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USE OF MONK PARAKEET (*MYIOPSITTA MONACHUS*) NESTS BY SPECKLED TEAL (*ANAS FLAVIROSTRIS*) IN EASTERN ARGENTINA

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Resumen. – El uso de nidos de la Cotorra común (*Myiopsitta monachus*) por el Pato barcino (*Anas flavirostris*) en el este de Argentina. – La Cotorra común (*Myiopsitta monachus*) y el Pato barcino (*Anas flavirostris*) comparten una relación única entre psittácidos y anátidos. El Pato barcino ha modificando el hábito de anidar sobre el suelo, el cual es típico en los anátidos de la región, debido a que es capaz de utilizar las cámaras dentro de los nidos grandes y conspicuos construidos por las cotorras. Esta preferencia por sitios arbóreos tiene numerosas ventajas potenciales para la anidación, incluyendo la protección contra depredadores terrestres y la inundación periódica del campo. Los nidos de la Cotorra común son bastante duraderos y las parejas residentes mantienen activamente las cámaras ocupadas. Esto produce un recurso valioso y potencialmente reusable. Sin embargo, las cotorras ocupan los nidos durante todo el año y los defienden agresivamente frente a intrusos, incluyendo a los patos. Además, la disponibilidad de sitios arbóreos es limitada y produce una competencia intensa que puede generar un fracaso en la anidación. El Pato barcino no fue capaz de nidificar exitosamente en cámaras ocupadas por cotorras, aunque se observaron varios intentos de anidacion (n = 7). Los patos capaces de localizar nidos abandonados o cámaras disponibles dentro de nidos ocupados, generalmente obtuvieron éxito en la eclosión de sus huevos, en aquellos casos donde se conoce el resultado (12 de 17 tentativas).

Abstract.– Monk Parakeets (*Myiopsitta monachus*) and Speckled Teal (*Anas flavirostris*) share a relationship that is unique among psittacids and anatids. Utilizing chambers within the large, conspicuous nests constructed by the parakeets, the nesting behavior of Speckled Teal has diverged from the ground-nesting habits typical of other waterfowl in the region. This preference for arboreal sites has numerous potential advantages for nesting teal, including safety from periodic flooding of grasslands and from numerous terrestrial predators. Parakeet nests are fairly durable and resident pairs actively maintain occupied chambers. This produces a potentially re-usable and valuable resource for the teal. However, parakeets occupy stick nests year-round and aggressively defend their nests from intruders, including teal. In addition, availability of these arboreal sites is limited and produces intense competition for sites, potentially leading to a failure to nest. Teal were not observed to nest successfully in occupied parakeet nest chambers, although several clutches were initiated (n = 7). Teal successful in locating abandoned nests or available chambers within multi-chambered stick nests were generally successful in hatching a clutch when the outcome was known (12 of 17 attempts). *Accepted 29 October 2003.*

Key words: Anatidae, Speckled Teal, Monk Parakeet, *Anas flavirostris, Myiopsitta monachus*, nest adoption.

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INTRODUCTION

The relationship between Speckled Teal (*Anas flavirostris*) and Monk Parakeets (*Myiopsitta monachus*) is unique among anatids and psittacids. Monk parakeets themselves are unique among psittacids because they build large, enclosed stick nests that are often integrated into a compound nest containing the chambers of several breeding pairs (Navarro *et al.* 1992). These stick nests are conspicuous and are generally occupied throughout the year by breeding pairs and non-breeding individuals (Martella 1985, Martella & Bucher 1993).

The association between Speckled Teal and Monk Parakeets has long been known. Gibson (1920) noted that Speckled Teal prefer to lay in the chambers of Monk Parakeet nests in the province of Buenos Aires in eastern Argentina. Gibson (1919) records that nests were once exclusively found in the canopy of native tala (*Celtis tala*) trees but, since the introduction of eucalyptus (*Eucalyptus* spp.) trees to the region in 1872, the parakeets have begun nesting in the much taller eucalyptus. Plantations of eucalyptus often enable higher densities of parakeet nests (Navarro *et al.* 1992) and, in most places, *Eucalyptus* spp. groves now serve as the focal point for Speckled Teal breeding activity.

Speckled Teal are small, South American dabbling ducks most closely related to the North American Green-winged Teal (*Anas crecca*) (Johnson & Sorenson 1999). Widely distributed throughout southern and western South America, the range of the Speckled Teal overlaps widely with that of the Monk Parakeet. In contrast to their northern hemisphere relatives, the Speckled Teal have a preference for arboreal nest sites, typically the abandoned chambers in stick nests of Monk Parakeets (Port & McKinney 2001). In addition to the observations reported here, Speckled Teal have been reported nesting in parakeet nests in this and other parts of their range (Dabbene 1918, Aramburu 1990, Eberhard 1998).

Although Monk Parakeets typically occupy their nests year-round, nesting activity in much of Argentina does not begin until mid to late October (Navarro *et al.* 1992), several weeks after the initiation of Speckled Teal clutches. A reduced presence at the stick nests by parakeet pairs during the non-breeding season provides a narrow window of opportunity for prospecting Speckled Teal pairs. During the weeks preceding the onset of Monk Parakeet breeding, Speckled Teal have greater access to nest chambers and many initiate clutches in them. In addition, Monk Parakeet pairs occasionally abandon stick nests or cells within compound nests, leaving potentially useful chambers available for prospecting Speckled Teal pairs (Eberhard 1998).

STUDY AREA AND METHODS

Study area. These observations were made in the context of a larger study on Speckled Teal during August to December in 1990, 1991, 1992, and 1994. In 1993 observations were made between 10 September and 2 October. Observations were made on the Estancia Los Yngleses, a private sheep and cattle ranch in east central Buenos Aires province in central Argentina (36°30' S 57°30' W) (Fig. 1), about 450 km south of the city of Buenos Aires. There has been a concentration of breeding Speckled Teal on this ranch since at least 1879 when it was first described by Gibson (1879). The ranch is located on the eastern edge of the Argentine 'pampas', the open grasslands that extend over about 44,400,000 ha across central Argentina.

General landscape features and vegetation of the region were described by Gibson (1920; see also Weller 1967). Temperate in climate and receiving a moderately seasonal rainfall of 600 to 1200 mm each year, the

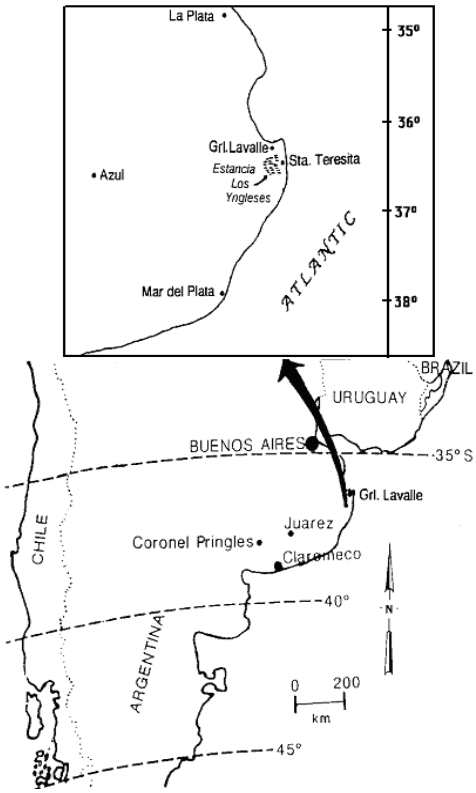

FIG. 1. Map of location of Estancia Los Yngleses, where observations were conducted.

coastal grasslands are interspersed with a network of freshwater wetlands, many of which are connected by tidal creeks to the nearby Atlantic Ocean. These wetlands rarely exceed 2 m in depth and shallow areas are typically dry by mid-summer. Most of the region is less than 9.1 m a.s.l. and subject to frequent flooding (Weller 1967).

The primary study site was a eucalyptus grove (hereafter called the grove) about 250 m in length, consisting of three rows of trees running parallel to the road leading into the estancia. About 100 m across the grasslands to the east, south and west of the grove, were a series of wetlands that served as feeding and roosting areas for teal using the area.

Methods. Individual Speckled Teal (220 males and 117 females) were captured and marked using the methods described in Port (1998a). Using binoculars and spotting scopes, marked Speckled Teal individuals were observed primarily during the morning hours for a total of 1587 h. Most observations were made from 4-m tower blinds constructed 35 m south of the grove or from vantage points near nests. Resighting data were obtained from daily observations of marked individuals using the study site during the breeding season. Accessible parakeet nests were monitored on a regular basis between 1990–1994. The contents of most natural nest chambers were checked every third day using a ladder. In addition to natural nests, we erected nest boxes (30 x 40 x 45 cm) 4–10 m above ground adjacent to parakeet nests in eucalyptus trees. Ten boxes were installed in 1991 and ten more in 1992. Inspections of nests were used to document laying patterns and the presence of nesting teal females. The onset of incubation was estimated using three criteria: (1) the amount of down placed within the nest cavity, (2) the external temperature of the eggs, and (3) the presence of the female on the nest. Nests were monitored for level of down and classified by degree (e.g., light, moderate, heavy). Warmth of eggs was determined by touch. Nests with eggs well covered by down during nest checks were also noted. Each nest was monitored throughout the incubation period. The use of three criteria was intended to minimize any error in estimates for the onset of incubation based solely on female presence, since females will spend considerable time on the nest while laying (Rohwer 1992). These same criteria were also used to help determine whether females had abandoned clutches.

While individual parakeets were not marked or followed from year to year, parakeet activity at individual nests was recorded during observations of Speckled Teal prospecting behavior. The onset of parakeet laying

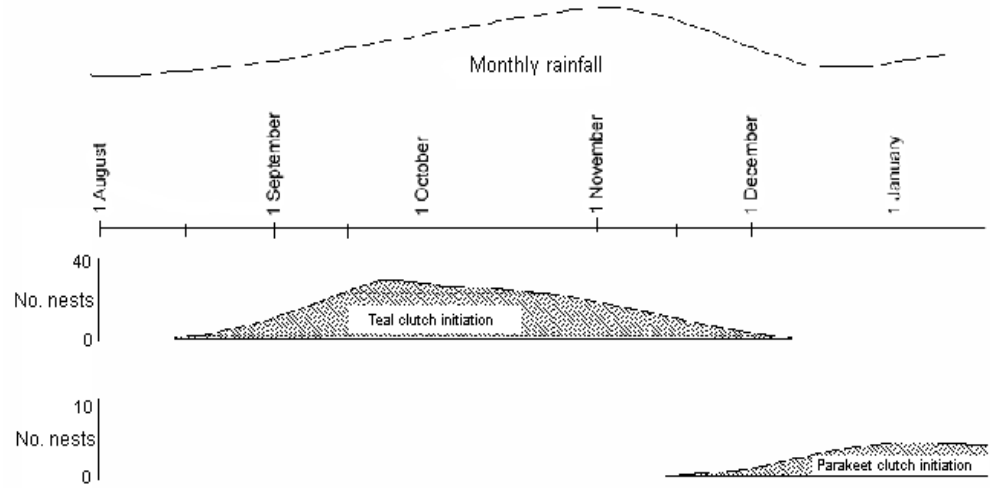

FIG. 2. Reproductive chronology of Speckled Teal and Monk Parakeet at the Los Yngleses study site. Data for 1991–1994 combined. Data after mid-December speculative.

was determined from the nest check data. We collected data on the aggressive encounters between parakeets and teal during 1990 (338 h of observation) as part of the monitoring of Speckled Teal behavior. Parakeet nests within the study area were censused annually and estimates of the number of parakeets present in the study grove were made through early morning counts prior to the exodus of most birds on feeding flights.

For statistical analysis, all test results report two-tailed probabilities. All tests were carried out using SYSTAT software (Wilkinson 1987).

RESULTS

Chronology of teal and parakeet nest initiations. Teal initiated nests beginning in mid-August on the study site and continued through September, October, and November before nest initiations tapered off in December. The earliest recorded nest initiation occurred on 9 August with peak initiations in late September (Fig. 2). This period of initiation was several weeks earlier than most parakeet laying activity on the study site. Parakeet laying did not begin prior to mid-November in any year and the earliest recorded egg within accessible nests in the grove occurred on 9 November. Most laying did not occur until late November and early December in this region.

In addition to a chronological gap between peak parakeet and teal breeding seasons, daily activity patterns of parakeets favored teal prospecting and laying activity in the morning hours. Most parakeets typically left the study grove shortly after sunrise to forage for 1–2 h. This exodus was easily observed as many of the birds would vocalize loudly prior to and during departure, leaving in a large group or several small flocks. Peak prospecting activity by Speckled Teal coincided with parakeet absence. Following the return of the parakeets to their stick nests, teal activity and success in entering nest chambers decreased.

Teal-parakeet interactions. Speckled Teal spent much of their time in the tree grove prospec-

tion for nests by flying up to collapsed stick nests, unoccupied but still intact parakeet nests, and both abandoned and active chambers in active parakeet nests (n = 3419 prospecting flights). Members of a pair usually approached these potential nest sites (n = 53 sites) together. Flights sometimes ended in actual visits to the nest, with the pair landing on or near the nest, or the female entering the nest chamber with the male landing on or near the nest (44.3 %, n = 1515 of 3419 prospecting flights). Monk Parakeets were generally aggressive towards any teal that approached or entered their nest chambers, or even abandoned or active nearby nests, by calling, threatening with an open bill, flying at, or chasing teal. Monk Parakeets were aggressive to Speckled Teal females on 27 occasions, and to pairs on 33 occasions, during attempts by teal to enter or land on a nest. Teal males, females, or pairs were displaced from nests by parakeets a total of 6 times, and females were harassed by parakeets when they were inside of nests on 16 occasions. Teal success in landing on, or entering a nest, was negatively affected by parakeet presence ($\chi^2 = 142$, df = 1, $P < 0.0001$, McNemar test). On rare occasions, Speckled Teal were aggressive to Monk Parakeets, including pecks and threatening with an open bill by females (n = 3), fights with physical contact by a female (n = 2), and a threat display by a male (n = 1). On two occasions, parakeets backed away when a female teal was occupying the nest chamber (n = 2 nests). In one of these nests, the female was eventually driven away by the parakeets after repeated attempts to enter the nest, and after laying eggs in it. In the other nest, the female successfully hatched a clutch. This female may have been successful because she nested early in the season (incubation began 16 September), and the three parakeets did not actively defend and tend the nest site until early November.

Availability of parakeet nests. Within the study grove, parakeet nests were located in eucalyptus trees. Most were located near the tops of these trees and often on the thin, brittle outer branches. The number of active parakeet nests increased from 13 with 22 chambers (1990) to 38 with 71 chambers (1994), although not all chambers were occupied. Parakeet numbers increased from about 40 in 1990 to near 70 in 1994. While accurate counts of the number of occupied parakeet chambers were difficult to obtain due to accessibility, estimates of those chambers unoccupied could be made based on observations of teal and parakeet activity. The number of unoccupied chambers in active nests known to be available to teal increased from three in 1990 to six in 1994. These unoccupied chambers were in nearly continuous use by teal throughout the breeding season. Active parakeet stick nests had a mean of 1.86 (SD = 0.93, n = 38) chambers per nest. The number of unoccupied parakeet nests that were visited by teal varied from nine in 1990 to three in 1994. All but two of these nests had one chamber.

Nest success. A total of 112 Speckled Teal clutches were initiated on the study site during the study period. Of this total, 27 were initiated in parakeet stick nests and 24 had a known result: 12 (50 %) hatched successfully, while the remaining 12 (50 %) were abandoned at various stages of laying or early incubation, or classified as destroyed. Three nests were not directly accessible and their outcome was unknown.

Competition for nest sites among prospecting teal pairs was intense, in part because of the inability of teal to take over nest chambers occupied by parakeets. No attempts to take over active parakeet nests were known to be successful, although one female used a nest that was actively occupied by parakeets only after her clutch hatched. This female incubated a clutch 16 September – 11 October,

TABLE 1. Clutch initiations by Speckled Teal in Monk Parakeet nests and outcome.

Year	Number of clutch initiations in occupied chambers (and hatch)	Number of clutch initiations in unoccupied chambers (and hatch)	Number of clutch initiations in unoccupied nests (and hatch)
1990	1 (0)	3 (1)[a]	3 (2)[c]
1991	3 (0)	1 (1)	2 (1)[d]
1992	1 (0)	0 (0)	2 (2)
1993	1 (0)	0 (0)	1 (1)
1994	1 (0)	5 (3)[b]	3 (1)[e]
Total	7 (0)	9 (5)	11 (7)

[a]Outcome of two nest initiations unknown.
[b]Outcome of one nest unknown and one clutch predated.
[c]One nest abandoned.
[d]One nest predated.
[e]Two nests abandoned.

and she and her mate received some harassment by parakeets on 3 and 9 October. Parakeets worked on the nest starting on 2 October, but did not consistently defend this nest against other teal until early November. Seven nest initiations were recorded in chambers occupied by parakeets but were abandoned prior to hatch. However, in five instances (one in 1990, one in 1991, three in 1994), females did successfully nest in empty cells of active multi-chambered stick nests (Table 1). A total of seven parakeet nest structures (three unoccupied and four with at least one unoccupied chamber) were used successfully by teal during the study. In five of these nests, teal hatched clutches successfully.

Unoccupied parakeet nests were the site of intense interest by teal prospecting for nests, and 11 teal clutches were initiated in these nests (Table 1). Seven of these attempts were successful, one clutch was predated, and three clutches were abandoned. Nine teal nests were initiated within unoccupied chambers of multi-chambered parakeet nests. Five of these attempts were successful.

The occupancy status of parakeet nests was subject to change from year to year. One parakeet nest was unoccupied from 1991 until 1993. Parakeets resumed residence in a portion of this nest in 1993, but the nest continued to have an unoccupied chamber. This nest was heavily used by teal and was the site of seven recorded initiations, of which five hatched successfully.

Longevity of parakeet nests. In general, parakeet stick nests were extremely durable. Eight of the 14 structures present at the beginning of the study were present at the conclusion, and several were added to during the course of the study. Parakeet pairs were diligent in the maintenance of these structures, continually repairing and adding to the nest. Storms frequently brought down portions of parakeet nests, and eight multi-chambered stick nests and large portions of five others were blown down during the course of the study. One nest was destroyed by the collapse of the nest structure, apparently as the result of its own weight.

DISCUSSION

The availability of Monk Parakeet nests over large areas in South America could have led to the present preference for arboreal nesting

sites by Speckled Teal in central Argentina. Teal have been documented using parakeet nests elsewhere in Argentina (Buenos Aires, Aramburu 1990; Entre Rios, Eberhard 1998), but the extent of this behavior is unknown. Potential advantages to the use of parakeet nests by Speckled Teal would be similar to those suggested for colonial nesting in parakeets and other birds, including increased ability to detect predators and security from clutch destruction by predators (Hoogland & Sherman 1976). Monk Parakeets build large nests consisting of multiple chambers, and several nests are often located in close proximity to each other within a tree or several neighboring trees. Although easily visible, nest sites are constructed of thorny twigs, and chambers typically have narrow entrances. Loud alarm calls given by resident parakeets ensure that predators do not approach chambers unnoticed (Martella 1985). Some nesting teal females flushed immediately after parakeet alarm calls, suggesting responsiveness to these calls. The use of other bird species for predator detection and protection is not unusual in waterfowl, having been documented in a number of different species (reviewed in Johnson *et al.* 1992).

Durably constructed, Monk Parakeet nests typically last several years and teal are able to return to existing, unoccupied chambers. Arboreal sites may also be important in areas subject to periodic flooding, since nest loss in ground nesting species can be frequent in these areas (e.g., Stoudt 1982, Majewski 1986). Strong nest-site fidelity, particularly among females nesting successfully, has been documented in this population (Port & McKinney 2001) and supports the hypothesis that parakeet chambers are a valuable resource to nesting Speckled Teal.

In this study, Speckled Teal initiated clutches exclusively in Monk Parakeet stick nests, old stick nests of other species, and adjacent nest boxes (Port & McKinney 2001). While teal do rarely nest on the ground in the surrounding area (M. Beade pers. com.), no ground nests were found on the study site. Grant (1911) and Gibson (1920) noted nesting primarily in parakeet nests, the exceptions being three elevated nests in debris-filled crotches of *Eucalyptus* trees (Gibson 1920). A clutch incubated on a debris pile in the crotch of a tree was also noted near Bariloche in southwestern Argentina (G. Brewer & F. McKinney pers. com.). In other areas where parakeets are scarce or absent, nesting presumably occurs on the ground as noted by Hudson (1920), but further studies of additional populations are needed.

While the move to arboreal sites can reduce the risk of nest loss due to periodic flooding, the use of arboreal sites may also entail costs. The use of the compound nests of Monk Parakeets often results in nesting colonies with several teal females nesting in close proximity. Among the potential costs associated with colonial nesting in the Speckled Teal are: 1) defense of limited nest sites due to intense competition (Port 1998a), 2) increased exposure of females to male forced copulation attempts, 3) abandonment due to interference at the nest by conspecifics (Port & McKinney 2001), and 4) increased risk of parasitic egglaying by conspecifics, as documented in other cavity nesting species (Semel *et al.* 1988).

In addition, Gibson (1920) noted that opossum were commonly present in Monk Parakeet nests and he believed they were potential competitors with the teal for chambers. White-eared opossum (*Didelphis albiventris)* were frequent visitors to artificial boxes and were responsible for the loss of both eggs and nesting females during the study (Port & McKinney 2001). We believe white-eared opossum were competitors for nest chambers and took female teal or eggs opportunistically. Opossum were observed returning to the grove in the early morning hours and moving

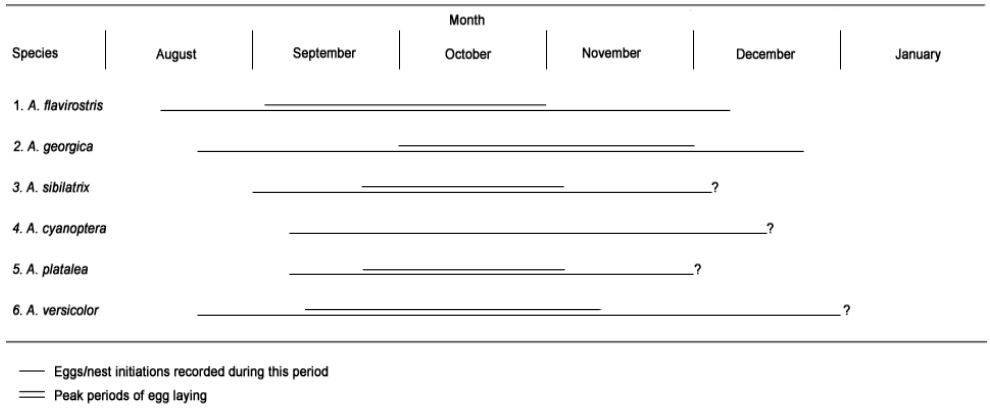

FIG. 3. Timing of egg laying by *Anas* species in the central provinces of Argentina (Buenos Aires, Entre Rios, La Pampa, Santa Fe). 1: data compiled from this study and G. Brewer (unpubl.); 2: from Gibson (1920), Wetmore (1926), and J. Port (unpubl.); 3: from Phillips (1922) and this study; 4: from Gibson (1920), Weller (1967), and this study; 5: from Johnsgard (1978); 6: from Gibson (1920), Nores & Yzurieta (1980), G. Brewer (unpubl.), and J. Port (unpubl.).

directly to a particular tree, immediately entering the chamber to bed during the daylight hours. Opossum are also predators on parakeet eggs and nestlings (Martella *et al.* 1985, Navarro *et al.* 1992).

Heavy reliance on parakeet chambers also reduces the number of sites available to prospecting teal pairs. Since parakeets defend their nest sites aggressively and teal appear unable to take over active parakeet nest chambers, the number of nest sites available to prospecting teal was limited. For example, in 1994, the year with the greatest number of stick nests, only six chambers were known to be available while an average of 40 pairs prospected within the study grove each day (Port & McKinney 2001).

The intense competition for nest sites may have led to 'risk taking' during nest site selection on the part of female teal. Many teal did not appear to be inhibited by the presence of parakeets in the selection of their nest sites. Prospecting pairs continued to attempt to inspect parakeet nests even if resident pairs were present. In addition, the departure of parakeets in the morning hours allowed teal to prospect and initiate nests without interference from the resident parakeet pairs. In some cases, this may have led to the initiation of nests and the laying of one to several eggs. However, once the female teal began spending time on the nest during the day, conflicts with resident parakeet pairs were inevitable and always led to the abandonment of the teal clutch prior to incubation (Table 1). The only observed instances of a teal nesting successfully within a parakeet stick nest occurred in either abandoned nests, abandoned cells within active multi-chambered nests, or nests where teal established themselves before a parakeet nest became active. Parakeets appeared relatively tolerant of teal prospecting unoccupied chambers, perhaps as a consequence of the close association between individual parakeet pairs and the chamber they have constructed. Eberhard (1998) observed that parakeet chambers are constructed individually by each pair and the multi-chambered nests may be the result of the ease of adding a chamber to an existing

structure, compared to constructing a new nest. If individual parakeet pairs are indeed defending only their individual chamber, it provides an explanation for the tolerance of resident parakeet pairs for nesting teal in neighboring, unoccupied chambers. It also provides the teal an opportunity to occupy relatively secure nest sites and obtain the benefits associated with the use of arboreal sites and colonial nesting. These benefits would include: 1) access to nest sites that are more difficult for predators to access, compared with ground nests, and 2) securing increased predator detection and deterrence. While competition for parakeet nest chambers is intense, continued use of these nests along with high nest-site fidelity suggests that breeding success is higher in parakeet chambers compared to nesting on the ground (Port & McKinney 2001).

The timing of teal nesting is also of interest. Teal initiate nesting starting in mid-August with greater than 80% of the nest initiations on the study site completed by the end of October. In contrast, most ground nesting anatids in the region do not initiate nesting until September or October (Fig. 3). Our observations, as well as those of Gibson (1920) and Weller (1967), suggest that Speckled Teal are among the earliest nesting *Anas* species in the region. We suggest that the timing of nesting is advantageous for the utilization of parakeet chambers. Parakeet nesting does not begin until mid-November and teal nesting in early spring can utilize parakeet chambers with less risk of disruption. In addition, early nesting by teal may be promoted by the early availability of arboreal nest sites. Upland and marsh nesting waterfowl must wait until later in the spring when drier and warmer conditions are appropriate for the initiation of clutches. Nesting in Speckled Teal is not limited by ground conditions and females can potentially initiate clutches much earlier in the season and perhaps even rear a second brood late in the breeding season (Port 1998b).

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