

BREEDING BIOLOGY OF THE CRESTED CARACARA IN SOUTH TEXAS

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ABSTRACT.—We studied the breeding biology of six nesting pairs of Crested Caracaras (*Caracara plancus*) from January to August 1989 in Austin and Colorado Counties, south Texas. Four of the pairs nested in Macartney rose (*Rosa bracteata*). All nests were built below the nest-support canopy. We found caracaras laying eggs between 17 January and 23 June. Eggs hatched from February to April, and in June for two second nesting efforts. Young from successful first nesting efforts fledged from April to June. By August we did not see young or adults in the natal area. Nest building and courtship averaged 21 days ($N = 2$ pairs). Incubation periods averaged 30 days ($N = 4$ pairs), nestling dependency periods averaged 56 days ($N = 5$ pairs), and post-fledgling dependency periods averaged 33 days ($N = 4$ pairs). We believe that two of the pairs each laid a second clutch in June, but the newly-hatched chicks were killed by red imported fire ants (*Solenopsis invicta*). Overall nesting success was 45.7%. Success for first nesting attempts was 72.6%. Received 7 Sept. 1995, accepted 13 Feb. 1996.

In the United States, the Crested Caracara (*Caracara plancus*) primarily is found in Texas, Florida, and Arizona (Palmer 1988). The Florida population is listed as threatened under the Endangered Species Act (U.S. Fish and Wildlife Service 1987). Natural history of the Crested Caracara in North America has been described (Bent 1938, Brown and Amadon 1968, Oberholser 1974), but there has been little in-depth study of the species. Knowledge of the Texas population is limited to Oberholser (1974) and several brief notes. In general, little is known about the Crested Caracara's breeding biology. The lack of data on breeding biology precludes ability to make proper evaluations of population status and trends. Our objective was to describe the breeding biology, egg measurements, and nesting structures of the Crested Caracara in south Texas.

METHODS

We studied nesting pairs of Crested Caracaras in Austin and Colorado Counties, south Texas, from January 1989 to August 1989. The study area was centered on the Attwater Prairie Chicken National Wildlife Refuge (APCNWR), Colorado County (29°40'N, 96°15'W). The study area was at the western boundary of the Gulf Coast Prairie and the southern boundary of the Post Oak Savannah. The climax vegetation is tallgrass prairie characterized by big bluestem (*Andropogon gerardi*) and Indiangrass (*Sorghastrum nutans*) with overstory trees such as post oak (*Quercus stellata*) and blackjack oak (*Q. marilandica*) (Gould 1975). Invading shrubs include Macartney rose (*Rosa bracteata*), dewberry (*Rubus trivialis*), and yaupon (*Ilex vomitoria*) (Gould 1975).

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We located nests through aerial and ground surveys. Once we located a nest, we recorded the following information: nest-tree species and height, height of nest above ground, location of nest with respect to nest-tree canopy, and nest dimensions (length, width, internal bowl depth). When a nest was under construction or refurbishment, we recorded the materials used (species where possible), participation of each sex in nest-building, and duration of construction or refurbishment. We defined a nest as refurbished if we observed pairs adding material to an existing nest.

We divided the breeding season into courtship, incubation, nestling, and post-fledging dependency periods. The onset of courtship was the first day we observed a pair copulating. We defined post-fledging dependency as the period when juveniles were fed by the adults within 0.8 km of the nest. The end of the post-fledging dependency period was the date the young were last seen under these criteria. When we located a nest, we checked for eggs or nestlings. If there were no eggs or nestlings, we inspected nests daily with a mirror to determine onset of egg-laying. We determined the laying sequence by marking eggs with a soft lead pencil. We inspected each nest once a week to record any losses. At the completion of egg-laying, we recorded mass, length, and width of each egg.

Once we located a nest, we began observations of daily behavior of nesting pairs from sunrise to sunset. We observed each pair one day a week during the entire breeding season. Beginning three days before hatching (25 days after the onset of incubation) and three days before fledging (8 weeks after the onset of incubation), we inspected nests daily to record the initiation and sequence of hatching and fledging, respectively.

After the young hatched, we monitored nests at one-week intervals to check nestling survival and to record when young fledged. Nestling ages were estimated from plumage characteristics as described by Bent (1938) and Oberholser (1974). To facilitate monitoring young after fledging, we marked nestlings at approximately six weeks of age. Measurements and mass were taken for each nestling, and a U.S. Fish and Wildlife Service band was attached to its right leg. Nestlings were measured with a 24-cm ruler and a Mitutoya Model 550-633 caliper as described by Baldwin et al. (1931). Young were color-marked with a 7 cm-long blue, white, or pink vinyl plastic streamer attached to the left leg. Each streamer had an alphanumeric code painted on each side using NazDar, an ink formulated to fuse with vinyl surfaces. We were able to distinguish the sexes by size.

We estimated nesting success, using the method developed by Mayfield (1961, 1975) and a computer program created by J. L. Morrison. We calculated weekly survival for the incubation, nestling, and post-fledging dependency periods and the total probability of nest success. We defined a nest as our sample unit and a successful nest as a nest in which at least one young survived to end of the respective period.

RESULTS

We found six caracara nests in various stages of development through 10 h of aerial and 400 h of ground surveys from late December to mid-July. Two nests were on the APCNWR and four were on private property. Five nests were in shrubs; four in Macartney rose and one in yaupon. One nest was in eastern red-cedar (*Juniperus virginiana*). All nests were constructed in the tallest shrub or tree in the immediate area. Measurement were taken on five nests, as the sixth (Nest 3) deteriorated before we could measure it. Nest trees averaged 4.3 ± 1.4 m (SE) in height, nests averaged 3.7 ± 1.2 m in height above ground, and the distance between the nest and the canopy averaged 55 ± 25 cm. Nests averaged 59 ± 5

TABLE 1
BREEDING CHRONOLOGY OF CRESTED CARACARAS, SOUTH TEXAS

Nest no.	Date found	Eggs laid		Eggs hatched		Nestlings fledged		Last seen fledglings
		Date	No.	Date	No.	Date	No.	
1-1 ^a	10 Jan	17 Jan	2	13 Feb	1	9 Apr	1	17 May
1-2 ^b		17 Jun	1	16 July	1 ^d	— ^c	—	—
		18 Jun	1 ^c	—	—	—	—	—
2 ^f	21 Feb	12 Mar	2	—	—	—	—	—
3 ^g	27 Mar	—	—	—	—	—	—	—
4	9 Mar	19 Mar	1	16 Apr	1	10 Jun	1	7 July
		21 Mar	1	18 Apr	1	12 Jun	1	7 July
5-1 ^a	27 Mar	?	?	?	?	25 Apr	2	4 Jun
5-2 ^b		24 Jun	2	23 July	2 ^h	—	—	—
6	17 Mar	?	?	31 Mar	1	24 May	1	20 Jun
				1 Apr	1	24 May	1	20 Jun
				2 Apr	1	26 May	1	20 Jun

^a Denotes first nesting attempt.

^b Denotes second nesting attempt.

^c Egg did not hatch.

^d One nestling killed by red imported fire ants (*Solenopsis invicta*).

^e No data.

^f Adults abandoned nest at 31 days of incubation.

^g Adults abandoned nest building after three days.

^h Two nestlings killed by red imported fire ants (*S. invicta*).

cm in length, 50 ± 2 cm in width, and bowls averaged 11 ± 2 cm in depth. All nests were buried in the canopy and were impossible to see from the air or ground. Two of the nests constructed in Macartney rose could be entered and exited by the caracaras through only one opening in the foliage. Nests were constructed of Macartney rose, dewberry, yaupon, or broomweed (*Gutierrezia sarothrae*) twigs. Nests built in Macartney rose were almost exclusively built with that shrub's twigs.

Four nests were reused in the 1989 nesting season. Nests 4 and 6 were built by caracaras in 1988 (O. Benton, pers. comm.; J. Holtkamp, pers. comm.; respectively). Nests 1 and 5 had eggs laid in them in January and February 1989, respectively, and again in June 1989.

We observed breeding behavior from January through July (Table 1). We observed pairs copulating as early as 10 January and as late as 19 September. Pair 1 copulated four times during the nestling period (March and April), and Pair 4 copulated on 19 September, 100 d after the young had fledged. We observed courtship behavior during 12.5 ± 2.1 d ($N = 6$ pairs). The incubation, nestling, and post-fledging dependency periods averaged 29 ± 0.5 d ($N = 3$), 56.2 ± 0.4 d ($N = 5$), and 31.8 ± 2.5 d ($N = 5$) in length, respectively.

TABLE 2
MEASUREMENTS FROM SIX CRESTED CARACARA NESTLINGS AT VARIOUS STAGES OF
DEVELOPMENT IN AUSTIN AND COLORADO COUNTIES, SOUTH TEXAS, 1989

Nest	ID	Age (days)	Wing chord (cm)	Tail (cm)	Tarsus (cm)	Hallux (cm)	Culmen (cm)	Mass (g)
1	A1	47	28	17	9	1.4	2.32	1100
4	D3	26	16	7	8.5	1.48	2.24	880
4	D3	45	29	16.5	9	1.57	2.49	960
4	E1	28	14	6.7	8	1.33	2.15	880
4	D1	47	29	17	8	1.7	2.67	960
6	A2	39	23	11	9.5	1.21	2.51	1200
6	A2	43	26.5	14	10	2.05	2.49	1220
6	D1	37	20.5	9.5	9	1.53	2.48	1160
6	D1	54	35	19	9	1.74	2.28	1160
6	A4	38	24	12	8	2.1	2.53	1100

Pairs laid eggs from January through June ($N = 5$) (Table 1). Pair 2 laid two eggs on 12 March but abandoned the eggs after 30 d of incubation. We opened the eggs and found them infertile. Pair 3 did not lay eggs, as the pair abandoned the nest on 29 March after 3 d of nest building. Pair 4 laid two eggs from 19 March to 21 March. We did not locate Pair 6's nest in time to determine when the eggs were laid, but we observed three young hatch from 31 March to 2 April. Pairs 1 and 5 laid second clutches. Pair 1 laid two eggs on 17 January and laid two eggs from 17 June to 18 June. Pair 5 fledged two young 25 April and laid two eggs on 24 June. One chick hatched in Nest 1 and two chicks hatched in Nest 2 on 16 July and 23 July, respectively. All three nestlings from these second clutches were killed by red imported fire ants (*Solenopsis invicta*).

Clutch size was determined for five nests; four nests had two eggs, and one nest had three eggs. Eggs were laid at 1–2 day intervals ($N = 3$ nests). Eggs averaged 53.1 ± 0.1 mm in length, 41.3 ± 0.03 mm in width, and 65.2 ± 0.6 g in mass ($N = 4$).

Young caracaras were found in the nest from late February to mid-June, and fledged from early April to mid-June ($N = 8$). The older chick always left the nest first. Time between fledglings leaving the nest was between 1–2 days ($N = 5$ fledglings). Measurements and masses were similar for nestlings of similar age (Table 2).

Total probability of nest success for nests initiated in January through March was 72.6% ($N = 5$), compared to 45.7% ($N = 7$) for all attempts (Table 3). We did not include Pair 3 in the calculation of nest success.

TABLE 3
NESTING SUCCESS FOR CRESTED CARACARAS IN AUSTIN AND COLORADO COUNTIES, SOUTH TEXAS, 1989

Mayfield estimate	Incubation	Nestling	Post-fledging dependency	Overall
Earlier nests (Jan–Mar)				
Total nests observed	4 (3) ^b	4 (4) ^b	4 (4) ^b	—
Traditional success estimates	0.750	1.00	1.00	—
Total observed weekly exposure	13.0	28.0	32.0	—
Mayfield estimated weekly survival probabilities	0.923 ± 0.074 ^a	1.00	1.00	—
Total probability of success (Mayfield)	0.726 ± 0.116 ^a	1.00	1.00	0.726
All nests (Jan–Jun)				
Total nests observed	6 (5) ^b	6 (4) ^b	4 (4) ^b	—
Traditional success estimates	0.833	0.666	1.00	—
Total observed weekly exposure	21.0	28.2	32.0	—
Mayfield estimated weekly survival probabilities	0.952 ± 0.046 ^a	0.929 ± 0.048 ^a	1.00	—
Probability of success for entire period	0.823 ± 0.083 ^a	0.555 ± 0.082 ^a	1.00	0.457 ± 0.140 ^a

^a Standard deviation.

^b Number of successful nests is in parentheses.

We observed Pair 3 copulating and nest building for only three days before they left the study area.

By mid-August, young and adults were not regularly observed on or around the nest. On 19 September, the family group from Nest 4 was observed roosting on a powerline 2 km from the nest. Pair 6 was seen 2 km from the nest on 13 September.

DISCUSSION

We report several new findings from our research. Previously unreported for Crested Caracaras has been double brooding, fire ant predation on newly-hatched nestlings, body measurements and masses of nestlings, yaupon and eastern-red cedar as nest trees, and duration of the post-fledging dependency period. Pairs constructed nests from January to June. Simmons (1925) found nest materials collected as early as December in

Florida, and Levy (1961) observed nest construction in Arizona on 20 March. In this study, caracaras nested in tall, dense Macartney rose stands. Caracaras nested in the tallest vegetation in the area, Macartney rose on the APCNWR, and eastern red cedar on the Underwood Ranch. Previous accounts from North America reported caracaras nested in ebony (*Pithecollobium* spp.), hackberry (*Celtis* spp.), Macartney rose, mesquite (*Prosopis* spp.), oaks, palmettos (*Sabal* spp.), pines (*Pinus* spp.), saguaros, yuccas, and on cliffs (Bent 1938, Dillon 1961, Levy 1961, Oberholser 1974, Layne 1978, Farquhar 1986, Ellis et al. 1988). This is the first time yaupon and eastern-red cedar have been reported as nest supports.

Nest heights were similar to those reported by Oberholser (1974). In this study caracaras built their nests below the nest-support canopy. Caracaras may prefer their nests below the canopy rather than on top. Only Bent (1938) and Brown and Amadon (1968) report the nests as hard to locate. Nests were similar in structure and construction materials to those of other studies. Nests composed entirely of broomweed are reported from Texas (Bent 1938), although most authors described the nest as simply a bulky structure of weeds and twigs (Brown and Amadon 1968, Oberholser 1974, Layne 1978).

In central Texas, two-thirds of 35 nests observed were reoccupied annually, but whether by former owners was not known (Schultze 1904). In this study, four of six nests had been previously used by caracaras. Farquhar (1986) reported caracaras using White-tailed Hawk (*Buteo albicaudatus*) nests on the APCNWR, and Mader (1981) noted one caracara nest refurbishment in Venezuela.

We suspect eggs laid in June were second broods from Pairs 1 and 5, based on our confidence at identifying the adults from daily behavior observations. Howell (in Bent 1938) reported one case of double brooding, but whether by the same parents was unknown. Doubling brooding has never been confirmed, although it was suspected (Slud 1964, Palmer 1988).

We observed copulations throughout the breeding season, which may help to maintain the pair bond (Newton 1979). Eggs were smaller than those reported by Bent (1938) and Oberholser (1974) and weighed less than those reported by Newton (1979). We found most nests had a clutch size of two, unlike Bent (1938) who reports a larger percentage of clutch sizes of three. The lengths of incubation and nestling periods were similar to those of earlier studies (Bent 1938, Layne 1978, Newton 1979).

Timing of nest initiation at our study was comparable to those of other studies. Four nests in Arizona had nestlings in May (Levy 1961, Ellis et al. 1988), and one nest in Texas had young in July (Ellis et al. 1988). Layne (1978) reported that the young fledge at about eight weeks.

Rivera-Rodriguez and Rodriguez-Estrella (1992) found 83% of 16 caracara nests in Mexico in 1990 were successful. They did not define nesting success using the Mayfield method. In this study, lower nest success for the incubation and nestling periods was the result of failure of Nest 2 and nestlings preyed upon by red imported fire ants in the second nesting attempt by Pairs 1 and 5.

Our data provides insight into length of the post-fledging dependency period, which was previously unknown (Newton 1979). Dillon (1961) last saw a family group in Central Texas in late June or July and did not see the nesting pair again until the following January. The duration of the post-fledging dependency period may be longer than reported here, as we had a narrow definition of this period and we did not use radio-transmitters to monitor fledglings.

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