



Double Take: Ingestion of Two Rats by a Juvenile Burmese Python (*Python bivittatus*) in Big Cypress National Preserve, Florida, USA

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The Burmese Python (*Python bivittatus* Kuhl 1820) was introduced to southern Florida through the release of pet pythons and has since established a successful breeding population (Reed and Rodda 2009; Willson et al. 2011; Guzy et al. 2023). Thought to have become established in Everglades National Park as early as the 1980s, the species has expanded to inhabit most of southern Florida, reaching as far north as Lake Okeechobee (Guzy et al. 2023). Pythons pose a difficult management problem because they have high fecundity (e.g., Currylow et al. 2022, 2023a) and are very challenging to detect (Nafus et al. 2020, reviewed in Guzy et al. 2023).

As a dietary generalist, Burmese Pythons consume native wildlife across several vertebrate classes (Snow et al. 2007a, 2007b; Dove et al. 2011; Dorcas et al. 2012; Romagosa et al. 2023). Adult pythons are capable of handling large prey such as the American Alligator, *Alligator mississippiensis* (Snow et al. 2007a, 2007b), White-tailed Deer, *Odocoileus virginianus* (Rochford et al. 2010; Boback et al. 2016), and Bobcat, *Lynx rufus* (Snow et al. 2007a), whereas young pythons are thought to prey on small mammals and birds as a consequence of gape limitation (Shine 1991; Falk and Reed 2015). Increasing python abundance has had detrimental effects on native mammalian species, with as high as a 99.3% decrease in observations of some species (Dorcas et al. 2012, McCleery et al. 2015, Sovie et al. 2016, Taillie et al. 2021). Federally-protected species such as the threatened Wood Stork (*Mycteria americana*), endangered Key Largo Woodrat (*Neotoma floridana smalli*) (Greene et al. 2007), and endangered Key Largo Cotton Mouse (*Peromyscus gossypinus allapaticola*) (Lord et al. 2023) have also been documented as prey items. Although a

total of 76 species to date have been found in digestive tracts of Burmese Pythons removed from the wild (Romagosa et al. 2023), feeding frequency is unknown. Herein we report an observation that provides additional insight into feeding capacity and frequency in juvenile Burmese Pythons in southern Florida.

At 1850 h on 4 February 2023, we observed a juvenile Burmese Python crossing a road in Big Cypress National Preserve, Ochopee, Florida, USA, and captured it by hand (111.5 cm total length; 620 g post-regurgitation; Fig. 1). The python was removed from the wild and retained in the laboratory for morphological measurements. Two days later, at

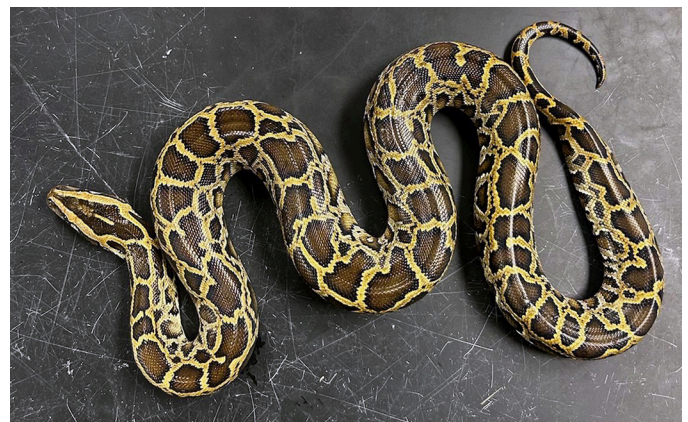


Figure 1. A juvenile Burmese Python (*Python bivittatus*), estimated to have hatched in 2022, after regurgitating two rat carcasses (a Marsh Rice Rat, *Oryzomys palustris*, and a Black Rat, *Rattus rattus*). The snake was caught in Big Cypress National Preserve, Florida, USA, in 2023 and measured 111.5 cm in total length and 620 g (post-regurgitation). Photograph courtesy of the U.S. Geological Survey.

0840 h on 6 February 2023, we discovered that the python had regurgitated two rats (combined weight 168.7 g; 27.2% of the python's body weight). The rats were identified as an adult male Marsh Rice Rat (*Oryzomys palustris*) and a juvenile Black Rat (*Rattus rattus*) of unknown sex. Based on the state of decomposition, we determined that the Marsh Rice Rat had been consumed first (Fig. 2). Snakes primarily consume their prey headfirst (Diefenbach and Emslie 1971; Klein and Loop 1975; Secor 2003) and the partial decomposition of the Marsh Rice Rat's cranium suggested it was farther down in the digestive tract (Fig. 3). To our knowledge, this is the first report of two prey items consumed by a wild juvenile Burmese Python that were two different species consumed nearly at the same time and had been very recently consumed.

No rigorous estimates address feeding frequency in wild Burmese Pythons, largely because few data exist for comparisons. An examination of 1,716 pythons known to have contents in their digestive tract found on average 1.28 prey items per individual, although an adult female (218 cm SVL, 9380 g) contained 14 Hispid Cotton Rats (*Sigmodon hispidus*) at various stages of decomposition (C. Romagosa, in litt., 10 August 2023). Published accounts of adult feeding behavior in Florida include an adult male that had consumed two Key Largo Woodrats (Greene et al. 2007) and an adult female with the remains of three White-tailed Deer (one adult and two fawns) in the large intestine (Boback et al. 2016). How often multiple prey items are consumed by adult Burmese Pythons in the wild is unclear, as most observations are of prey items of the same species (Boback et al. 2016; Romagosa et al. 2023). However, an adult female (266 cm SVL, 7340 g) regurgitated four waterfowl consisting of at least two different species (Gruiformes and Anseriformes) upon capture



Figure 2. An adult male Marsh Rice Rat (*Oryzomys palustris*) (top) and a juvenile Black Rat (*Rattus rattus*) (bottom) regurgitated by a juvenile Burmese Python (*Python bivittatus*) caught in Big Cypress National Preserve, Florida, USA. Combined rat weight was 168.7 g. Photograph courtesy of the U.S. Geological Survey.



Figure 3. A Marsh Rice Rat (*Oryzomys palustris*) consumed by a juvenile Burmese Python (*Python bivittatus*) caught in Big Cypress National Preserve, Florida, USA. Partial decomposition of the cranium suggests it was lower in the digestive tract than the juvenile Black Rat (*Rattus rattus*) and thus had been consumed first. Photograph courtesy of the U.S. Geological Survey.

in Everglades National Park (R. Darling, in litt., 29 October 2019).

Snakes can have long and variable fecal retention times (Lillywhite et al. 2002; Falk and Reed 2015; Boback et al. 2016), which renders determination of feeding frequency difficult once prey items have entered the small intestine. Because the rats in this study were regurgitated, estimating how much time passed since their consumption can be based on decomposition and digestion rates. In Burmese Pythons, within the first 48 h of feeding, digestive acids and enzymes secrete rapidly, digestive organs double in size, and metabolic rate increases 40-fold, which is the highest in all vertebrates studied to date (Secor and Diamond 1995, 1998, 2000; Secor 2008; Castoe et al. 2013). Secor (2003) monitored digestion in captive juvenile Burmese Pythons in the days following feeding of one or two rats weighing approximately 25% of the snake's body weight. By day two, the cranium of the second rat was partially decomposed and by day three, the first rat and half of the second rat had been digested and passed to the small intestine. When only one rat was consumed, the carcass showed signs of partial decomposition within the first day and complete digestion at day six (Secor 2003). Therefore, the two rats in this study likely were consumed within one to two days of each other (or, very conservatively, within six days of each other).

Notably, while rodents (12 species) were the most numerous prey items consumed by invasive pythons in Florida over a 25-year period and Black Rats were common (333 observations), the Marsh Rice Rat was rarely observed ($n = 28$) (Romagosa et al. 2023). In Florida, Black Rats occur most frequently in drier, elevated regions like hardwood hammocks (Goodyear 1992), whereas Marsh Rice Rats are semi-aquatic and more commonly associated with mesic habitats

(Hamilton 1946; Esher et al. 1978; Wolfe 1982). However, because both species can occasionally be found in either habitat type (Hamilton 1946; Smith 1980; Goodyear 1992), we were unable to determine whether the two rats in this study were consumed in the same or different areas.

This juvenile python quickly consumed a second prey item after first consuming one that was approximately 14% of the snake's body weight. Burmese Pythons in Florida can have large predator-prey size ratios and studies have reported individuals consuming more than their body weight (Ott and Secor 2007; Secor 2008; Reed and Rodda 2009; Bartoszek et al. 2018; Currylow et al. 2023b), sometimes even leading to the mortality of the snake (Snow et al. 2007b; Currylow et al. 2023b). The first prey item consumed by the juvenile python described herein might not have satiated the snake, resulting in it either actively searching for more prey (the python was found while crossing a road, demonstrating its capability for movement despite the food bolus) or opportunistically subduing the second prey item. Further studies of feeding behavior are needed in both the native and invasive ranges to expand our understanding of variations in feeding behavior.

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