

Reproductive Phenology and Breeding Success of the Monk Parakeet (*Myiopsitta monachus monachus*) in Argentina

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The breeding biology of the Monk Parakeet (*Myiopsitta monachus monachus*) was studied in Punta Blanca, central Argentina (34° 56' S, 57° 39' W). Observations on 9 communal nests (13 breeding chambers) were made during 1988 and 1989. The median date of the first egg for each year was 14 and 31 October (the median for 2 years was 16 October). Clutch size ranged from 5 to 12 eggs, averaging 6.9. Incubation took 23.6 days and hatching was asynchronous. Mean hatching success for clutches was 52.2 %. Only 17 % of the nestlings fledged. Only 8.9 % of the total eggs laid resulted in fledglings. Predation by Opossums (*Didelphis*) and Black Rats (*Rattus*) was the main cause of mortality at nests (82 %), but 17.9 % of the nestling mortality was due to intraspecific attacks, including sibling aggression.

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Introduction

The Monk Parakeet (*Myiopsitta monachus*) breeds in Paraguay, Uruguay, Bolivia, southern Brasil and northern and central Argentina (Orfila, 1937; Forshaw, 1989). It is not only one of the few psittacine species with no urgent conservation problems (Beissinger & Snyder, 1992) but can be an agricultural pest in parts of its native range. As a result of importation in the pet trade and its great adaptability to different climatic conditions (Weathers & Caccamise, 1975), the species has become established in other countries. The species occurs or has occurred in the United States and some Caribbean islands (Niedermayer & Hickey, 1977) a well as in Britain, France, Holland (Bull, 1973), some areas of the Mediterranean Spanish coast and Balearic islands (own data). This paper provides information on the breeding phenology, eggs, clutch size and breeding success of *M. monachus monachus*, a subspecies whose breeding range is from southern Brasil to Central Argentina (Darrieu, 1980; 1981).

Study Area, Material and Methods

The study was in a short "talar" woodland (*Celtis tala*) in Punta Blanca (council of Magdalena, province of Buenos Aires) in central Argentina (34° 56' S, 57° 39' W). The woodland had 3-6 m high *C. tala*, Cina-cina (*Parkinsonia aculeata*) and Figs (*Ficus carica*). The study area belongs to the phytogeographical range of the "Pampas" and is used as a cattle ranch. All parrot nests were situated in *C. tala* trees.

Data were collected between October and January during the 1988 and 1989 breeding seasons and comprise complete observations on 9 communal nests visited daily during the laying season and with intervals of 3-4 days during the nestling season. Five nest were observed in 1988 and 4 more were observed in 1989. The 1988 nests comprised a total of 8 breeding chambers, whereas in 1989 there were only 5 breeding chambers. A breeding chamber is the place where a bird (or more than one in a species like the Parakeet with intraspecific parasitism (Aramburú, 1991)) lays its eggs. A total of 90 eggs were observed, measured, weighed (to the nearest 0.5 g) and individually marked according to the laying sequence. Later they were re-weighed to measure weight loss. Calculated weights of some eggs that were not weighed at laying, were based on the formulas of Bergtold (1929) and Rahn et al. (1975) that connect this parameter with the female body weight. (96.3 g in the study area) (s.d. = 5.43, n = 243). Mean egg volume was calculated according to Hoyt (1979).

The methods used to estimate breeding parameters and breeding success were similar to those used by Bucher and Orueta (1977).

Results

Eggs and egg-laying

The onset of egg-laying in 1988 was the 5 October (median = 31 October) and it was 14 October in 1989, (median = 16 October). In both cases, median was based on the date of onset of the breeding chambers. In both years, the egg laying period lasted one month. Only one second clutch was observed in January, although many nest-chambers were ready as new material had been added during this month. Eggs were layed every two days, and only in two cases were eggs laid daily. Measurements of 47 eggs averaged 29.0 by 22.2 mm (s.d. = 1.1 and 1.2, respectively). Eggs weight averaged 7.8 g according to Bergtold's (1929) formula and 7.5 g with the Rahn's et als. (1975) formula. During incubation there was a progressive loss in the total weight of the eggs. The mean weight of the eggs at the end of incubation period was 5.8 g (s.d. = 1.3). Egg volume as calculated by Hoyt (1979), was 7.3 cc. There was no statistical relationship between the egg weight and hatching success ($p > 0.05$, $n = 56$, Mann-Whitney U test).

Clutch size, Incubation and Hatching

Clutch size ranged from 5 to 12 and averaged 6.9 eggs (s.d. = 2.1, $n = 13$) (tab. 1). Most often there were 7 eggs in a clutch (38.5 %), followed by 5 (30.8 %), 6 (15.4 %) and then 11 or 12 (7.7 % for both).

Incubation period, assessed as the time which elapses from the laying of the last egg in a clutch to its hatching, lasted 22 to 25 days ($\bar{x} = 23.6$ days). There were attempts of incubation in 72.2 % of the chamber nests. Mean hatching success for Monk Parakeet clutches was 52.2 %. Eggs were lost to predation (58.1 %), inviability (18.6 %), nest abandonment (16.3 %), destroyed during incubation (4.6 %) or failed to hatch properly (2.3 %). There was little synchronization of hatching. We observed only 3 instances of synchronous hatching when

Table 1. Egg and reproductive data in two different Monk Parakeet (*Myopsitta monachus*) subspecies. Sources come from: (+) Navarro (1988); (#) Bucher et al. (1990) and (*) present study.

	<i>M.m.catita</i> (+)	<i>M.m. monachus</i> (*)
Egg measurements (mm)	27.2 x 20.2	29.0 x 22.2
Egg fresh weight (g)	6.3	7.8
Egg volume (cc)	5.7	7.3
Incubation time (days)	24 (#)	23.6
Total clutch size (number of eggs)	5.3	6.9
Hatchling success (%)	54.1	52.2
Nestling success (%)	41.7	17.0

2 or 3 eggs from different chambers hatched on the same day. Typically, hatching was asynchronous and the difference between the hatching of the first and last chicks was more than 2 days.

Nestling mortality

Nearly 83 % of nestlings were found dead in the nest or disappeared. Mortality was most common during the fourth and fifth week of age (50 % of the nestlings). The main cause (82 %) was predation mainly by Opossum (*Didelphis albiventris*) and Black Rats (*Rattus rattus*). On one occasion, a female Opossum with young lived in a nest chamber, next to chambers occupied by breeding parakeets. Five 30 - 41 days old nestlings (12.8 % of the total) were found dead, probably by other monk parakeets, probably adults according to the injuries and 5.1 % of the mortality was due to sibling aggression. Only 17.0 % (n = 8) of the nestlings fledged. The proportion of successful fledglings compared to total eggs laid was only 8.9 %. However, 15.4 % of the nests had at least one successful fledgling

Discussion

The fresh egg weights obtained following Bergtold (1929), in spite of its high 5 % error, are very similar to those obtained according to the Rahn et al. (1975) method. Other parrot species with egg weight similar to *M.m. monachus* are the Ground Parrot (*Pezoporus wallicus* 7.3 g) and the Crimson Rosella (*Platycercus elegans diemenensis* 7.7 g), both from Australia (Saunders et al., 1984). Navarro (1988) found a relationship between egg weight and fledgling success in two of his three study years; but there was no relationship in our study. Egg laying in *M.m. monachus* was earlier than that of *M.m. catita* (3 - 9 November) (Bucher et al., 1990; Navarro, 1988). The incubation time following the Rahn et al. (1975) formula was of 18.6 days, much less than what we obtained by field data. The principal predator of the Monk Parakeet is the Opossum, which is an important predator of many neotropical birds (Contreras et al., 1983; Martella et al., 1985). The introduced Black Rat could represent a new and more important mortality factor as has happened in some passerine colonies in southwestern Europe (Peris, 1980).

Second clutches rarely occurred in our population. This was quite different from Pergolani (1953) but in agreement with Courault and Don (1982) and Bucher et al. (1990). Gonad measurements of both sexes in January showed minimum development (Aramburú, 1991).

The minimum clutch size we observed was of 5 eggs (range = 5 - 12), which is bigger than the 5 eggs maximum reported by Pergolani (1953) or the average found by Bucher et al. (1990) in the subspecies *catita* (range = 1 - 11). Probably larger clutches of 11 and 12 eggs in both subspecies could be due to intraspecific parasitism, as it occurs in the subspecies *monachus* (Aramburú, 1991). The interval of 2 days in egg laying is also observed in many psittacidae species as *Melopsittacus undulatus*, *Bolborhynchus lineola*, *Enicognathus ferruginous*, *Amazona vittata* (Bucher, 1983), *Forpus passerinus* (Beissinger & Waltman, 1991) and, in a lesser extent, in the genus *Agapornis* (Dilger, 1960). The start of incubation with the second or third egg is also in accordance with other parrot species, such as *Psittacula krameri*, *Psephotus haematonotus*, *Neophema bourkii* (Lack, 1968) and the genus *Agapornis* (Dilger, 1960). The incubation time of *M.m. monachus*, averaged 23.6 days, and is similar to the 24 days found by Bucher et al. (1990) in *M.m. catita* and many psittacine species in the wild: *Prosopeia tabuensis* (Rinke, 1989); *Cacatua pastinator* (Saunders et al. 1984); *Agapornis taranta* and *A. roseicollis* (Dilger, 1960); *Psittacula krameri* (Lack, 1968), but it is shorter than the 31 days observed in captivity by Caccamise and Alexandro (1976) working on the subspecies *catita*. Both *catita* and *monachus* have similar breeding parameters in the wild. The relative high proportion of nestlings killed by intraspecific as well as the asynchronous laying in the Monk Parakeet point up that this delayed laying could be a strategy to avoid the attack on conspecific chicks as was reported by Yom-Tov (1975) for the Common Crow (*Corvus corone*).

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