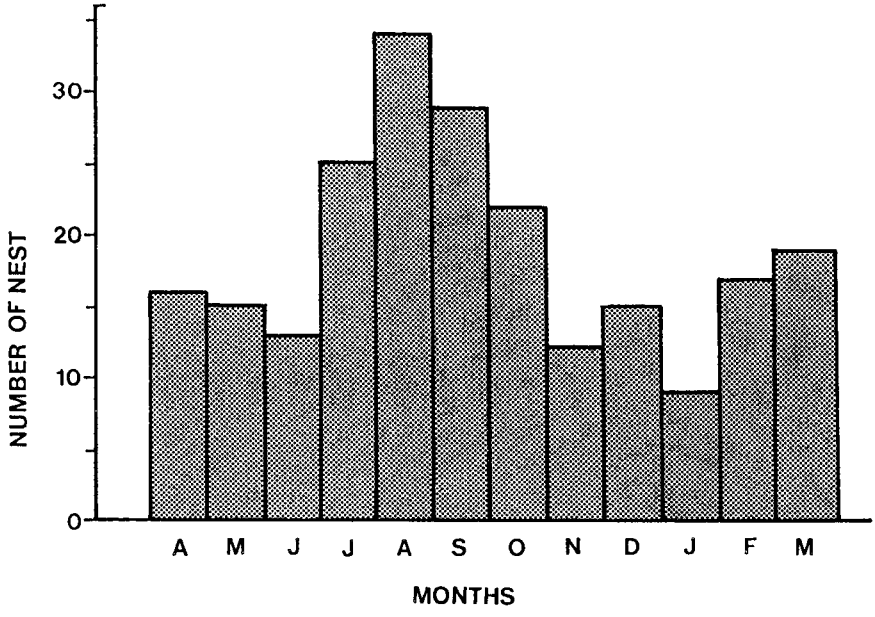

FIG. 5. Monthly frequencies of nest building by Brown Cacholotes.

the laying and the nestling period, especially the first days when the young were small.

During a 420-min period at one nest in the non-breeding season, a pair brought material 51 times; the male 26 times (51%), the female 22 (43%), while a juvenile collected three twigs (6%). During a 1920-min observation at another nest in the breeding season, the male brought 62 twigs and the female 24. At a different nest, a juvenile carried three twigs (4% of the total number brought to this nest, during 1200 min of observation).

Pair bond.—Brown Cacholotes are monogamous; they remain paired throughout the year and for consecutive breeding seasons. Four pairs were mated throughout the four study years, eight pairs for three years, and 13 pairs for two years. When a bird died, the survivor of the pair promptly found a new partner. We observed two banded birds who changed mates during the breeding season. One female who lost her mate in the second week of September had acquired another (banded) by the first week of October. In a second case, a male who lost his mate during the first days of December had mated with an unbanded female by the second week of the same month.

Courtship and copulation.—Courtship displays are given almost exclusively by the male cacholote, near and inside the nest, as we could see in

some nests with thinner walls. The display begins when both birds are near the nest. After they repeatedly sing in duet, the male, with his body nearly horizontal, bristles his feathers, spreads and elevates his tail, droops his wings until they nearly touch the floor, depresses his bill, and utters a series of short notes at a rate of about two per second. He enters the nest. The watching female enters the tunnel where she remains for a few seconds while the male, maintaining the same posture, rotates his body two or three times in the chamber, stopping with his bill toward her. Then the female joins him in the nest chamber and crouches low for about 15 sec. With feathers still erect, the male advances towards her. He circles around her and mounts her, depressing his tail while she elevates hers. After copulation, the birds sing a duet inside their nest. We observed this behavior four times in the pre-laying and the egg-laying periods. Similar displays were observed when the pair started to build a breeding nest, but they did not copulate on these occasions.

Egg-laying.—Mean clutch initiation date was 19 November (range = 25 Sept.–14 Jan.). Throughout the study, seven replacement clutches were laid from mid-December to late January. In every case, the nests were preyed upon, and the cacholotes built new nests. Most of the eggs were deposited with an interval of two days (N = 177, range = 1–3). Two-day laying intervals are usual in furnariids (Skutch 1969, Fraga 1980).

Clutch size.—Brown Cacholotes lay two or three eggs, rarely four. The mean clutch size was 2.6 eggs. Older pairs had larger clutches ($\bar{x}$ = 3.2 eggs, N = 34, range = 2–4) than younger pairs ($\bar{x}$ = 2.2, N = 16, range = 2–3)(Mann-Whitney test, $Z = 4.55$, $P = 0.001$). There was no significant difference in clutch-size among the first-time breeders of different age.

Egg measurements.—The average length and diameter of 135 eggs was 27.1 ± 0.4 mm (range = 25.5–29.1) and 20.8 ± 0.5 mm (19.1–21.5). Differences in egg size between females with previous breeding experience and first-time breeders were not significant (Mann-Whitney test; $Z = 1.08$, $P = 0.27$). The mean weight was 7.6 ± 0.5 g (6.8–8.5). Frequently, the eggs were stained with blood.

Incubation.—The incubation period was 18 to 20 days ($\bar{x}$ = 18.6). Both parents incubated in daytime, but only the female at night. Sessions on the eggs were 5–35 min ($\bar{x}$ = 28), and the longest period of neglect was 30 min. The sexes incubated with equal constancy. The male usually entered the nest soon after the female left and remained until she returned.

Second broods.—Second broods were found in only four of 67 nests examined (5.9%). In all cases the pairs built a new nest. The intervals between the departure of the last young of the first brood and the laying of the first egg of the second set were 106, 98, 89, and 74 days, respectively.

Nestling period.—Male and female cacholotes spent equal time and

energy during the nestling period and made similar contributions to feeding the nestlings. During the first days, females devoted 45.8% (5 trips/h) and males 46.0% (4 trips/h) of the hours of observation (N = 19 h) to feeding them. During the second week, the females and males spent 65.8 and 63.3%, respectively (N = 17 h), bringing 9 and 12.5 items/h. During the last week of nestling life, the pair increased the time of feeding to 72 and 73%, respectively, and brought 18 and 19.6 items/h (N = 21 h). After the young fledged, the parents continued to feed them freely for about 20 more days, then gradually reduced the number of meals. Although young cacholotes continued to beg their parents for food for 36–40 days after leaving the nest, they were ignored. Both parents brooded the nestlings in daytime but usually only the female at night. The time spent in brooding gradually decreases through the nestling period. Both sexes carried away the egg shells and fecal sacs.

Development of nestlings.—The mean mass of the newly-hatched cacholotes was 5.7 g (SD = 1.2 g, N = 98). The mouth lining is grayish-yellow and the flanges are pale yellow. They have gray plumule on the head, wings, and dorsal flanks. The nestlings' eyes begin to open at days 4–5, but until day 10 they are closed most of the time. Feather tracts become visible as darker lines on the skin at days 3–4. Pinfeathers visibly project from the skin at days 5–6. The first feather tips are seen on day 7 in the pinfeathers of the dorsal tracts. By day 10–11, most of the pinfeathers are visible except those of the capital tract. At this time, nestlings have conspicuous yellow oral flanges, pale gray feet, and grayish bills. The eyes are bluish-gray or greenish-gray. Wing flapping was observed at day 9. Nestlings are almost completely feathered at day 17. When the young fledge, they are well feathered, but the tail and crest are still quite short. The growth of the nestling shows a typical sigmoidal curve (Fig. 6). At first slow, growth accelerates until the young weigh about 80 g. Young cacholotes are about as heavy as adults when they leave the nest. The mean nestling period is 19 ± 2.3 days (range = 18–23 days).

Departure and dispersion of the juveniles.—The young remained in the parental territory five to 13 months. Parents were more intolerant of young males than of young females; consequently, the latter remained longer with their parents ($\bar{x}$ = 245.3 days ± 35, N = 14, range = 198–414) than the males ($\bar{x}$ = 65 days ± 27, N = 16, range = 60–256) (Mann-Whitney test; $Z = 2.45$, $P = 0.05$). They often defended the parental nests. When the parents were present, the juveniles were not allowed to help with nest construction and were often chased from the nest. Nestlings about to leave the nest frequently answer parental calls and may even attempt to duet with a parent or siblings.

After departure, 42 (40%) of the fledglings occupied new areas near the

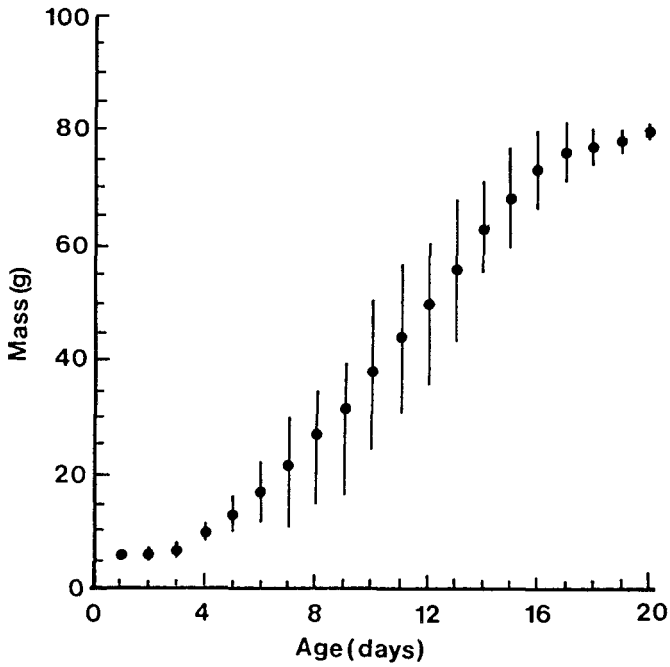

FIG. 6. Masses of nestling Brown Cacholotes.

parental territories when they built their first nests after they mated. The average distance between a young birds' nest and an active parent's nest was 120 m (range 98–1300). The other fledglings disappeared from the study area. Of the 105 juveniles fledged during the four-year study period, 42 (40%) mated and reared fledglings. Nine (21.4%) were one-year-old birds, 22 (52.3%) two years old, and 11 (26.1%) three years old.

Nesting success.—Of 177 eggs laid in 67 clutches, 144 eggs hatched (81.3%). Losses were attributed to failure to hatch (N = 10, 30.3%) and predation by white-eared opossums (*Didelphis albiventris*)(N = 8, 24.2%), rats (*Rattus rattus*) (N = 7, 21.2%), and various birds (N = 6, 18.1%). The losses due to manipulation by us were minimal (N = 2, 6.1%). Of the 144 nestlings, 105 fledged (fledgling success: 72.9%). Most of the losses were death in the nest (N = 12, 30.7%) and predation (N = 24, 61.5%). On four occasions, nests were attacked and occupied by white-eared opossums. Twice nests were preyed upon by rats. Both predators were common in the study area and were observed inside the nest chamber.

Nesting success of older experienced pairs was significantly higher than that of first-time breeders (Mann-Whitney test; $Z = 3.68$, $P = 0.002$). Juveniles with previous breeding experience have significantly higher nest-

ing success than those of the same age without experience (Mann-Whitney test; $Z = 5.32$, $P = 0.003$). The over-all nesting success was 59.3%. An average of 1.5 (range = 1–3) fledglings were reared per clutch.

Secondary tenants.—Paper wasps occupied 56 of the 368 nests (15.2%) in the autumn, 42 (75%) of these by *Polybia occidentalis* and 14 (25%) by *Polistes canadensis,* (Vespidae, Hymenoptera). Wasps built honeycombs in the nest chamber, in the nest tunnel, or under the nest. Eighty percent of all nests occupied by *Polybia occidentalis* were active, whereas only 15% of all nests occupied by *P. canadensis* were active. Occupation of an active nest by any species of paper wasp caused cacholotes to abandon it. Ants of the genus *Camponotus* occupied eight (2.1%) abandoned nests. Large numbers of other arthropods (Arachnidae, Reduviidae, Cimicidae, Chrysomelidae, Coccinelidae), use Brown Cacholote nests, mainly to hibernate.

On nine occasions (2.4%) Monk Parakeets (*Myiopsitta monachus*) chose abandoned or occupied nests as winter roosts or for breeding in the spring. In every case, the parakeets remodeled the nest, extending the entrance tunnel with thorny twigs. Once (0.2%) a Tropical Screech-Owl (*Otus choliba*) slept in an abandoned nest in December. Bay-winged Cowbirds (*Molothrus badius*) used 14 (3.8%) abandoned and two active nests (0.5%) for breeding in January and February. Cacholotes relinquished both nests and started new ones. A cacholote nest with one egg was parasitized by a Shiny Cowbird (*Molothrus bonariensis*) on 19 January 1991. By the next day, the cowbird's egg had disappeared and a second egg of the cacholote had been laid. House Sparrows (*Passer domesticus*) bred in four (1%) abandoned cacholote nests. Frequently they pilfer feathers and shreds of nylon from active and abandoned nests. Once Cattle Tyrants (*Machetornis rixosus*) and twice White Monjitas (*Xolmis irupero*) and Saffron Finches (*Sicalis flaveola*) selected deserted cacholotes' nests for breeding.

Mammals also occupy nests of Brown Cacholotes. During the winter, we found two rats (*Rattus* sp.) inside a newly built nest. The birds abandoned this nest and started to build a new one. Once we found a mouse (Cricetidae) with three young in a nest with two cacholote's eggs. The eggs disappeared and the birds abandoned the nest.

White-eared opossums occupied five deserted cacholotes' nests and one active nest. Probably the birds were preyed upon by the opossum because they disappeared from the area.

DISCUSSION

The Brown Cacholote is monomorphic, and male and female live together in the same territory throughout the year. Both members of a pair

build and repair nests. The young remain with their parents until the next breeding season, so that the birds are found in pairs but more frequently in families of four or five individuals. Similar results are also observed in the White-throated Cacholote (*Pseudoseisura gutturalis*) (Hudson 1920).

Brown Cacholotes build several nests throughout the year and use them for breeding and sleeping. According to Skutch's (1961) dormitory classification, the Brown Cacholote falls into category 2 d: nests are occupied by parents and self-supporting young throughout the year. Also in this category is the Firewood-gatherer (*Anumbius annumbi*), a sympatric species, which likewise builds elaborate nests of thorny twigs.

Increasingly, evidence indicates that heavy infestation of nests by ectoparasites affects the survival and fecundity of breeding adult birds (Clark and Mason 1988) and causes the death of nestlings (Ricklefs 1969). The use of a nest for only one breeding season (Clark and Mason 1988), and for a short period during the nonreproductive season reduces the time during which ectoparasites multiply in it. These strategies are used by cacholotes and could diminish infestation by ectoparasites. Some authors suggest that some birds use green material with secondary compounds in their nests to repel or kill avian ectoparasites (Wimberger 1984; Clark and Mason 1985, 1988; Bucher 1988). The Brown Cacholote does not line its nests with green material, but it uses the nest for a short time. It differs from the Firewood-gatherer, which lines its nests with green plants but usually occupies it for two breeding seasons (Nores and Nores unpubl. data).

The long entrance tunnel and thorny materials like those found in the Brown Cacholote's nests have been considered as probable elements to deter predators, especially snakes and mammals (Collias 1964, 1986). The nest location among the lower branches of mesquite trees could reduce its detection by avian predators. The nest interstices permit birds inside to see through the walls and fly away when an intruder approaches (Skutch 1969, Thomas 1983). All nests in this study contained only one entrance tunnel, but de la Peña (1987) mentioned a nest with two.

The different materials used in nest construction reflect differences in their availability. Although cacholotes usually build with thorny sticks, they can complete a nest with thornless twigs, sometimes with the addition of other materials such as bits of wire and plastic materials.

Some birds use methods that reduce the energetic cost of nest construction (Mountjoy and Robertson 1988). Brown Cacholotes take material from their old nests to build new ones. Those close to the new site are convenient sources. This procedure reduces the large expenditure of time and energy required to procure nest materials, especially for breeding nests.

Other animals frequently occupy cacholote nests as safe sites for roosting, hibernating, or breeding. Thus the nests play an important role in the Chaco ecosystem.

In our study, the laying period was from September to February. This period was longer than that reported by Narosky et al. (1983) and de la Peña (1987), who recorded egg-laying only from September to December.

The Brown Cacholote copulates and does part of the courtship inside the nest chamber. This fact is apparently unknown among birds, but it may occur in the Sociable Weaver (*Philetairus socius*)(Collias and Collias 1978).

Fraga (1980) studied the Rufous Hornero (*Furnarius rufus*), a sympatric ovenbird, which builds elaborate nests of mud or clay. This species and the Brown Cacholote nested with different success. Fraga pointed out that the combination of low mortality and high productivity found in Rufous Horneros is unusual among local birds. The Brown Cacholotes' productivity was lower; 1.5 vs 2.52 fledglings per clutch. The clutch size was also lower; 2.60 in cacholote vs 3.35 in hornero.

Among factors which may control clutch-size and nesting success in birds, the role of parental age and breeding experience has received much attention (Perrins and McCleery 1985, Buitron 1988, Lequette and Weimerskirch 1990, Goodburn 1991, Croxall et al. 1992). Older and more experienced Brown Cacholotes had significantly larger clutches and higher nesting success than first-time breeders. Because this species begins breeding over an age range of 1–3 years, individuals of the same age can have variation in breeding experience. This provides a framework for analyzing the influence of age and experience separately. First-time breeders of different age did not differ significantly in these two variables. Juveniles with breeding experience had significantly larger clutches and higher nesting success than those of the same age without breeding experience. This suggests that experience, rather than age, is the more important influence on clutch-size and nesting success in the Brown Cacholote.

The last nestlings in broods of three usually died as did all in broods of four, probably of starvation. In the cases where these last-hatched nestlings survived, they were underweight.

The young remain in the parental territory for many months after they become self-supporting. They occasionally help their parents to defend their territory and bring sticks and adjust them in the nest. The birth-to-breeding distance is short ($\bar{x}$ = 120 m). These characteristics may be considered a step toward cooperative breeding. According to the classification of avian communal systems (Brown 1978), the Brown Cacholote might be included in TSD (territorial, single breeding, delayed breeding).

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LITERATURE CITED

BROWN, J. L. 1978. Avian communal breeding systems. Ann. Rev. Ecol. Syst. 9:123–155.

BUCHER, E. H. 1988. Do birds use biological control against nest parasites? Parasit. Today 4:1–3.

BUITRON, D. 1988. Female and male specialization in parental care and its consequences in Black-billed Magpies. Condor 90:1–14.

CLARK, L. AND J. R. MASON. 1985. Use of nest material as insecticidal and anti-pathogenic agents by the European Starling. Oecologia 67:169–176.

——— AND ———. 1988. Effect of biologically active plants used as nest material and the derived benefit to starling nestlings. Oecologia 77:174–180.

COLLIAS, N. E. 1964. The evolution of nests and nest-building in birds. Am. Zool. 4:175–190.

———. 1986. Engineering aspects of nest building by birds. Euro-Article. Endeavour New Series 10:9–16.

COLLIAS, E. C. AND N. E. COLLIAS. 1978. Nest building and nesting behaviour of the Sociable Weaver *Philetairus socius*. Ibis 120:1–15.

CROXALL, F. P., P. ROTHERY, AND A. CRISP. 1992. The effect of maternal age and experience on egg-size and hatching success in Wandering Albatrosses *Diomedea exulans*. Ibis 134: 219–228.

DE LA PEÑA, M. R. 1987. Nidos y huevos de aves argentinas. Ed. Lux S.R.L. Santa Fe. Argentina.

FRAGA, R. 1980. The breeding of Rufous Horneros (*Furnarius rufus*). Condor 82:58–68.

GOODBURN, S. F. 1991. Territory quality or bird quality? Factors determining breeding success in the Magpie *Pica pica*. Ibis 133:85–90.

HUDSON, W. H. 1920. Birds of La Plata. E. P. Dutton, New York, New York.

LEQUETTE, B. AND H. WEIMERSKIRCH. 1990. Influence of parental experience on the growth of Wandering Albatross chick. Condor 92:726–731.

MARTELLA, M. B., J. L. NAVARRO, AND E. H. BUCHER. 1987. Método para la captura de cotorras *Myiopsitta monachus* en sus nidos. Vida Silv. Neotr. 1:52–55.

MASON, P. 1985. The nesting biology of some passerines of Buenos Aires, Argentina. Pp. 954–971 *in* Neotropical ornithology (P. A. Buckley, M. S. Foster, E. S. Morton, R. S. Ridgely, and F. G. Buckley, eds.). Orn. Monog. No. 36.

MASRAMÓN, D. O. DE. 1971. Constribución al estudio de las aves de San Luis. Hornero 2:113–123.

MOUNTJOY, D. J. AND R. J. ROBERTSON. 1988. Nest-construction tactics in the Cedar Waxwing. Wilson Bull. 100:128–130.

NAROSKY, S., R. FRAGA, AND M. DE LA PEÑA. 1983. Nidificación de las aves argentinas (Dendrocolaptidae y Furnariidae), Asoc. Orn. Plata. Bs. As.

PERRINS, C. M. AND R. H. MCCLEERY. 1985. The effect of age and pair bond on the breeding success of Great Tits *Parus major*. Ibis 127:306–315.

RICKLEFS, R. E. 1969. An analysis of nesting mortality in birds. Smiths. Contr. Zool. 9:1–48.

SHORT, L. L. 1975. A zoogeographic analysis of the South American Chaco avifauna. Bull. Am. Mus. Nat. Hist. 154:255–261.

SKUTCH, A. F. 1961. The nest as a dormitory. Ibis 103:50–70.

———. 1969. A study of the Rufous-fronted Thornbird and associated birds (Pts. 1, 2). Wilson Bull. 81:5–43, 123–139.

THOMAS, B. T. 1983. The Plain-fronted Thornbird: nest construction, material choice, and nest defense behavior. Wilson Bull. 95:106–117.

VAURIE, C. 1980. Taxonomy and geographical distribution of the Furnariidae (Aves, Passeriformes). Bull. Am. Mus. Nat. Hist. 166:1–357.

WELTY, J. C. 1979. The life of birds. Saunders College Publ. Philadelphia, Pennsylvania.

WIMBERGER, P. H. 1984. The use of green plant material in bird nests to avoid ectoparasites. Auk 101:615–618.