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Male Carolina Chickadees Provide More Parental Care

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Introduction

Parental care is an important factor affecting the fitness of offspring in many species. Many forms of parental care behavior have been documented in animals, among both living and extinct species, including the dinosaur ancestors of birds (Watanabe 2009). Parental care has been studied extensively in extant birds because most of these species have altricial young that require a great deal of care. The need for extensive care explains why over 75 % of bird species have biparental care (Cockburn 2006), unlike most mammals where female-only care is the norm. In birds, both male and female parental investment in the form of foraging and waste (fecal sac) removal is often extensive (Ketterson and Nolan 1994). Accordingly, parents must allocate energy to provide these parental behaviors while still maintaining enough energy to sustain themselves (Clutton-Brock 1991). In addition, sexual conflict between males and females over the relative amount of care to provide can occur when their fitness interests differ (Chapman et al. 2003), leading to different amounts of care being provided by each gender.

To investigate gender differences in parental behaviors, we studied parental care in the Carolina Chickadee (*Poecile carolinensis*), a widespread, non-migratory, cavity-nesting species that readily creates moss nests in artificial nest boxes erected close to forest edges (Brewer 1961; Mostrom et al. 2002). Carolina Chickadees are generally socially monogamous (Humann 2001). The plumage of the male and female does not differ between sexes, but males on average are larger in size (Mostrom et al 2002). Only females incubate the eggs, but males will provide food for incubating females. Carolina Chickadees typically produce one to two broods per year, with anywhere from 3-10 white and brown speckled eggs, and a mean of 5.8 eggs per brood (Mostrom et al. 2002). Both parents bring arthropod prey to the nest to feed nestlings and both remove fecal sacs from the nest (Humann 2001, Mostrom et al. 2002). Brewer (1961) noted that male Carolina Chickadees in an Illinois population seemed to provide more parental care than females to young nestlings, but little is known about the specific provisioning dynamics of male and female Carolina Chickadees.

To gather insight into the parental care of this species, we observed several wild Carolina Chickadee nests over two consecutive summers. We investigated whether provisioning rates changed over time and whether there were differences in provisioning and fecal sac removal rates between genders.

Methods

We conducted this study at St. Anne Convent in Melbourne, KY, during the summers of 2011 and 2012. We erected 30 nest boxes during early April 2011 and added eight more boxes in April 2012 to attract Carolina Chickadees. We inspected each nest every other day to check for new nesting activity. Once females laid eggs and began incubation, we captured and banded them with colored bands for identification. To determine parental provisioning rates, once the eggs hatched, we conducted 53 one-hour observation periods on 10 different nests.

We observed the birds with a viewing scope from a distance of approximately 30 m to reduce the chance of disturbing provisioning males and females. We conducted all observations between the hours of 0900 EDT and 1200 EDT. We did not begin observations if the parents

were disturbed because of our activities. If parents were disturbed (and giving alarm calls), we moved farther away or returned later to the nest. During the observation periods, we recorded the number of visits to the nest by each parent, as well as the number of fecal sac removals that occurred.

We analyzed our data using the statistical software R (R Development Core Team, 2006). Because we made repeated measures of the same individuals, we used linear mixed effects models with the individual bird as a random effect to control for the repeated measures. Our predictor variables were gender and number of days since hatching. Our response variables were number of provisioning visits per hour for the first model and number of fecal sac removals per hour for the second model.

Results

During this study we found that males visited the nest with food more times per hour than females ($F_{1,9} = 5.951, P = 0.037$, Figure 1) and also removed more fecal sacs per hour than females ($F_{1,9} = 5.899, P = 0.038$, Figure 1). We also found that provisioning increased as nestling age increased ($F_{1,42} = 33.567, P < 0.001$, Figure 2) and fecal sac removal also increased as nestling age increased ($F_{1,42} = 27.671, P < 0.001$, Figure 3).

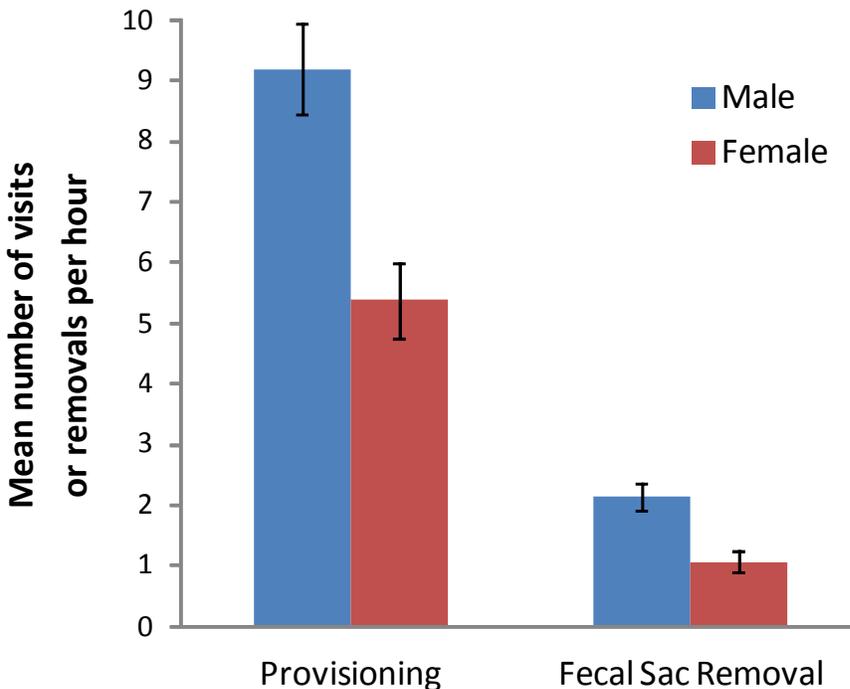


Figure 1. Comparison of mean provisioning rates and mean fecal sac removal rates (\pm SE) of males versus females. Both male provisioning rates and fecal sac removal rates were significantly higher than those of the female.

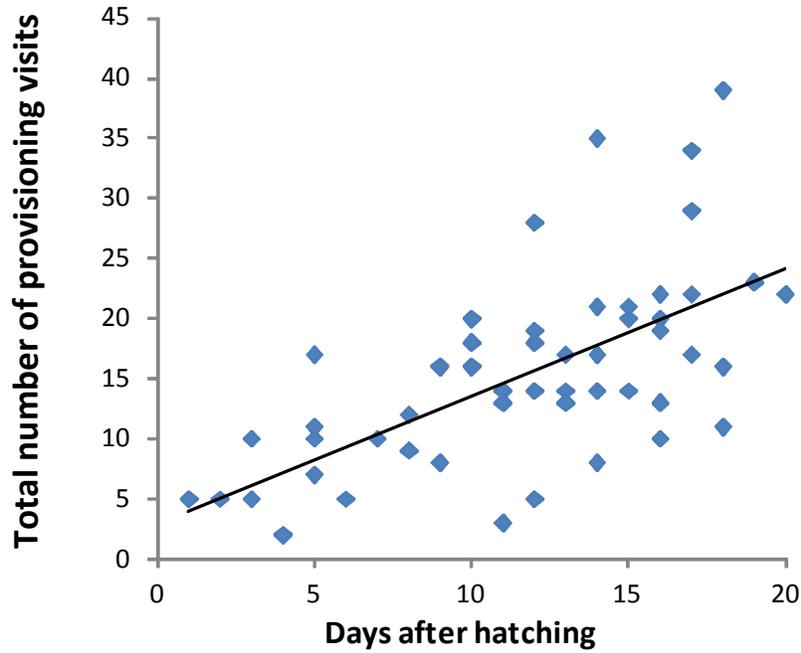


Figure 2. Total number of provisioning visits by both genders in one hour in comparison to age of the nestlings. Provisioning increased as the nestlings matured.

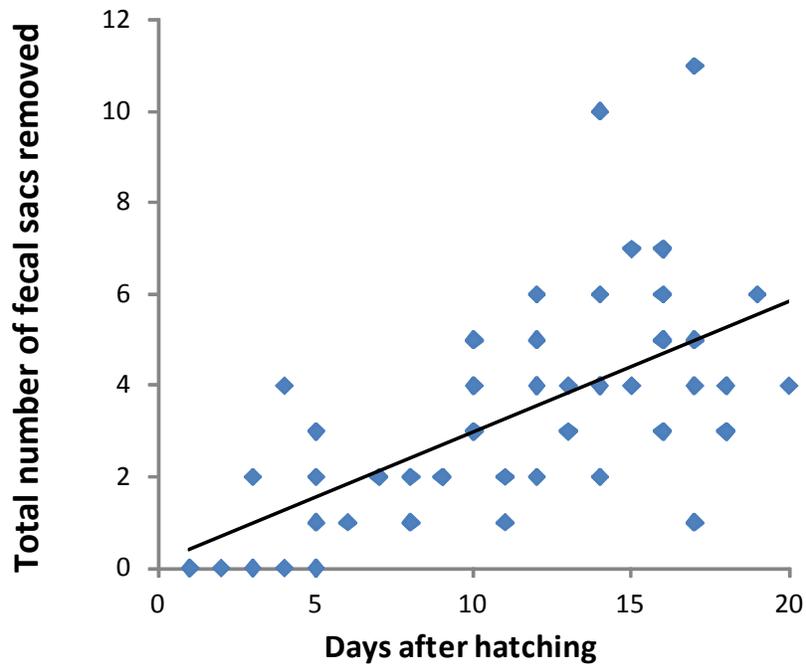


Figure 3. Total number of fecal sacs removed by both genders in one hour in comparison to age of the nestlings. Removals increased as the nestlings matured.

Discussion

We found that male Carolina Chickadees in our Kentucky study population both provisioned more and removed more fecal sacs than females. According to Ketterson and Nolan (1994), in avian taxa in which males resemble females in external appearance and morphology, males tend to care more for the offspring because female mate choice is driven more by the parental efforts of the male and less by physical attractiveness. This idea appears to hold true for our observations of the Carolina Chickadee, although males do not incubate their eggs as they do in other monomorphic species. Brewer (1961) reported that male Carolina Chickadees generally provisioned more than females in an Illinois population. Our results corroborate greater provisioning by males and also demonstrate that males perform more waste removal duties. We also found that both the number of visits and the number of fecal sacs removed increased as the hatchlings aged, likely a consequence of increased food consumption by growing hatchlings. Increased food consumption by chicks resulted in increased chick defecation.

Future studies about parental care in this species should investigate how males and females respond to changes in each other's parental effort. Hinde and Kilner (2007) found that Great Tit (*Parus major*) male and female parents matched provisioning efforts to each other, and that the amount of effort expended by a mate was more important than the begging calls of nestlings in determining provisioning effort. Since male Chickadees provide more care, it would be interesting to determine whether a female would increase her efforts if male provisioning were hindered.

Future studies are also warranted to determine how provisioning rates influence nestling fitness. We assume that more provisioning yields healthier chicks, thus enhancing parent (and chick) fitness, but that assumption has not been thoroughly tested. It would be interesting to follow Carolina Chickadee families for several years to see if the parents who provisioned more had a higher percentage of fledglings that survived to breeding age, and if those fledglings were more successful at fledging their broods. These investigations would shed needed insight into the general evolutionary principles behind the dynamics of biparental care in birds.

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