

CLUTCH SIZE, LAYING DATE, AND INCUBATION PERIOD IN THE CAROLINA PARAKEET

BY DANIEL MCKINLEY

Literature on egg-laying and incubation in the Carolina Parakeet (*Conuropsis carolinensis*) is a mosaic of hearsay, second-guessing, and inference. Not only are the ornithological waters on this subject full of shoals but also their undercurrents may take the unwary by surprise. Because the species is extinct, there is no possible recourse to experience with the birds themselves.

For parrots in general, the major guides are writers in the cage-bird trade. Anecdotal summaries are found in Bronson (1953) and Tavistock (1954). Avicultural information has lately been authoritatively reviewed by Smith (1972) and Rutgers and Norris (1972). A good ornithological evaluation of records is found in Forshaw's recent works (1969, 1973). Strictly oological matters are summarized by Schönwetter (1963–1964) and Harrison and Holyoak (1970). A review of some physical aspects of Carolina Parakeet eggs has been written by McKinley (1977).

CLUTCH SIZE

Information on clutch size in the Carolina Parakeet is disappointingly meager. Alexander Wilson (1811) was unable to learn with any precision how many eggs were laid, although Bonnaterre and Vieillot, being prophets from a foreign land, wrote with certainty that "the clutch is two eggs" (1823: 1402). Audubon noted that, although females laid their eggs many together, individual birds probably laid only two eggs (1831: 139). Both attributions were guesses.

W. B. Seward, not a trained ornithologist, recalled five as the number of *young* brought him from a felled tree in pioneer Indiana (Butler, 1892: 53). J. M. McCrary, a collector with four spring season's experience in Florida, wrote (1891) that the clutch was two—but he was probably reporting hearsay, as no doubt was the more informed ornithologist C. J. Maynard (1890: 68) who suggested the same number.

Hearsay is catching, of course, and that may be why so many dubious parakeet eggs come in "sets" of two or three eggs. David Weeks's clutch of eggs from Louisiana, suspected by Bendire (1895: 6) not to be genuine, contains two. Another Louisiana haul of doubtful authenticity, supposed to have been found by James Fairie in 1859, also has two eggs in it. So does the originally unlabeled set from Georgia found by Dr. S. W. Wilson (thought by Ridgway and Bendire to be authentic) (Bailey, 1883). Two dubious sets of eggs collected by C. E. Doe in Florida in 1927 are in clutches of two and three (McKinley, 1977). The Staatliches Museum für Tierkunde Forschungsstelle at Dresden has three accessions of two, two, and one egg each, as if these were considered "sets" of eggs. All are "from the zoo" and lack other data; it is entirely possible that these are all that the keepers were able to save or thought worth

saving. Two "sets" of quite unknown provenance are two each (University of Nebraska Museum; Newark Museum); but not only are these questionably from Carolina Parakeets in the first place, even if genuine, they may have been made up into what the trade considered a "set" of eggs. (These and other undocumented references to eggs are taken from my unpublished survey of specimens of parakeet skins, skeletons, and eggs.)

Originally Karl Russ (1879) rather indefinitely believed that Carolina Parakeets in captivity laid two eggs but later experience taught him to expect from three to five, a number that he later urged upon Bendire (1895: 6). Four eggs were laid in the Frankfurt Zoo in 1860 and two in the Hannover Zoo in 1868 by a pair of parakeets in both cases (we are unsure of total clutches in either case). Neunzig recorded that Dr. Russ's single pair of parakeets "hatched out three young and later on five more" (Prestwich, 1951: 79). Apparently there were no addled eggs, for we are told that the clutches of eggs were three and five. The clutch of three appeared just prior to 1870; the date of the clutch of five is unknown. Russ's birds also laid four eggs in 1878 (Finsch, 1867: 67, 486; Russ, 1879: 231, 234).

Dr. Nowotny of Vienna, an amateur bird-keeper, had a pair of Carolina Parakeets whose female laid five eggs in late June 1879 and an additional two eggs by 6 July. These seven eggs, *certainly one clutch*, were destroyed, the first five by the parent birds. A second set was begun on 19 July and completed with three eggs shortly thereafter, with the parents sitting assiduously (Russ, 1879: 838-840; Bartsch, 1898).

A bird held in captivity by Robert Ridgway apparently laid one egg in each of the years 1877, 1878, and 1883 (at least, that is the number of eggs that he deposited in the U.S. National Museum). One might conclude that the clutch was one in these cases but nothing is known about possible lost eggs, and it seems that Ridgway was not an altogether exemplary aviculturist. Furthermore, a possibly parallel case urges caution. Beebe reported that a single egg (one would immediately assume the complete clutch) was successfully hatched at the Philadelphia Zoo in 1885 (1909: 583). But there are four additional eggs from the Philadelphia Zoo dated 1885 in the Bayard Cutting Arboretum collection, making a total of five.

Gedney gave the clutch as four to six (1876: 64), which, although probably a guess, was better than most reports we have.

That Ridgway had not sold additional eggs in the 1880's is perhaps indicated by his statement to Childs in 1901 (Amadon, 1966) that "not a single private collection in the world contains one." Additional eggs may, of course, have been broken in those years, considering the careless habits of parakeets in captivity and the admittedly haphazard housing provided the birds. (However, Ridgway did part with another egg—an 1897 egg now at the Museum of Comparative Zoology, Harvard University—but that transaction may have occurred after his dealings with Childs.) Altogether, clutch size among the earlier Ridgway birds is un-

decipherable from the bits of evidence that have so far been found. More complete information exists on his last laying bird.

A female that Ridgway brought back from Florida in 1896 laid eight eggs in the summer of 1900. Apparently she laid only two eggs in 1901 and these were sold to John Lewis Childs (1905). As one of the specimens was damaged, Childs haggled about the price and Ridgway pirated one egg the following summer (to make up the fabled two eggs to a "set," I suppose) (Amadon, 1966). The female went on to lay a total of six eggs in the summer of 1902 and was dead by mid-November. Even though the five remaining eggs hatched, little came of the venture (Butler, 1931; Bartsch, 1952), and even less resulted from a clutch of four eggs in the aviary of Captain Nicholl in England about the same time (Anon., 1903-1904).

In summary, enough has been discovered to show that clutch size in the Carolina Parakeet was perhaps rarely as small as two. The effects of captivity upon the species and its egg-laying habits cannot be estimated. Thus, in the total absence of information drawn from the field, little can be definitive, even in a speculative way. It may be worth examining the record, imperfect as it is, in other American species of small parrots.

Prestwich (1949: 16) gives clutches of species of the genus *Aratinga* (to which the Carolina Parakeet is assumed by many taxonomists to be closely related) in captivity as: 2 (six clutches), 3 (eight clutches) and 4 (two clutches). One female *A. auricapillus* (= *A. solstitialis*) laid three clutches of 2, 2, and 3 in one year. The tendency among Aratingas to lay two or three eggs is further shown by the few records from the wild: *A. euops*, two to five (Bond, 1958: 5); *A. pertinax* in the West Indies, two (Nichols, 1943: 34); *A. pertinax* in Venezuela, number of clutches not stated, three to four eggs (Friedmann and Smith, 1950: 472); *A. canicularis*, one to three in the wild, three to five in captivity (Dickey and van Rossem, 1938: 205; Hardy, 1963: 198); *A. (Thectocercus) acuticaudatus*, three; and *A. (Eupsittula) aurea*, two or three (Orfila, 1936: 222, 224).

All these species, of course, are more tropical in their distribution than *Conuropsis* and the generally small clutch sizes may support an ecological "rule" that birds nesting in higher latitudes tend to have larger clutches. However, it is well to remember that in the tiny short-tailed tropical American parrots of the genus *Forpus* the clutches reported by Prestwich (1949) are: 4 (four sets) and 5 (four sets), with apparently one set of 6 known. Friedmann and Smith (1950: 473), however, found only two nestlings in a clutch of *F. passerinus* in the wild. Clutches of up to eight are recorded for *Brotogeris jugularis* in the wild in Panamá (Wetmore, 1968: 87).

Another complicating factor is that of determinateness in egg-laying: that is, whether the number of eggs in a clutch is definite or if a female continues to lay if eggs are lost or removed (which thus keeps the clutch "incomplete" insofar as the bird is concerned). Smith (1972: 161) reports parrots, with minor exceptions, as determinate layers. Brockway (1968)

showed that when budgerigars are allowed to retain even one egg, they lay only the "usual" number of eggs, but that, when all eggs are promptly removed from the nest, at least up to 20 eggs may readily be laid. In captivity, especially when birds lay from the roosting perch or when no proper nest-hole cavity is available, circumstances approaching the second condition mentioned by Brockway tend to prevail.

LAYING DATES

Of five decidedly uncertain sets of wild-taken eggs alleged to belong to the Carolina Parakeet (McKinley, 1977), all have been assigned to the spring of the year: Georgia, 26 April; Louisiana, March; Pendry's Florida set, 2 April; and two Doe sets taken in Florida, 30 April. The only two dates mentioned by Bent (1940: 11) and 2 and 26 April; both were said by Bent to apply to Florida although one (the S.W. Wilson set) obviously refers to Georgia. In view of several well-known records to the contrary of eggs laid in captivity, these two dates seem poorly chosen. I suspect they are both wrong. The Pendry eggs (Childs, 1906) have disappeared and were probably entirely spurious. The Wilson group is questionable at best, and the date may be unreliable in any case, because even if not a faked collection, the eggs may have been taken from a nest of the previous season.

Dates of egg-laying for the western subspecies (note the March date claimed above for Louisiana) inferred in the literature are extremely circumstantial. Furnas (1902) told of a "nesting" on an island in the Missouri River near Brownville, Nebraska, in the 1850's. The account seems to indicate a "spring" breeding period but it is vague, and too much substance ought not to be read into it; (for example, it was recorded nearly 50 years after the event). Goss (1891: 316) related that "in the spring of 1858, a small flock reared their young" near Neosho Falls, Kansas (1891: 316). Goss never saw their eggs; his statement hardly claims that he saw the young. The report is probably hearsay only and, anyway, it is certainly not a precise seasonal date. One of Rollin Baker's informants (1956: 357) in eastern Texas "thought that they were most abundant at the time when corn began to ripen but also thought that the birds nested in Tyler County." (Obviously, Baker thought that the nesting season—after which the season's greatest numbers would occur—would not be when corn ripened, that is in late summer; if the report is at all valid, it may well be founded upon a nesting of the parakeet at or after midsummer.)

It is difficult to untangle allusions to nesting by the parakeet in early accounts. John Lawson (1967: 146–147) found "Parrakeetos" in coastal North Carolina in the early 1700's to be present sporadically except winter. However, despite his being the source of much homely lore on the species, he did not guess at an egg-laying date. Mark Catesby (1731: 11) made nothing of their time of nesting. That he thought they came farthest north in autumn—in pursuit of apples, as he indicated—is perhaps suggestive. Buffon, kingpin of naturalists of the Age of Reason,

interpreted Catesby to say that although a few breed in Carolina, "most of them retire southwards in the love season, and appear again during the harvest." Buffon thus assumed that parakeets bred to the south in the *proper* spring season and came north later in the year to wreak havoc upon orchards rather than to breed.

Guided by a sound distrust of what he could not see, Alexander Wilson may have come near the truth, at an early day, when he wrote: "That they commence incubation late in summer, or very early in spring, I think highly probable, from the numerous dissections I made in the months of March, April, May and June . . ." (1811: 94). By this Wilson obviously meant that he had detected no indication of egg-laying during those months. ("Very early in the spring" evidently meant *before* those months.) The size of his sample cannot be known with much precision but he certainly shot a great many parrots on his trip through the Ohio and lower Mississippi valleys in spring 1810. He considered his point further proved by "the great variety which I found in the color of the plumage of the head and neck, of both sexes, during the two former of these months . . ."

With a Buffonian dislike of a hole left unplastered, Audubon matched his reckless statement to "Dear Reader" that cockleburbs were perennials (species of *Xanthium* are annual plants) with the distinct inference that the parakeet's nesting season was the more or less usual one. This is shown by his statement (1831: 139) that the young retain an *entirely green* plumage during the first season, until "towards autumn a frontlet of carmine appears." Since he was incorrect about these important details of molt and color, it is certainly risky to take the rest of his commentary seriously.

People continued to look for parakeet nests during the spring, however, as is proved by the promotional announcements of Fred Ober in 1874 that he confidently expected to have eggs next season, to go with the never further documented "authentic information" on nests that he had garnered that year. He had started for the Okeechobee region on 1 February and was back in the lap of civilization by 18 March. It is worth noting that Maynard, who had hunted assiduously in winter and spring for information on the parakeet in prolonged field trips in Florida, was unsuccessful in finding nests or young (1881: 251). He finally began to credit informants' claims that the birds nested in June; one party sent out by him found, in mid-June "nothing but young"—which, in monumental thick-headedness, they bothered neither to count nor to preserve. August Koch reported from western Florida, where he had collected during several spring seasons, that professional bird-catchers came to the Apalachicola region "always in July, when the young birds were collected in flocks . . ."; or so he was told by residents (1891). This may be seen to coincide fairly well with Maynard's conclusions.

It is true that W. E. D. Scott (1889: 249) thought that the ovaries of females he collected at Linden about mid-February "seemed to indicate that the breeding season would begin not later than the last of April."

The absence of evidence makes this a meaningless statement. More importantly, contrast it with F. M. Chapman's findings. In mid-March 1889, Chapman secured 15 specimens on the Sebastian River. The undeveloped condition of sexual organs in the individuals shot and the pattern of molt in one that was captured alive led him "to suppose that they nested late in the summer" (1890).

The evidence on egg-laying in captivity tends to confirm an early to late summer period of laying in the Carolina Parakeet. The single exception is the circumstantial statement by the generally unreliable Gedney (1876: 64) that "their breeding season varies considerably in this country [England], some commencing as early as February, whilst others defer matters until September"; in the former case, he said, two or three clutches might be laid, although one ought not to expect good luck with late broods.

Records in captivity are, as might be expected, less than perfect. The earliest known instance of a Carolina Parakeet depositing eggs in captivity is 1860, when a pair in the Zoological Garden of Frankfurt laid a clutch of four eggs in July (Finsch, 1867: 486; Russ, 1879: 234). Some time previous to 1871, Karl Russ, a German bird-fancier of note, had one pair (of a total of three pairs) of parakeets that raised two broods "in the summer months" (1879: 231), but few details of their history survive. Russ also related (p. 234) that Dr. W. Niemeyer (=Niemeier) had a bird of this species that laid two eggs in a nestbox in June 1868.

Three early eggs (U.S. Natl. Mus.) laid by captive birds are dated 19 July 1878, August 1877, and September 1883 (days not known for the latter two). The number of females involved in this collection is not known. There is a female specimen in the U.S. National Museum labeled a "caged specimen, said to have been brought from Texas. Laid 3 eggs in captivity" (R. Zusi, pers. comm.); but, even if all this were true—and there is no supporting evidence—she certainly did not lay the egg of 1883 because her death was February 1879: her three eggs may have been a single clutch.

At least two days previous to 29 June 1879, the female parakeet belonging to Dr. Nowotny of Vienna (Bartsch, 1898) had begun to lay. On that date, he found two eggs in the bottom of the cage. Another egg is said to have appeared later the same day. (I am suspicious of the alleged rate of laying, for Nowotny claimed that by the time he transferred the latter egg into the box with the original two, there were four—*possibly*, I suppose, because the bird had already laid one in the nestbox where he was unaware of its presence.) A fifth egg was laid on 30 June. By 1 July, the entire batch had been destroyed by the parent (or parents), even though a sixth and seventh egg appeared "between the second and sixth of July." Three eggs only made up a later clutch that was laid beginning 19 July. These dates more or less agree with the *hatching* on 9 September of the single egg incubated at the Philadelphia Zoo (Beebe, 1909).

One of Ridgway's birds produced an egg on 29 July (now at Museum of Comparative Zoology). Whether there were others laid that summer is not known; perhaps they broke in falling from the perch. Furthermore, evidently the same female laid eight eggs in July to August 1900, providing the U.S. National Museum with as many eggs as its curators cared to have. Ridgway then proceeded to sell three eggs to John Lewis Childs (Amadon, 1966), their dates of laying being 5 and 12 July 1901 and 29 July 1902.

Ridgway seemed to indicate that his female laid only two eggs in 1901; I think it possible that this was merely the number of eggs that he managed to salvage. Despite the eggs' rarity, Childs quibbled at the damage done one as it fell from the roosting perch to the floor of the cage. Ridgway promised him a replacement if his parakeet laid any more eggs in 1902, a rather indefinite pledge he thought, because the bird was then at least six years old, and he feared that she was becoming barren presumably because of the small clutch laid in 1901. (He had, of course, no good reason for assuming them to be short-lived birds, the contrary being the case [McKinley, unpubl. data].)

Barrenness hardly accounted for the two-egg clutch, because the Ridgway bird laid her last eggs, a total of six, in 1902, the first one being taken to alleviate the grumbles of Childs. The remaining five hatched, as I shall recount elsewhere.

This review of the times when eggs are known to have been laid (all of them in captivity) makes it apparent that Carolina Parakeet eggs were not laid in spring at all and seldom before 1 July. From evaluation of the time of molt in young birds, preliminary evidence shows that the green freathers of the head were replaced by yellow ones in Florida specimens from September (rarely) to perhaps June (with the bulk in January–February); a very small sample of western specimens suggests a similar schedule. The exact age at which this molt occurred is poorly known; it may have been as early as age six to 10 weeks. Whether captivity had altered the laying cycle cannot be determined. From the skimpy evidence at hand, at any rate, it seems clear that most of the people looking in Florida for nests of the Carolina Parakeet were searching at the wrong time of year. When the collectors were not simply frost-weary Northerners out for a tropical lark in midwinter to early spring, they were outlanders who assumed that parrots would sensibly nest at the same time robins laid their eggs in the North.

Oddly enough, received opinion—already conceived in an ignorance that could, at least at first, have been called honorable—came to accept a late spring laying season, as if the matter had somehow really been investigated and settled. Despite his clear feeling to the contrary in 1890, Chapman wrote in his 1912 books (both “Color Key” and a so-called revised edition of the “Handbook”) that the breeding season was probably June. This did not change in the final (and really revised) edition of the “Handbook” (1932: 330).

INCUBATION PERIOD

The story of the length of incubation in the Carolina Parakeet is soon told. For what it is worth, the very diverse parrot family is said by Jean Dorst to have an incubation period "averaging three weeks" (Thomson, 1964: 600-602). Just what basis this has in fact is not clear to me, for René Verheyen gives the minimum incubation period, even for the smallest species, as 17 to 21 days (1956: 10), figures comparable to those of Smith (1972: 161-162).

Apparently, the first published account of incubation period for the Carolina Parakeet—from captive birds, if valid at all—was contributed by Gedney (1876: 64): It "extends over a period of fourteen or sixteen days." This surely must have been an example of what Arthur A. Prestwich has characterized in Gedney as "his rather elastic imagination." Possibly Gedney was of the same opinion as T. G. Gentry; of the latter Nice (1954: 176) wrote: "as he considered that incubation was a most wearisome task for both parent and chick, he compassionately made it short." The only scrap of evidence that Gedney may have been correct is a statement by Beebe, reported at second hand (1909: 583): "The Carolina Parakeet was bred in the Philadelphia Zoological Garden on September 9th, 1885, when one bird was hatched from an egg which had been placed under a Turtle Dove. The period of incubation was fourteen days." I do not know who told Beebe the incubation period; it is not mentioned in records surviving at the Philadelphia Zoo (letter from John A. Griswold). Oddly, Beebe, although alleging to list nesting successes in the United States, did not mention Ridgway's limited achievements.

As for Robert Ridgway, whether in regard to failure to record full scientific information or to lack of success in preserving a dying species, it is too easy to blame him. There is indeed a maddening bit of evidence that Ridgway had somewhere kept precise information on incubation periods of his hatchlings. Part is secure: the first egg of the clutch (transmitted to Childs) was laid 29 July 1902. *If* one assumes that the next five eggs were laid at two-day intervals, the last would have been deposited on 8 August. *Perhaps* one may safely guess that incubation began immediately upon laying of the first one that the parents were allowed to retain: Ridgway noted that the birds emphatically showed that they "had other uses" for the eggs and he let them keep them. In the U.S. National Museum there are two skins of birds that hatched from that clutch, only to die mysteriously the following June. These specimens bear labels noting that they hatched on 26 August and 1 September. *If* incubation began with the second egg (the first left to the parents), *if* the last egg was laid on 8 August and *if* this egg hatched on 1 September, a *minimum* incubation period of 24 days is suggested. (Could Beebe's 14 days have resulted from a jumbling of numerals of 24 to 14?). But, of course, we do not really know when the clutch was finished, when the first and last chick hatched or the order of hatching of the eggs.

It is all very sad.

Despite several reports of successful hatchings of the parakeet in Europe (see, particularly, Prestwich, 1966), from the entire number apparently only one aviary keeper published records of the important matter of incubation period. The single exception is the otherwise unknown Dr. Nowotny of Vienna. His pair of parakeets laid an egg on 19 July 1879, and afterwards a second and third. It seems probable from Nowotny's account that incubation began with the first egg. He heard "a young one scream" on 9 August and a second one was calling on 10 August. He did not find out when the third hatched. This indicates an incubation period of 21 days, assuming that we know when the first egg was really laid and assuming that the first laid was the first hatched. This is probably the source for published statements that the incubation period for the parakeet was "21 days" and "19-20 days" (Bergtold, 1917: 93; Reilly, 1968: 233).

A pair of Carolina Parakeets kept by an English bird fancier incubated closely for three weeks on eggs that proved to be addled (Anon., 1903-1904). That birds, however, will incubate long past the regular time if eggs do not hatch is well known—twice the usual period is not uncommon.

Information on incubation period in all American parrots is scanty. In captive *Aratinga canicularis* the period is around 26 days; this is a species whose eggs are substantially smaller than those of *Conuropsis* (Hardy, 1963: 191; Schönwetter, 1964: 517). One-egg clutches of the Thick-billed Parrot (*Rhynchopsitta pachyrhyncha*) in captivity hatched in 28 days (Lint, 1966; Dyson, 1969), the eggs of this species being somewhat larger than those of the Carolina Parakeet (Schönwetter 1964: 518).

SUMMARY

Meager information from eggs laid in captivity indicates clutch sizes of four to six as common in Carolina Parakeets. Information from the wild is unreliable. Uncritical general opinion has been that such eggs were laid in the spring. Eggs laid in captivity, when dates can be proved, have been deposited from very late June well into August; this seems also to coincide with the timing of the relatively brief period in autumn to early winter when birds with immature plumages were found. Although the incubation period in this species was reportedly 14 days, it was probably at least 21 days or thereabouts.

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Department of Biological Sciences, State University of New York at Albany, Albany, NY 12222. Received 18 December 1977, accepted 10 April 1978.