The Wilson Journal of Ornithology 119(1):118–121, 2007

Wild Great Hornbills (*Buceros bicornis*) Do Not Use Mud to Seal Nest Cavities

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ABSTRACT.—The literature pertaining to nesting of the Great Hornbill (*Buceros bicornis*) is ambiguous regarding whether the birds use mud as plaster material to seal their nest cavity entrances. We studied the breeding biology of the species in southern India and detected no evidence of mud delivery or usage in 183 hrs of nest observations. Chemical analysis of plaster material showed that it was composed exclusively of fecal material and not mud. *Received 15 May 2006. Accepted 9 August 2006.*

The Great Hornbill (*Buceros bicornis*) is a large, principally frugivorous, and endangered species of south- and southeast Asian rainforests. Its nesting habits are largely typical of the family. The female becomes sealed in a tree cavity and remains in confinement during incubation and for a period after hatching of the chick (Kannan 1994, Kannan and James 1997). There is considerable ambiguity in the literature concerning whether the species uses mud in sealing its nest cavities. Some authors indicated that mud was used, some were uncertain if mud was used, and some categorically stated that mud was not used. No quantitative evidence exists and statements made by previous authors have been based mostly on anecdotal observations. Hume (1890: 69), quoting others who observed the nesting behavior of the species in Burma (Myanmar), indicated the nest entrance was ‘‘covered with a thick layer of mud.’’ Hume (1890: 70) also included nebulous statements attributed to others about ‘‘the male plastering the female in with his ordure’’ and the plaster being ‘‘composed of dung and earth.’’ Bingham (1897: 309) wrote that all five nests he examined in Burma had their entrance covered with ‘‘a plastering of earth leaf-mould and the birds’ own droppings.’’ Poonswad et al. (1987: 260) presented a rough composition of sealing material from adjacent Thailand, which showed earthen material only in miniscule amounts, the rest being ‘‘wood dust, piece of wood, (and) food debris’’, about one-third each. Baker (1927: 285, 1934: 429) stated that the male ‘‘sometimes, but not always’’ brings wet mud, remains of fruit, and his own droppings. Ali and Ripley (1970: 145), describing the race *B. b. homrai* of southern India, indicated the nest entrance was an amalgam of the female’s dung and remains of figs, bits of leaves and sticks, ‘‘possibly supplemented with wet mud brought by the male.’’ Kemp (1995: 181), describing the species’ habits, wrote that it hops when on the ground to feed on fallen fruit, to search for animals along stream banks, ‘‘or to collect soil for sealing.’’ He also wrote the nest entrance is sealed with droppings, chewed pieces of wood and bark, food and nest debris, but ‘‘little if any soil.’’ The species has been observed to descend to the ground occasionally to collect fallen fruit (Ali and Ripley 1970), but Kemp’s (1995) description of it collecting soil from the ground is the only mention in the literature. Datta (2001) was the only report that unequivocally stated no mud usage in a 4-yr study (416 hrs of observations) involving eight nests in northeast India. All nests in her study were sealed with fecal material of the female, which was comprised mainly of fig seeds (Aparajita Datta, pers. comm.).

The ambiguity also extends into the literature on captive breeding accounts of the Great Hornbill. Stott (1951: 114) wrote the material used by the species during an unsuccessful breeding attempt in the San Diego Zoo was gray and apparently non-granular in texture, ‘‘and may well have included among its components the fine sand that had been placed in

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TABLE 1. Composition (%) of Great Hornbill nest plaster (obtained from the Western Ghats of southern India), feces, and top soil.

	Chemical elements							
	P	K	Ca	Mg	S	N	Total ash	Total organic
Hornbill plaster[a]	0.2	2.1	1.5	0.3	0.2	2.0	15	85
Chicken feces[b]	1.3	1.2	2.9	0.6	0.8	5.0	8[c]	92
Cattle feces[b]	0.7	1.7	2.9	0.6	0.2	2.0	19[d]	81
Tropical soil[e]						0.2	96	4

[a] Present study.
[b] Spector 1956 (Table 159).
[c] Gerry 1968.
[d] Ensminger et al. 1990.
[e] Sanchez 1976.

the bottom of the nesting barrel.'' Poulsen (1970) and Choy (1980) reported a mixture of mud, the birds' feces, and mashed fruits as plaster material used in zoos in Denmark and Singapore, respectively. (The former breeding attempt was abandoned after partial nest sealing, and the latter was successful). Reports from three other captive breeding attempts (all successful), one in the United Kingdom (Golding and Williams 1986), and two in the United States (Bohmke 1987, Thormahlen and Healy 1990), unequivocally indicated no mud was used in the sealing process. Golding and Williams (1986) and Bohmke (1987) did not say whether mud was made available to the birds, but Thormahlen and Healy (1990) stated that mud was not provided.

Darwin (1871: 778) reported ''The female Horn-bill (*Buceros*) . . . plasters up with her own excrement the orifice of the hole in which she sits on her eggs.'' This is an apparent early confirmation that only excrement constituted the plaster. He quoted the earlier observation of Horne (1869). However, inspection of the paper by Horne (1869) shows he was referring to the Indian Grey Hornbill then named *Meniceros birostris* now *Ocyceros birostris* (Grimmett et al. 1999), which Horne incorrectly gave the trivial name *bicornis*. Darwin incorrectly thought Horne was describing *Buceros bicornis*.

OBSERVATIONS

We observed a nest of the Great Hornbill in the Anaimalai Hills of the Western Ghats of southern India in 1992 and 1993. We found no evidence of mud delivery or usage in 183 hrs of observation. The female was observed to only use her feces as plaster material. After exit of the female, the chick was observed to use exclusively its feces for resealing the entrance. The male did not participate in nest sealing (Kannan 1994, Kannan and James 1997).

We verified these observations by collecting broken chunks of plaster that had fallen to the ground on the fecal midden at the base of the nest tree and had the chunks analyzed for chemical element composition, total ash, and organic components at the Agricultural Services Diagnostic Laboratory, University of Arkansas, United States. The values obtained were compared with published information on the properties of tropical soil, chicken feces, and cattle feces (Table 1).

The data from the plaster sample matched the chemical composition of chicken and cattle fecal material (Spector 1956, Gerry 1968, Ensminger et al. 1990), and was different (Table 1) from the low nitrogen, high total ash, and low total organic content of tropical soil (Sanchez 1976). Thus, the plaster used to seal the nest cavity opening was wholly fecal material without an admixture of soil. Chicken fecal matter was included (Table 1) to represent a bird and cattle manure was added to characterize an animal with a vegetarian diet to compare with the fruity and mainly vegetarian diet of the hornbill (Kannan 1994).

DISCUSSION

There are three possible reasons for the ambiguity in the literature about hornbill sealing material. First, early authors such as Hume (1890) could have mistaken the sealing material to be mud because of its earthen appearance. Ali and Ripley (1970) noted the plaster dries to the consistency and appearance of sunbaked clay. Second, some authors may have merely assumed mud to be involved because use of mud is widespread in other species in the family (Kemp 1979, 1995). This error may have been perpetuated in subsequent writings. The commonly used phrase for plastering, ‘‘mudding up’’, (used by Golding and Williams [1986] who reported no mud!), may have further contributed to this assumption. Finally, it is possible this species uses mud opportunistically when the need arises. Captive birds use mud only when cementing material such as rotting wood, wood shavings, and squashed fruit are not available (Thormahlen and Healy 1990; S. Y. Healy, pers. comm.). Captive birds may need cementing material in addition to their feces because they are usually offered a diet of mixed soft fruits (Christine Sheppard, pers. comm.). This renders their excreta poor in tiny seeds such as fig (*Ficus*) found abundantly in feces of wild birds. One report from captivity indicated a chronic problem of the plaster failing to adhere properly to the cavity opening (Thormahlen and Healy 1990). Thus, an opportunistic inclusion of mud in the plastering material seems plausible in captivity. Mud usage in the wild is highly unlikely because the myriads of tiny fig seeds in the feces apparently hold the plaster together ‘‘much like gravel in a concrete mix’’ (Kannan and James 1997: 455). This makes mud or any cementing mixture other than its own feces unnecessary. The issue of whether mud is used in captivity and if mud should be furnished to captive birds may have conservation implications because captive breeding of endangered hornbills is one of the proposed ways to manage these species (Kemp 1995).

Kemp’s (1995) assertion that wild Great Hornbills descend to the ground to collect mud for sealing is probably based on a logical assumption (i.e., if the birds use mud, they have to get it from the ground) rather than direct observation. We did not observe Great Hornbills descend to the ground in two years of intense observations in the wild. With the exception of Datta (2001), all studies on wild birds indicated use of mud as sealing material. Our field observations, albeit from just one nest, are supported by those of Datta (2001) from multiple nests. Our chemical analysis data and field observations, and the fact that the species has not been reliably observed in the wild to collect mud from the ground, indicate that wild Great Hornbills do not use mud for plastering their nest cavity entrances, but instead exclusively use fecal material.

ACKNOWLEDGMENTS

Financial support came from the Wildlife Conservation Society, the Oriental Bird Club (via Ornitholidays), the Arkansas Audubon Society Trust, and B. R. Chander, M. D. The tribal people of the Anaimalai Hills, especially Natarajan and Ganesh, located most of the nests. The Tamil Nadu Forest Department permitted our work inside the Indira Gandhi Wildlife Sanctuary. A. C. Kemp, T. R. Shankar Raman, D. C. Mudappa, Aparajita Datta, and an anonymous reviewer made comments that improved the manuscript. Christine Sheppard and S. Y. Healy offered helpful advice and suggestions regarding hornbills in captivity. Several hornbill researchers attending the 4th International Hornbill Conference in South Africa made useful comments on a poster of this paper.

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The Wilson Journal of Ornithology 119(1):121–124, 2007

First Description of the Nest, Eggs, and Breeding Behavior of the Mérida Tapaculo (*Scytalopus meridanus*)

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ABSTRACT.—We provide the first description of the nest, eggs, and breeding behavior of the Mérida Tapaculo (*Scytalopus meridanus*). Data are from one pair in the moist cloud forest of Yacambu National Park, Venezuela during April–May 2004. Two nests, constructed by the same pair, were globular in structure and consisted of mossy material placed in a rock crevice of a muddy rock wall. The eggs were cream colored with an average mass of 4.19 g. Clutch sizes were one in the first nest and two in the second. The species showed bi-parental care in nest building and incubation. Nest attentiveness (percent time spent on the nest incubating) averaged 83.4 ± 14% (SD). Average on and off bouts were 33.24 and 6.34 min, respectively.

Received 22 December 2005. Accepted 11 August 2006.

Breeding biology and life history traits of tropical birds remain poorly known. Nests have not been found nor described for many species limiting our knowledge and understanding of tropical life histories. Of approximately 40 currently recognized species of *Scytalopus*, nests of ~12 species have been described (Sclater and Salvin 1879; Skutch 1972; Stiles 1979; Hilty and Brown 1986; Sick 1993; Krabbe and Schulenberg 1997, 2003; Christian 2001; Young and Zuchowski 2003; Greeney and Gelis 2005; Greeney and Rombough 2005). *Scytalopus* is found throughout the Andes from Central America to Tierra del Fuego Island (Fjeldså and Krabbe 1990, Krabbe and Schulenberg 2003). We present data on life history traits (nest description, clutch size, egg mass, nest building, egg laying, and incubation investment) of *Scytalopus meridanus* in Yacambu National Park, a wet cloud forest of north central Venezuela (09° 42′ N, 69° 42′ W; 1,900 m elevation).

Scytalopus are elusive birds, often only detectable by sound (Hilty et al. 2003, Krabbe and Schulenberg 2003). *Scytalopus meridanus*, a small 16.5-g bird, similar to a wren, is

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known to scuttle on the ground among thick brush and grasses (Hilty et al. 2003). We observed individuals within 30 m of a creek, foraging low to the ground with short, rapid movements. Their call is a series of 25–30 quick sharp monotone 'wick' notes, similar to that of the Northern Flicker (*Colaptes auratus*), repeated for 10–15 sec.

OBSERVATIONS

The first nest, found on 16 April 2004, was 0.8 m above a creek bed in an obscured crevice about 6.25 cm deep into a muddy, rock face. The globular nest was at the end of this crevice and was composed of moss, rootlets, and decomposing leaves. The inside diameter and height were 6.8 and 6.2 cm, respectively, while the outside diameter and height were 10.5 and 8.5 cm, respectively. Incubation had commenced prior to finding the nest and the adults were incubating a single, cream-colored egg of unknown age with a mass of 4.07 g. We monitored the nest for 5 days during the incubation period until it was depredated on 21 April, and videotaped it once for 5.75 hrs (17 Apr, 0705–1345 hrs EST) following Martin (2002). In the video, *S. meridanus* exhibited simultaneous incubation exchange, revealing that both male and female incubate. Nest attentiveness (percent time spent on the nest incubating) averaged 82.2%, while incubation bouts averaged 33.13 min ($n = 11$); the mean off bout length was 7.26 min ($n = 11$).

The second nest, a re-nest of the same pair, was located on 4 May 2004 approximately 15 m from the first nest. The nest was 1.2 m above the bottom of the creek bed, in a similarly concealed crevice 7 cm deep, and constructed from similar material. The nest contained one egg when found and, after checking the nest daily for eight days, another egg was laid. The day the second egg was laid (12 May), the eggs of the second nest weighed 4.38 and 4.12 g. We videotaped the nest three times: once during the laying period and twice during incubation, totaling nearly 19 hrs (7 May, 0741–1345; 15 May, 0732–1352; and 23 May, 0711–1346 hrs). The first video revealed that during the laying period, both adults continued to build the nest after one egg had been laid. Both parents repeatedly brought small mossy material to the nest. In addition, both adults appeared to intermittently incubate the single egg, but had an average attentiveness of only 45.2%. This incubation activity occurred only during the cool early hours between 0741 and 0920 hrs. From 0921–1345 hrs, the parents visited the nest only briefly, bringing nesting material, but did not incubate. The two incubation videos revealed that nest attentiveness on the third day of incubation (15 May) and the eleventh day (23 May) was comparable to that of the first nest of unknown incubation age (percent time on = 82.6 and 84.8%, respectively). Mean on and off bout lengths during first and second incubation videos (37.20 min on, 7.34 min off; and 29.38 min on, 4.43 min off, respectively) also were similar to the first nest. We monitored the nest daily for 8 days before the second egg was laid (4–12 May), and for 13 days after (12–25 May), until depredated, at which point the eggs had not yet hatched. The incubation periods documented for other *Scytalopus* are 15–23 days (De Santo et al. 2002, Krabbe and Schulenberg 2003); the period that we monitored this nest is well within this range.

DISCUSSION

Life history traits have been described for only a few other species of *Scytalopus*. Egg color and shape were similar to most other *Scytalopus* described to date, as was clutch size (Stiles 1979, Whitney 1994, De Santo et al. 2002, Krabbe and Schulenberg 2003). Nest composition, placement, and shape were consistent with other tapaculos (Stiles 1979, Whitney 1994, De Santo et al. 2002, Krabbe and Schulenberg 2003, Young and Zuchowski 2003, Greeney and Gelis 2005, Greeney and Rombough 2005). Many tropical birds have been reported to lay eggs on alternating days, some even with three days separating egg laying (Skutch 1976). Unlike any passerine of which we are aware, *S. meridanus* laid a second egg nearly one week after the first. We do not know if this pattern is typical, but may result from the large investment in eggs. Few records report detailed information on parental investment. We observed fairly high nest attentiveness not atypical of shared incubators (Martin 2002; TEM, unpubl. data). *Scytalopus meridanus* is sexually monomorphic and we could not ascertain if parents contributed evenly in nest attentiveness. However, length

TABLE 1. Reproductive attributes (means) of *Scytalopus meridanus* in Venezuela, 2004 (this study) and four other congenors in Central and South America (Krabbe and Schulenberg 2003).

Species	Clutch size	Egg volume (cm^c)	Egg mass (g)	Adult mass (g)	Egg mass/body mass (%)
S. meridanus[a]	1–2	4.064	4.190	16.5	25.39
S. speluncae	2	2.897	2.987[b]	13.75[c]	21.72
S. indigoticus	2	3.006	3.099[b]	14.80[c]	20.94
S. magellanicus	2–3	3.179	3.278[b]	11.00[c]	29.80
S. griseicollis	2	2.531	2.609[b]	17.97[c]	14.52

[a] Sample sizes for *S. meridanus* are: clutch size (2), egg mass/volume (3), and adult mass (1).

[b] Egg mass calculated from measurements reported in Krabbe and Schulenberg (2003) (sample sizes not given) using the equation in Van Noordwijk et al. (1981).

[c] Information from descriptions in Krabbe and Schulenberg (2003) (sample sizes not given).

of alternating bouts of different individuals appeared similar.

Scytalopus meridanus laid remarkably large eggs relative to the size of the 16.5-g adult (Martin et al. 2006), about 25% of its body weight. We could not locate egg mass records for other species of *Scytalopus*, but egg length and width measurements as well as adult mass were available for four species (Krabbe and Schulenberg 2003). We developed a relative coefficient (1.031) between mass and volume using egg length, width, and mass measurements from nine passerine species in Argentina (TEM, unpubl. data) to estimate egg mass. We inserted this coefficient to get the equation: $\text{mass} = (0.5 \times \text{length} \times \text{width}^2) \times 1.031$ (adapted from Van Noordwijk et al. 1981). All five *Scytalopus* species appear to have relatively high reproductive investment in eggs, given their body mass (Table 1). The allometric relationship across other species in Venezuela (Martin et al. 2006) predicts an average egg mass of approximately 2.6 g based on the 16.5-g body mass of adult *Scytalopus meridanus*. This predicted egg mass is much less than that observed and indicates that *Scytalopus* lays a large egg, even compared with other tropical species.

Scytalopus joins the ranks of other species in endemic tropical families by having small clutch size and shared incubation that yields relatively high nest attentiveness. What may be unusual is the interval between laying eggs and the size of the egg.

ACKNOWLEDGMENTS

We thank J. J. Fontaine, A. D. Chalfoun, and the rest of the students and researchers in our lab for advice and comments on this manuscript, as well as M. J. Foguet and J. R. Lang for field assistance. We are also grateful to Carlos Rengifo and Carlos Bosque for editorial comments and valuable suggestions. This study was made possible by support under NSF grants DEB-9981527 and DEB-0543178 to T. E. Martin. Permit numbers are DM/00000455 from FON_ACIT and PA-INP-0072.003 from INPARQUES.

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The Wilson Journal of Ornithology 119(1):124–126, 2007

An Interspecific Foraging Association Between Nearctic-Neotropical Migrant Passerines in Bolivia

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ABSTRACT.—I present the first published record of a foraging association between Nearctic-neotropical migrant bird species during the austral summer in South America. I observed Barn Swallows (*Hirundo rustica*) and Cliff Swallows (*Petrochelidon pyrrhonota*) in February 2005 repeatedly foraging on aerial insects flushed by flocks of Bobolinks (*Dolichonyx oryzivorous*) settling onto soybean plants (*Glycine max*). Additional observations would be needed to distinguish this behavior between an opportunistic association and a commensal relationship. *Received 25 November 2005. Accepted 28 July 2006.*

Foraging associations assumed to be commensal between passerine species have been described within mixed species flocks (e.g., Hino 1998) and between non-flocking species (e.g., Willis 1972, Maxson and Maxson 1981, Robbins 1981). Here, I report the first documentation of a foraging association between two flocking Nearctic-neotropical migrant species during the austral summer.

On 11 February 2005 from 0900 to 1000 hrs EST in San Juan, depto. Santa Cruz, Bolivia, ~100 km northwest of the city of Santa Cruz, I observed a flock of ~1,000 Bobolinks (*Dolichonyx oryzivorous*) foraging in soybean (*Glycine max*) fields. This large aggregation consisted of a series of smaller (30–400 individuals) flocks that moved across the field by landing in the soybeans for 15–60 sec, lifting to 1–3 m above the soybeans, flying 25–50 m, landing again, and repeating this pattern. After each landing, ~10–30 Barn Swallows (*Hirundo rustica*) and 0–5 Cliff Swallows (*Petrochelidon pyrrhonota*) captured aerial insects above the Bobolink flock, foraging 1–5 m above the soybean canopy for 5–10 sec. During two subsequent walking transects (400 m), perpendicular to and intersecting the flight path of the Bobolink flocks, I flushed Pyralid moths (*Omiodes indicata* Fabricius) with every step. The other insect species that flushed above the canopy, the adult stage of the velvetbean caterpillar (*Anticarsia gemmatalis* Hübner), was not abundant. No other insect species were observed flying

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above the soybean canopy. The insect fauna on soybean leaves appeared to be species-poor and dominated by Pyralid moths, with species of Coleoptera and Homoptera occasionally noted.

The ‘‘following’’ behavior I observed is frequently used by swallows, which are known to follow mammals, birds, humans, and farm equipment that flush prey. In some cases, concentrations of animals serve as cues to swallows that indicate local concentrations of food resources (Brown and Brown 1995, 1999). Once a few individual swallows locate a food source, they may serve to attract more swallows, known as ‘‘local enhancement’’ (Brown 1988). My observation of swallows feeding on lepidopterans is unusual, as lepidopterans have been previously reported as comprising only a small fraction of the diet of Cliff and Barn swallows (Beal 1918). However, diet for these opportunistic feeders varies depending on availability of prey items (Brown and Brown 1995, 1999).

The association between the three species, if observed on a regular basis, could be an example of commensal insectivory, whereby the swallows increase their foraging efficiency, while Bobolink foraging efficiency is unaltered. Bobolinks are not known to forage on aerial insects and were not observed feeding above the soybean canopy. They were eating caterpillars on the soybean leaves (RBR, pers. obs.), indicating they were not competing with swallows for food resources. I did not observe interspecific aggression or other direct interactions between the Bobolinks and swallows, suggesting the swallows were not interfering with or otherwise altering Bobolink activity.

There are two ways that swallows might be increasing their foraging efficiency by following Bobolinks. However, I did not measure swallow foraging efficiency with, versus without, Bobolinks as ‘‘beaters’’ (Rand 1954). Bobolink flock activity appeared to invariably increase the number of prey flying per unit area (prey density), and swallows may have had a greater chance of locating prey, resulting in more capture attempts per foraging bout or per unit time (increased feeding rate, Brown 1988). Alternatively, when insects are forced to fly upon being flushed, the proportion of successful capture attempts per time spent foraging may be higher (increased success rate, Kushlan 1978).

This association was not sustained over time. On seven subsequent dates over 2 weeks, I observed monospecific flocks of Bobolinks using the same soybean field in the absence of swallows. On one of these dates, Bobolink flocks were also observed in two soybean fields ~3 km away, but swallows were not seen over or adjacent to the fields. I also observed swallows foraging over soybean fields in the absence of Bobolinks.

The association reported may occur sporadically in South American soybean fields when Bobolink and swallow distributions overlap spatially and temporally. Conditions under which this phenomenon may occur in soybean fields must include (1) caterpillars consumed by Bobolinks are available (e.g., after emergence and prior to application of insecticides), (2) flying insects preferred by swallows are available, and (3) Bobolink flocks are sufficiently large to flush prey in quantities that enable swallows to increase their foraging efficiency. Swallows may opportunistically use a ‘‘following’’ strategy to increase their foraging efficiency in different habitats with different beater species in South America.

ACKNOWLEDGMENTS

I thank A. M. Saavedra for her priceless assistance in the field and the Museo de Historia Natural Noel Kempff Mercado for providing logistical and administrative support in Bolivia. Dr. D. W. Winkler and C. C. Rimmer provided helpful comments on the manuscript. I am grateful to Michael Sabourin and Dr. Alma Solis (Smithsonian) for identifying insects. I thank the anonymous referees for their suggestions and comments that improved this manuscript.

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The Wilson Journal of Ornithology 119(1):126–128, 2007

Interspecific Egg-dumping by a Violet-green Swallow in an Active Western Bluebird Nest

Danika Kleiber,[1,2,6] Jenne Turner,[1,3] Amber E. Budden,[1,4] and Janis L. Dickinson[1,5]

ABSTRACT.—We observed a Violet-green Swallow (*Tachycineta thalassina*) laying an egg in an active Western Bluebird (*Sialia mexicana*) nest. The Western Bluebird male and not the female, was aggressive to the Violet-green Swallow but the swallow remained to lay the egg. This is the first documented incidence of which we are aware involving altricial interspecific egg-laying during the nestling phase. We suggest the timing of this event was more consistent with incidental egg deposition, or egg-dumping, than brood parasitism or nest usurpation. *Received 13 December 2005. Accepted 24 July 2006.*

Observations of birds laying eggs in nests of other species are of interest because this behavior, when timed appropriately and directed at nests where parents fail to recognize foreign eggs and offspring, may be the starting point for evolution of interspecific brood parasitism. Other explanations for this behavior are nest usurpation and egg-dumping, which is the deposition of an egg into another species' nest without any specific adaptive function. We collected video footage of a Violet-green Swallow (*Tachycineta thalassina*) laying an egg in an active Western Bluebird (*Sialia mexicana*) nest containing nine-day-old nestlings at Hastings Natural History Reservation, Carmel Valley, California (36° 22′ N, 121° 34′ W). Nest boxes have been monitored at Hastings and nearby ranches as part of a long-term study of Western Bluebirds since 1983 (Dickinson et al. 1996). Western Bluebirds are the primary box-nesting species at this study site, but other secondary cavity nesters use nest boxes at lower frequencies, including Ash-throated Flycatchers (*Myiarchus cinerascens*), Oak Titmice (*Baeolophus inornatus*), House Wrens (*Troglodytes aedon*), Bewick's Wren (*Thryomanes bewickii*) and Violet-green Swallows (Table 1).

We conducted a study of parental feeding behaviors during spring 2005 using video to identify patterns of resource allocation within

TABLE 1. Frequency of nest box use by secondary cavity-nesting species at Hastings Natural History Reservation, Carmel Valley, California, from 1983 to 2004.

Species	Nests (*n*)	Total use (%)
Western Bluebird	1,860	69
Ash-throated Flycatcher	298	11
Oak Titmouse	204	8
House Wren	175	7
Violet-green Swallow	122	5
Bewick's Wren	2	<1
Total nesting attempts (at least one egg)	2,661	100

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the nest. The day before filming we replaced the natal nest box and nest material with a box of the same dimensions containing a Western Bluebird nest, but with a Plexiglas side to accommodate the camera. A video camera and small LED light were positioned within a sleeve connected to the nest box on the morning of filming, which began at approximately 0530 hrs PST. Tapes were set on short play and recorded for a period of 120 min. During the first recording an experimenter collected simultaneous observational data on parental activity from a blind approximately 30 m away. Following tape completion, a second tape was inserted to record an additional 120 min of nestling provisioning observations. No additional observational data on parental activity were collected from outside the nest.

OBSERVATIONS

We collected video data on 27 May 2005 from a Western Bluebird nest containing five nine-day-old nestlings and a single unhatched Western Bluebird egg. In this instance, the time stamp on the video unit failed, and observations were timed using the video counter and calibrated using the corresponding observational data. The video nest watch began at 0520:00 hrs. At 0711:53 hrs, a female Violet-green Swallow entered the nest box and sat in the far left corner at the top of the nest cup. At 0712:46, the Western Bluebird male entered the box and proceeded to peck at the Violet-green Swallow's head six times before leaving the nest box at 0713:03. The Violet-green Swallow responded to the pecking attack by tucking her head down and remaining still. After 5 sec, the female Western Bluebird fed a nestling from the box entrance. She appeared to ignore the Violet-green Swallow and entered the box only to turn around, leaving 11 sec after arrival. The adult male and female Western Bluebirds fed the nestlings twice more while the swallow was in the nest box, but did so without entering the nest. At 0721:41, the first video tape ended and the second was inserted. We estimated the time from the ending of the first tape and beginning of the second to be approximately 30 sec, and added that time to our calculations. The Western Bluebird adults did not enter the box again while the Violet-green Swallow female was present. At approximately 0733 hrs, the Violet-green Swallow left the nest box, leaving a white egg on the outer rim of the nest cup where she had been sitting. During the afternoon the video nest box and nest were replaced with the natal nest box and nest; the Violet-green Swallow egg was also transferred. When we returned to the nest the following day the Violet-green Swallow egg was lying broken in the bottom of the nest. There was no second Violet-green Swallow egg.

DISCUSSION

Three hypotheses are possible explanations for our observations: nest usurpation, brood parasitism, and interspecific egg-dumping. Nest usurpation is a possible explanation given that Western Bluebirds and Violet-green Swallows are both secondary cavity nesters whose breeding times overlap (Brown et al. 1992, Guinan et al. 2000). However, in this instance, timing of egg-laying and the observed behavior of the Violet-green swallow was not consistent with nest usurpation. Violet-green Swallows in our population use nest boxes at a low frequency (Table 1), but are common and presumably use natural cavities as nesting sites. Previously described nest usurpation interactions between Violet-green Swallows and Western Bluebirds do not match the behavior we observed. In Arizona, Brawn (1990) observed large groups of Violet-green Swallows taking over a nest box defended by a Western Bluebird, but a single Violet-green Swallow, such as we observed, was not successful in displacing Western Bluebirds. Successful use of a Western Bluebird box by a single pair of Violet-green Swallows has been observed, but was preceded by interspecific provisioning of the bluebird's young (Eltzroth and Robinson 1984).

Brood parasitism can also be ruled out due to improper timing of laying. We found no record of either intra- or interspecific brood parasitism by Violet-green Swallows in the literature (Brown et al. 1992). The placement of the egg outside the nest cup would be inconsistent with brood parasitism behavior.

It is more likely the Violet-green Swallow laid the egg because she was physiologically committed to do so but was unable to lay in her original nest, a behavior known as ''egg-dumping'' (Wiens 1971). There are many documented cases of interspecific egg-dumping in avian species not known for brood parasitic behavior (Bailey 1886, Holcomb 1967, Wiens 1971, Gustafson 1975, Cannell and Harrington 1984, Littlefield 1984, Carter 1987, Sealy 1989). Females may lay in another cavity because they are unable to approach their own cavity at the time of laying, due to the presence of a predator, nest usurpation, or other disturbance. Based on monitoring of nest boxes at Hastings Reservation, 11.2% of 98 Violet-green Swallow nests with at least one egg failed before hatching from 1983 through 2005. This small incidence of nest failure during laying and incubation is only partially attributable to predation, but indicates that infrequent nest predation or disturbance during laying could account for the behavior we observed. Although there are no data on conspecific nest usurpation in Violet-green Swallows, nest usurpation has been well documented in Tree Swallows (*Tachycineta bicolor*) (Leffelaar 1985).

ACKNOWLEDGMENTS

We thank Wendy Fair and Caitlin Stern for helpful comments and Cachagua General Store for gastronomical support. This research was funded by NSF grant IBN-009702 to JLD. Edited video footage may be viewed at: http://www.birds.cornell.edu/birdhouse/nestboxcam/movies_home/vgsw_in_webl courtesy of Cornell Laboratory of Ornithology's "The Birdhouse Network."

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The Wilson Journal of Ornithology 119(1):128–129, 2007

Western Bluebird Captures a Western Fence Lizard

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ABSTRACT.—I observed a male Western Bluebird (*Sialia mexicana*) capture a western fence lizard (*Sceloporus occidentalis*), the first reported incidence of vertebrate-directed raptorial behavior in the Western Bluebird. There are no previously published reports of Western Bluebirds capturing vertebrate prey, although there is one previous report of a Western Bluebird carrying an unidentified lizard in the manner of a prey item, and a few reports of predation on vertebrates by the congeneric Eastern Bluebird (*Sialia sialis*). *Received 9 January 2006. Accepted 28 June 2006.*

Western Bluebirds (*Sialia mexicana*) are primarily insectivorous during the breeding season, and rely upon berry crops during winter (Guinan et al. 2000). Individual Eastern Bluebirds (*Sialia sialis*), a congeneric species,

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which is also primarily dependent upon insects and small fruits (Gowaty and Plissner 1998), have occasionally been observed capturing vertebrate prey, such as snakes (Flanigan 1971) and shrews (Pinkowski 1974). Beal (1915) reported the bones of lizards and tree frogs in the stomachs of Eastern Bluebirds, as did Bent (1949). Braman and Pogue (2005) found a dead, 8.3-cm-long flat-headed snake (*Tantilla gracilis*) in an Eastern Bluebird nest box, suggesting a past predation event. Of 217 Western Bluebird stomachs examined by Beal (1915), not one contained evidence of vertebrate prey. Herlugson's (1982) analysis of Western Bluebird stomach contents similarly yielded no evidence of vertebrate prey items, and adults were not observed delivering vertebrate prey to nestlings. Gaylord (1995) observed a male Western Bluebird carrying an unidentified lizard in his bill; however, she did not observe the capture or consumption of the lizard. There have been no previous reported observations of Western Bluebirds capturing vertebrate prey.

OBSERVATIONS

Western Bluebirds have been color-banded and their breeding biology monitored at Hastings Natural History Reservation, Carmel Valley, California, since 1983 (Dickinson et al. 1996). While censusing a winter group on 11 October 2005, I observed a first-winter male Western Bluebird catch a ~5-cm-long western fence lizard (*Sceloporus occidentalis*; Stebbins 1966) in his bill at 0928 hrs PST. The bluebird was perched on top of a wooden fence post, and the lizard was clinging to the side of the post ~7 cm below the bluebird. The bluebird left his perch, hovering briefly beside the post as he seized the lizard around its middle with his bill. This maneuver was executed quickly, and the lizard did not attempt to flee, although it arched its body after it was already held in the bluebird's bill. Returning to his perch on the same fence post, the bluebird twice beat the lizard's head against the post. This appeared to be an attempt to stun or kill the lizard. At 0930 hrs, the bluebird flew with the now immobile lizard still in his bill onto the property of a private ranch. I was not able to follow and ascertain whether the bluebird consumed the lizard because this ranch is closed to researchers.

DISCUSSION

Western Bluebirds commonly beat invertebrate prey against a perch before consumption, and both Flanigan (1971) and Pinkowski (1974) reported Eastern Bluebirds beating vertebrate prey items against perches before consuming them. The observed bluebird male was clearly treating the lizard as a prey item.

That vertebrate-directed raptorial behavior by Western Bluebirds has not been reported previously, despite intensive observation of Western Bluebird behavior, suggests that, similar to Eastern Bluebirds, Western Bluebirds rarely capture vertebrate prey. To my knowledge, capture of vertebrate prey by the third member of the genus *Sialia* (i.e., Mountain Bluebird, *Sialia currucoides*) has not been reported.

ACKNOWLEDGMENTS

I thank J. L. Dickinson, D. L. Kleiber, W. M. Fair, and three anonymous reviewers for providing valuable comments on this manuscript.

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