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CONSERVATION AND NATURAL HISTORY

INTRODUCED SPECIES

Consumption of Bird Eggs by Invasive Burmese Pythons in Florida

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Burmese Pythons (*Python molurus bivittatus* or *P. bivittatus*) have been reported to consume 25 species of adult birds in Everglades National Park, Florida (Dove et al. 2011), but until now no records documented this species eating bird eggs. Here we report three recent cases of bird-egg consumption by Burmese Pythons and discuss egg-eating in basal snakes.

On 8 January 2011, an adult (2.78 m snout-vent length [SVL], 3.14 m total length [TL], 13.9 kg) female Burmese Python was captured on a canal bank (L-29) adjacent to U.S. Highway 41, near Everglades National Park, Miami-Dade County, Florida (25.76200°N, 80.78211°W; WGS84). The lower GI tract included a small amount of decomposed feathers, small heavily digested bones, and the crushed, but intact, remains of two bird eggs. These egg remains were deposited (EVER 44949) in the South Florida Collections Management Center, Everglades National Park, Homestead, Florida. Many small pieces of eggshell fragments were attached to the white egg membranes (Fig. 1) making species identification possible. We used techniques described in Dove et al. (2008) to obtain DNA sequences for cytochrome c oxidase subunit 1 (CO1) from the intact egg membranes. DNA sequences were compared to the Barcode of Life Database (www.boldsystems.org/views/login.php) to obtain 100% matches to Limpkin (*Aramus guarauna*). The color of the eggshell fragments consisted of grayish white ground color with faint pinkish-brown, buff splotches on the outside, and the inner shell was white (not blue as in other bird species), which is congruent with an account for this species (Bryan 2002). Following DNA identification, the eggshell fragments were compared to reference specimens of Limpkin eggs at the Smithsonian Institution for verification. Pigmentation of the eggshells is evidence that the eggs were laid and not part of a consumed adult bird. Pigmentation is secreted in the uterus of most birds just prior to laying and is the final step in egg production (Proctor and Lynch 1993). We did not find associated with this sample any evidence of embryos or black downy feathers typical of Limpkin chicks.

On the morning of 21 May 2011, the Miami-Dade Fire Rescue Venom Response Unit responded to a rural residence in southwestern Miami-Dade County (25.54646°N, 80.54573°W; WGS84) following a report that a python was seen near the nest of a free-ranging Guineafowl (*Numida*

Fig. 1. Two Limpkin (*Aramus guarauna*) crushed but intact eggs (top; EVER 44949) recovered from a Burmese Python digestive tract and compared to a reference Limpkin specimen (below; USNM 25786) for size and color patterns. The arrow shows fragments of eggshells from the python sample placed on the museum specimen for color comparison. Photograph by Don Hurlbert, Smithsonian Institution.

meleagris domesticus) with 10 eggs that had recently disappeared. The Venom Unit captured an adult (2.27 m SVL, 2.61 m TL, 6.73 kg) male Burmese Python at the residence at 11:00 AM the same day. During transport, the snake regurgitated a Guineafowl hen (928 g) and 10 intact eggs (five of these are depicted in Fig. 2). The landowner claimed that this was the second time she had noted the disappearance of a Guineafowl and its eggs, but she had not previously observed a snake. The python is now catalogued (USNM 558849) in the herpetological collections at the Smithsonian Institution. The regurgitated Guineafowl eggs measured 45.6–49.0 x 35.3–37.8 mm and weighed 30–36 g, such that each egg represented approximately 0.5% of the python's body mass. Limpkin eggs average 55–64 x 41–47 mm (Walters 1994). These represent exceptionally small individual prey items for snakes of this size.

In addition to the two examples described above, bird egg fragments were found in the intestine of a third Burmese Python from U.S. Highway 41 near Everglades National Park, but evidence was insufficient to identify the species of bird.

Durophagy (consumption of hard-shelled objects) is relatively uncommon among snakes (Savitsky 1983). Specialized egg-eaters (e.g., *Dasypeltis*) exhibit a suite of morphological and behavioral traits allowing them to ingest eggs that are very large in relation to the size of the snake's head (Gans 1952, Gartner and Greene 2008), but few snakes are so highly specialized. Cundall and Greene (2000:326) stated that only the Colubroidea have morphological specializations for handling prey items that are difficult to handle (such as very large eggs), and that such prey "are correspondingly rare or absent from the diets of more basal snakes." Many colubroid snakes that occasionally consume relatively (to the snake's head) large bird eggs exhibit pointed or bladelike hypapophyses (ventral processes) on anterior vertebrae that serve to break the eggshell in the esophagus (Mullin 1996), and the presence of hypapophyses has been described as a "critical limiting factor" in consumption of large bird eggs by snakes (Cundall and Greene 2000:320).

Burmese Pythons exhibit hypopophyses on cervical vertebrae (Fig. 3), but these lack the sharp projections or bladelike ventral surfaces (cf. ratsnakes; Mullin 1996) usually associated with specialist egg-eaters. The hypapophyses are prominent in anterior vertebrae (to approximately vertebrum #48, at about the level of the heart), after which they undergo rapid reduction in size. They end as small ventral ridges on vertebral centra by approximately vertebrum #58, well before the stomach (personal observation, based on vertebrae from a male TL 265 cm and SVL 232.5 cm [EVER 66690] captured in the Everglades). The Guineafowl eggs consumed by the python were entire at the time of regurgitation, suggesting that either the hypapophyses are not used to crush eggs or that these eggs were too small to be engaged by the hypapophyses. Given the ability of pythons to digest even large bones, we doubt that an inability to physically break an eggshell during ingestion would impede a python's ability to access the egg's contents during digestion.

Our observations of egg eating in Burmese Pythons are not unique among large-bodied basal snakes, as Yellow

Fig. 2. Five of ten entire Guineafowl (*Numida meleagris domesticus*) eggs regurgitated by a Burmese Python. Photograph by R.W. Snow, Everglades National Park.

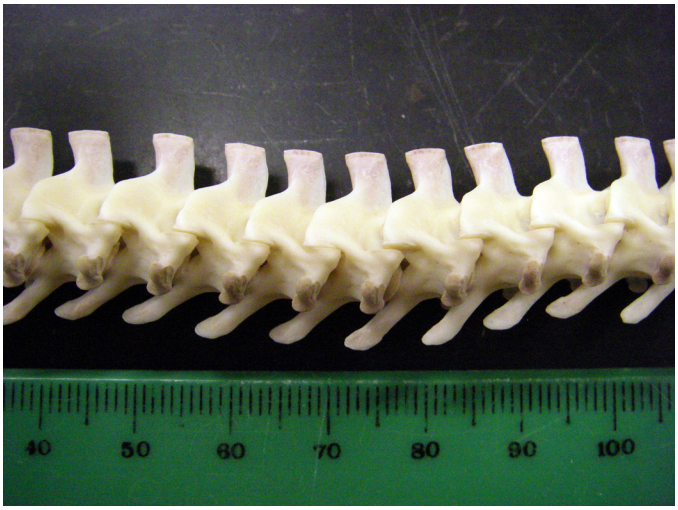

Fig. 3. Anterior vertebrae from a Burmese Python (*Python molurus bivittatus* or *P. bivittatus*) (267 cm SVL; EVER 66690), showing hypapophyses below the centrum of each vertebrum. Photograph by R.W. Snow, Everglades National Park.

Anacondas (*Eunectes notaeus*) in South America consume bird eggs (Strüssmann and Sazima 1991; T. Waller, pers. comm., June 2011). Interestingly, we are unaware of any reports of consumption of avian eggs among Green Anacondas (*E. murinus*), Boa Constrictors (*Boa constrictor*), Reticulated Pythons (*Broghammerus reticulatus*), or the large African pythons (*P. natalensis* and *P. sebae*; Reed and Rodda 2009; T. Waller, J. Rivas, R.W. Henderson, pers. comms., June 2011).

Several species of colubroid snakes native to Florida are known to consume bird eggs (Ernst and Ernst 2003). Our observations confirm that invasive Burmese Pythons consume not only adult birds but also eggs, suggesting a previously unrecognized risk from this introduced predator to nesting birds. How frequently such predation might occur or whether it represents a considerable increase in the baseline rate of predation on bird eggs by native snakes is difficult to assess, although pythons would be capable of eating eggs too large for consumption by most native snakes. Overall, the impacts of invasive python predation on native bird prey populations remain poorly understood.

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