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FLORIDA SCRUB-JAY EGG AND NESTLING PREDATION: SNAKES, CONSPECIFICS, AND BREEDING PARENTS

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Abstract.—Florida Scrub-Jays, *Aphelocoma coerulescens*, are especially harmed by nest loss due to their threatened status and declining numbers. However, because of the difficulty in observing predation events, little is known about nest loss or the identity of the predators. I used a video-surveillance system to monitor active Florida Scrub-Jay (FSJ) nests for predation, and monitored 10 FSJ nests from April-June 2004 on Cape Canaveral Air Force Station, Brevard County, Florida. Nest predators included ratsnakes (*Pantherophis obsoletus* and *P. guttatus*; four nests) and Florida Scrub-Jays (three nests). One of these nests was abandoned and two nests successfully fledged young. In one predation event by FSJs the "predator" was the breeding female, who removed her two living nestlings from the nest; these presumably died. I discuss the influence that resource availability (suitable nesting habitat) may have on predation by FSJs, as well as the impact habitat quality may have on densities of other predators.

After habitat loss, egg and nestling loss are thought to be the leading factors in the continuing population decline of the Florida Scrub-Jay (*Aphelocoma coerulescens*), a federally-threatened species endemic to Florida. At Cape Canaveral Air Force Station (CCAFS) the mean nesting success rate is 43%, with a yearly range of 33-62% (Stevens and Knight 2004). During the 2004 breeding season, nesting success was 47% (*ibid.*). However, despite the dramatic impact nest predation has on populations of Florida Scrub-jays, predation events are rarely witnessed or studied. A few studies have shown or hypothesized predation of Florida Scrub-Jay (FSJ) eggs and nestlings by snakes, mammals, and birds (Schaub et al. 1992, Schoech 1999), including conspecifics (Garvin et al. 2002), but these observations are few in number.

Surveillance video allows continuous monitoring of nests with minimal disturbance and provides accurate predator identification (Stake et al. 2003, Cutler and Swann 1999). I used infrared, time-lapse video

cameras to identify FSJ nest predators, and found predation of FSJ eggs and nestlings by snakes, conspecifics, and breeding parents.

Florida Scrub-jays live and breed in distinct territories, averaging 0.9-1.2 ha in size (Breininger and Oddy 2004), that they defend against conspecifics. FSJs live in family groups of two to four birds on average, and exhibit a cooperative breeding behavior in which the breeding pair is assisted by nonbreeding adult helpers. Helpers participate in feeding the young and in defending the nest and the surrounding territory. The presence of helpers increases the number of offspring that a breeding pair produces (Woolfenden and Fitzpatrick 1984), most likely because helpers reduce predation on eggs and nestlings (Woolfenden 1978) by serving as sentinels (McGowan and Woolfenden 1989) or by mobbing predators (Francis et al. 1989). However, these behaviors are not employed at night would therefore not help to reduce predation at night (Woolfenden and Fitzpatrick 1984).

METHODS

From 6 April to 22 June 2004 I monitored Florida Scrub-Jay nests on Cape Canaveral Air Force Station (CCAFS), Brevard County, Florida. This site contains approximately 113 resident groups of Florida Scrub-Jays that have been the focus of an ongoing population census and demographic study since 1995. All nests I monitored were located in one of two distinct habitats on CCAFS: coastal strand or coastal oak scrub. The coastal strand site, which supports the highest density of FSJs, is open habitat with low (<2 m), sparse vegetation and ample open spaces in which birds can forage and cache acorns. The coastal scrub site contains scrub vegetation consisting primarily of saw palmetto (*Serenoa repens*) and young, 1-2-m oaks (*Quercus* spp.). As a result of fire suppression, this site is dense with few natural openings, limiting foraging and food-caching spaces available for FSJs.

I placed time-lapse video recorder units (Sentinel Video Camera Surveillance Systems), consisting of a camera and videocassette recorder, on 10 active FSJ nests to monitor predation and identify predators. Cameras, measuring10 $\times$ 6 cm and equipped with infrared lighting to view nocturnal activity, were attached with cable ties to branches about 20-30 cm from a nest and focused directly on the nest contents. Each was connected to a videocassette recorder housed in a waterproof case. VCR units used 8-hour VHS tapes, and were powered by 12-V, rechargeable, marine, deep-cycle batteries. VCR units were set to allow 24 hours of continuous recording on a single tape. I checked nests daily for predation by connecting a handheld viewer to the VCR unit, which was located at least 50 m from nests, so that nests were minimally disturbed. Incubating females typically remained on nests during these daily checks, or returned to nests within 5 min if they flushed. The tapes and batteries were changed daily, and tapes were viewed to check for predation or abnormal nesting behavior due to the presence of the recorders.

Each time I set up a camera on a new nest, I either waited until the female returned to the nest, or I returned to the nest 30 minutes afterwards and viewed the tape using the hand-held monitor. I did this to ensure that females returned to the nests and continued incubating. In one case the female did not return within 30 minutes, and I immediately removed the camera unit.

All recordings were begun during the incubation period to minimize abandonment, and continued either until the nest was predated or the young fledged. I defined a predation event as one in which at least one egg or nestling was removed from an active nest.

RESULTS

The ten nests were located in oak trees (*Quercus* spp.) and ranged from 1-2.5 m in height (Table 1). Of these nests, two successfully fledged young (one in the coastal strand site and one in the coastal scrub site), seven were predated, and one was abandoned.

The abandoned nest was monitored from 7-12 May, during which time it contained four eggs of unknown age. This group consisted of two adults with a territory in the coastal scrub site. After mounting the camera at 0800 on 7 May, the female was seen on tape incubating the eggs on 7 and 8 May. After 0730 on 8 May, although the female was seen in the area, she did not return to the nest, and the camera unit was disassembled on 12 May. The reason for abandonment is unknown. The presence of the camera is a consideration, although the return of the female to the nest after the camera was mounted suggests that other factors may have been involved.

Predation by snakes—Snakes were predators at four (57%) of the seven nests that suffered predation. All four were predated during the

Table 1. Summary of observations at ten Florida Scrub-Jay nests monitored between April and June 2004 on Cape Canaveral Air Force Station. Nestlings age is calculated using hatching day as equal to Day 0 (D0).

Nest	Dates observed	Site	Group members	Nest contents at start	Fate of nest	Predator
1	6-29 Apr	Coastal Scrub	3	4 eggs	1 nestling (D10) taken	Ratsnake, *Pantherophis* sp.
2	6-30 Apr	Coastal Scrub	2	4 eggs	4 nestlings (D5) taken	Red Ratsnake, *Pantherophis guttatus*
3	4-22 May	Coastal Scrub	2	4 eggs	1 egg not viable; 3 nestlings (D10) taken	Red Ratsnake
4	7-12 May	Coastal Scrub	2	4 eggs	nest abandoned	
5	14-30 May	Coastal Scrub	2	4 eggs	2 eggs not viable; 2 nestlings (D3) taken	FSJ, Breeding female
6	23 May-6 Jun	Coastal Scrub	2	4 eggs	4 nestlings fledged on 21 Jun	
7	28-31 May	Coastal Scrub	2	3 eggs	1 nestling (D0/1) taken	Red Ratsnake
8	4-5 May	Coastal Strand	4	4 eggs	4 eggs taken	FSJ
9	5-25 May	Coastal Strand	4	4 eggs	4 nestlings fledged on 25 May	
10	2-19 Jun	Coastal Strand	2	3 eggs	1 egg broken, 2 eggs taken on 18 Jun	Unidentified (broke 1 egg) FSJ (took 2 eggs)

nestling stage, and all predations occurred at night while the female was sitting on the nest. In addition, all these nests were located in the coastal scrub (Table 1).

Predation by FSJs—FSJs were identified as predators at three of the seven lost nests (Table 1). In the first two cases, both located in the coastal scrub site, I do not know whether the predators were members of a neighboring group or part of the breeding group. In the third case, which occurred in the coastal strand site, the breeding female removed her two living nestlings, which were three days old. I discuss these three cases in more detail below.

On 4 May I positioned a camera on Nest 8. This group consisted of four adult FSJs with a territory in the coastal strand site. Although both the male and female had been breeders in previous years, this was their first year to breed together. The nest was located 1.5 m high on the northern edge of their territory. The camera was set up at 0930, at which time the nest contained four eggs, age unknown. At 0940 the female returned to the nest and incubated the eggs for 4-5 min. before leaving again. At 0952 a FSJ, identity unknown, perched at the edge of the nest, picked up one of the eggs in its bill, and flew away. This occurred twice more between 0952 and 0958. At 1024 a FSJ returned, pecked a hole in the remaining egg and ingested the contents before flying away. I removed the camera on 5 May. It is unknown whether the predator(s) of this nest were group members or invading birds; the position of the camera on the nest was not wide enough to capture territorial or defensive behaviors that may have occurred. Territories in the coastal strand site are close to one another, and I frequently saw birds in these groups trespassing in neighboring territories. The short time between the mounting of the camera and the predation of the nest is of concern. It is possible that distress due to the presence of the camera caused the nesting female to leave the nest unguarded, thus giving access to a neighboring group. (There was no disturbance due to the presence of people at this time, as I left the area immediately after seeing the female return to the nest.) Subsequent observations discussed below suggest that members of the breeding group could have removed eggs from the nest.

I monitored Nest 10, belonging to a group of two adults in the coastal strand site, from 2-19 June. The nest contained two eggs at the start, and a third egg was laid on 3 June. On 18 June one of the eggs in the nest was found to have a 1-cm^2 hole in the shell, although the contents had not been disturbed and the other two eggs were unbroken. The cause of this hole is unknown; it was not captured on tape due to technical problems. On 19 June the nest contained no eggs, and the tape revealed that the female had not incubated the eggs at any time on 18 June. The tape also showed that at 0230 on 18 June a FSJ removed all three eggs from the nest. As there are no other jay groups

near this group, it is probable that the breeding pair removed the eggs. Another possibility is that the eggs were not viable. When the predation occurred, the female had been incubating the eggs for at least 17 days, and yet the broken egg was completely undeveloped upon inspection on 18 June. This breeding pair has never successfully fledged a brood in five years of courtship; it is possible that their egg clutches are never viable or have always been destroyed by one of the pair.

I monitored Nest 5 from 14 May-30 May. This group, located in the coastal scrub site, consisted of two adults. The pair was newly formed during the 2004 breeding season, and it was the first breeding season for both the male and female. When monitoring began their nest contained four eggs, laid around 9 May. On 21 May a prescribed fire unexpectedly came within 3 m of the nest, burning the surrounding vegetation on two sides. During the fire the female was away from the nest for approximately three hours on the evening of 21 May. After this time the female continued to incubate, and two of the four eggs hatched on 27 May; the other two eggs, presumably not viable, were later removed from the nest by the breeding pair. From hatching until 30 May both parents participated in feeding the young, and the female was rarely away from the nest. On 30 May at 0931 the female raised herself from sitting on the nest, picked up one of the living nestlings, aged Day 3, and flew away with it in her bill. She then returned to the nest without the nestling she had removed, and continued to sit on the nest with the remaining nestling. At 1100 she once again got up from the nest, picked up the final living nestling, and removed it. Both nestlings were alive and seen moving in her bill when she picked them up and flew away. After removing the nestlings, both adults returned to the nest frequently for the rest of the day, and several times the female sat on the nest for a few minutes before getting up, inspecting it, and leaving. It is known that birds will remove unviable eggs (seen in this study) or dead nestlings from the nest; however, the removal of living nestlings by a parent is unusual. In this case, the presence of the camera is not thought to have been a contributing factor, as the female continuously sat on the nest during the 16 days of monitoring prior to removing the nestlings, and both parents exhibited normal behavior in caring for the young.

DISCUSSION

Although predation rates of FSJ nests have been monitored on CCAFS since 1995, predation events are witnessed only rarely. I was able to monitor 10 FSJ nests, seven of which suffered predation. Unexpectedly, FSJs were the predators in three of these cases.

Two of the three instances of conspecific predation occurred in the coastal strand site. One reason for conspecific predation may be compe-

tition among groups for food. The coastal strand site is the most suitable habitat on CCAFS, based on scrub height and percent open space (see Breininger and Oddy 2004 and references therein), and contains the highest concentration of jay groups; however, there are few to no acorn-producing trees within these breeding territories. This site also has far less vegetation than the coastal scrub site overall, which may limit the availability of insects as well. Heightened competition for food, as well as for territory, could lead to conspecific predation. In addition, overlapping territories of groups in this site may result in jays discovering conspecifics' nests more frequently. FSJs will take advantage of unprotected eggs as a food source (Antworth et al. 2005, unpublished manuscript), and disruptions within the territories of nesting groups, such as the invasion of neighboring groups, could cause females to temporarily leave their nests, thus exposing them to conspecifics (Garvin et al. 2002). Researchers should be aware of this possibility when searching for, and drawing attention to, FSJ nests. Group stability may also be a contributing factor; the breeding pair of Nest 5 was a newly-formed pair, although both members successfully nested as part of a different pair in previous years.

Although conspecific predation is thought to be an uncommon phenomenon, especially in species where groups defend both the nest site and the territory surrounding the nest (Garvin et al. 2002), my results suggest that it may occur more frequently than previously thought. This is possibly due to limited quality habitat in which FSJs reside and breed; habitat maintenance and restoration may be needed in order to create more optimal habitat and decrease competition among groups.

Instances of infanticide in FSJs have not been previously documented. Members of the breeding pair in this case were both first-time breeders and inexperienced in raising young, which may have contributed to the display of this behavior. The prescribed fire that came close to the nest may have been a factor; however, after the fire the female continued to incubate, and later she and the male were seen to care for the nestlings with perceived normalcy. Although the removal of one's own living young is probably a rare occurrence, the frequency with which it occurs is unknown.

All predation by snakes occurred in the coastal scrub site which primarily consisted of overgrown, dense vegetation. Such habitat may facilitate high snake densities, as snakes may be more hidden from their own predators in thicker vegetation but still able to view activity at nests (Mullin and Cooper 2000). In addition, dense vegetation may also enable snakes to search an area more efficiently for avian nests, since these arboreal predators would not have to descend to the ground during searching and could randomly search a greater amount of vegetation (Keller and Heske 2000, Weatherhead and Charland 1985).

At the first nest (monitored from 6-29 April) only one nestling was taken. After removing the first nestling (and presumably ingesting it), the snake returned to the nest for approximately one minute, but did not remove any of the three remaining nestlings, possibly because the seemingly small size of the snake did not allow it to ingest additional nestlings.

Brood reduction is a common occurrence in FSJs (Stevens and Knight 2004; personal observation), although this is typically attributed to the natural death of unhealthy nestlings, or to the starvation of nestlings low in weight. This observation suggests that brood reduction may be the result of predation.

More studies of this type are needed in order to gain a better understanding of predation, the species of predators, and the involvement of FSJs in removal of eggs or young from their own or nearby nests of conspecifics. Other studies have shown links between habitat quality and reproductive success (Schaub et al. 1992, Breininger et al. 1998, Fitzpatrick and Woolfenden 1986). Reduced success seems likely related to increased predator densities in unburned, overgrown vegetation. Proper habitat management therefore seems to be an important step in controlling predator densities and creating suitable nesting areas in order to prevent further population decline.

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LITERATURE CITED

BATÁRY, P., AND A. BÁLDI. 2004. Evidence of an edge effect on avian nest success. Conservation Biology 18:389-400.

BOWMAN, R., AND G. E. WOOLFENDEN. 2002. Nest site selection by Florida Scrub-Jays in natural and human-modified habitats. Wilson Bulletin 114:128-135.

BREININGER, D. R., V. L. LARSON, B. W. DUNCAN, AND R. B. SMITH. 1998. Linking habitat suitability to demographic success in Florida Scrub-Jays. Wildlife Society Bulletin 26:118-128.

BREININGER, D. R., AND D. M. ODDY. 2004. Do habitat potential, population density, and fires influence scrub-jay source-sink dynamics? Ecological Applications 14:1079-1089.

CONNER, L. M., AND M. W. PERKINS. 2003. Nest predator use of food plots within a forest matrix: an experiment using artificial nests. Forest Ecology and Management 179:223-229.

CUTLER, T. L., AND D. E. SWAN. 1999. Using remote photography in wildlife ecology: a review. Wildlife Society Bulletin 27:571-581.

FITZPATRICK, J. W., AND G. E. WOOLFENDEN. 1986. Demographic routes to cooperative breeding in some New World jays. Pages 137-160 *in* Evolution of Animal Behavior (M. H. Nitecki and J. A. Kitchell, eds.). Oxford University Press, New York.

FRANCIS, A. M., J. P. HAILMAN, AND G. E. WOOLFENDEN. 1989. Mobbing by Florida Scrub Jays: Behaviour, sexual asymmetry, role of helpers and ontogeny. Animal Behavior 38:795-816.

GARVIN, J. C., S. J. REYNOLDS, AND S. J. SCHOECH. 2002. Conspecific egg predation by Florida Scrub-Jays. Wilson Bulletin 114:136-139.

KELLER, W. L., AND E. J. HESKE. 2000. Habitat use by three species of snakes at the Middle Fork Fish and Wildlife Area, Illinois. Journal of Herpetology 34:558-564.

MARTIN, T. E. 1993. Nest predation and nest sites: new perspectives on old patterns. BioScience 43:523-533.

MCGOWAN, K. J., AND G. E. WOOLFENDEN. 1989. A sentinel system in the Florida Scrub Jay. Animal Behavior 37:1000-1006.

MULLIN, S. J., AND R. J. COOPER. 2000. The foraging ecology of the gray rat snake (*Elaphe obsolete spiloides)*. II. Influence of habitat structural complexity when searching for arboreal avian prey. Amphibia-Reptilia 21:211-222.

SCHAUB, R., R. L. MUMME, AND G. E. WOOLFENDEN. 1992. Predation of the eggs and nestlings of Florida Scrub Jays. Auk 109:585-593.

SCHNEIDER, M. F. 2001. Habitat loss, fragmentation and predator impact: Spatial implications for prey conservation. Journal of Applied Ecology 38:720-735.

SCHOECH, S. J. 1999. Florida Scrub-Jay nestlings preyed upon by an eastern coachwhip. Florida Field Naturalist 27:57-58.

STAKE, M. M., J. FAABORG, AND F. R. THOMPSON III. 2004. Video identification of predators at Golden-cheeked Warblers nests. Journal of Field Ornithology 75:337-344.

STEVENS, E. E., AND G. KNIGHT. 2004. Annual report: 2003-2004: Status and distribution of the Florida Scrub-Jays (*Aphelocoma coerulescens)* at Cape Canaveral Air Force Station, FL.

WEATHERHEAD, P. J., AND M. B. CHARLAND. 1985. Habitat selection in an Ontario population of the snake *Elaphe obsoleta*. Journal of Herpetology 19:12-19.

WOOLFENDEN, G. E. 1978. Growth and survival of Florida Scrub Jays. Wilson Bulletin 90:1-18.

WOOLFENDEN, G. E., AND J. W. FITZPATRICK. 1984. The Florida Scrub Jay: Demography of a Cooperative-breeding Bird. Princeton University Press, Princeton, NJ.

WOOLFENDEN, G. E., AND J. W. FITZPATRICK. 1996. Florida Scrub-Jay (*Aphelocoma coerulescens)*. *In* The Birds of North America, No. 228 (A Poole and F. Gill, eds.). Academy of Natural Sciences, Philadelphia, Pennsylvania, and The American Ornithologists' Union, Washington, D.C.