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First Record of Consumption of a *Spilogale putorius* (Eastern Spotted Skunk) by an *Alligator mississippiensis* (American Alligator)

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Abstract - Here, we detail the first confirmed consumption of a *Spilogale putorius* (Eastern Spotted Skunk) by an *Alligator mississippiensis* (American Alligator, hereafter, Alligator). In April 2017 in Osceola County, FL, we tracked a radio-collared Eastern Spotted Skunk to a wetland and discovered its remains inside the stomach of a deceased Alligator. We conducted a necropsy on the Alligator, but were unable to definitively determine the cause of mortality for either the Alligator or the Eastern Spotted Skunk. We believe this event represents the first record of a crocodilian predating a mephitid. Although the cause of the Alligator's death was unconfirmed, we believe there is a possibility that the Alligator succumbed due to toxicosis brought on by its digestion of Eastern Spotted Skunk spray.

Spilogale putorius L. (Eastern Spotted Skunk) is a small omnivorous carnivore native to most of eastern North America. The species is known to occur in a variety of habitats, including forest (Lesmeister et al. 2009, McCullough and Fritzell 1984, Thorne et al. 2017) and prairie ecosystems (Crabb 1948). The subspecies considered endemic to peninsular Florida, *S. p. ambarvalis* Bangs (Florida Spotted Skunk), has been documented in shrub-dominated coastal strand habitat (Kinlaw et al. 1995), treeless dry prairies (Fletcher et al. 2010), and even on beaches (Howell 1906).

Cause-specific mortality has not been extensively studied in the Eastern Spotted Skunk. Lesmeister et al. (2010) conducted the first detailed demographic study of Eastern Spotted Skunks in the Ouachita Mountains of Arkansas and determined that mean annual survival across sexes and age groups was ~35%. Of 19 mortalities documented in that study, 17 (89%) were attributed to predation events. Twelve of these mortalities were caused by avian predators, all of which were attributed to *Bubo virginianus* Gmelin (Great Horned Owl). The 5 other predation-linked mortalities were caused by undetermined mammalian predators. Other observers have reported predation events by the Great Horned Owl (Errington et al. 1940), *Canis lupus familiaris* L. (Domestic Dog) and *Felis catus* L. (Domestic Cat) (Crabb 1948), and *Lynx rufus* Schreber (Bobcat; Schwartz and Schwartz 1981). Documented predators of the closely related *S. gracilis* Merriam (Western Spotted Skunk) include *Aquila chrysaetos* L. (Golden Eagle; von Bloeker 1937). Here, we report the first known consumption of an Eastern Spotted Skunk by an *Alligator mississippiensis* Daudin (American Alligator, hereafter, Alligator).

On 15 March 2017, we fitted an adult male Eastern Spotted Skunk, weighing ~334 g, with a very high frequency (VHF) radio transmitter collar (Model M1525 [12 g]; Advanced Telemetry Systems, Inc., Isanti, MN) at Three Lakes Wildlife Management Area, Osceola County, FL. We collared this Eastern Spotted Skunk as part of a study on den site selection of Eastern Spotted Skunks occurring in a dry prairie ecosystem (Harris 2018), a natural community characterized by an expansive, treeless plain of low grasses and shrubs (Florida Natural Areas Inventory 2010). This radio transmitter contained a motion-sensitive mortality switch that would alter the radio pulse rate after 6 h of inactivity, indicating that the collared Eastern Spotted Skunk had either died or lost its collar. We also marked the Eastern

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Spotted Skunk with 2 uniquely numbered ear tags to aid in identification of this individual if subsequently recaptured. During this study, we followed American Society of Mammalogists guidelines and complied with Clemson University Animal Care and Use Committee protocol (permit #AUP2015-042) for all trapping, processing, collaring, and radio-tracking of Eastern Spotted Skunks (Sikes et al. 2011).

After collaring this Eastern Spotted Skunk, we tracked it over the next few weeks, homing to within 5 m of its location on each occasion. On 28 March 2017, we tracked the Eastern Spotted Skunk to an inundated, artificial borrow pit (a depression wetland created when soil is excavated and removed for use elsewhere). This site was surrounded by dry prairie habitat ~1039 m from its initial capture location, and north of a slough that was

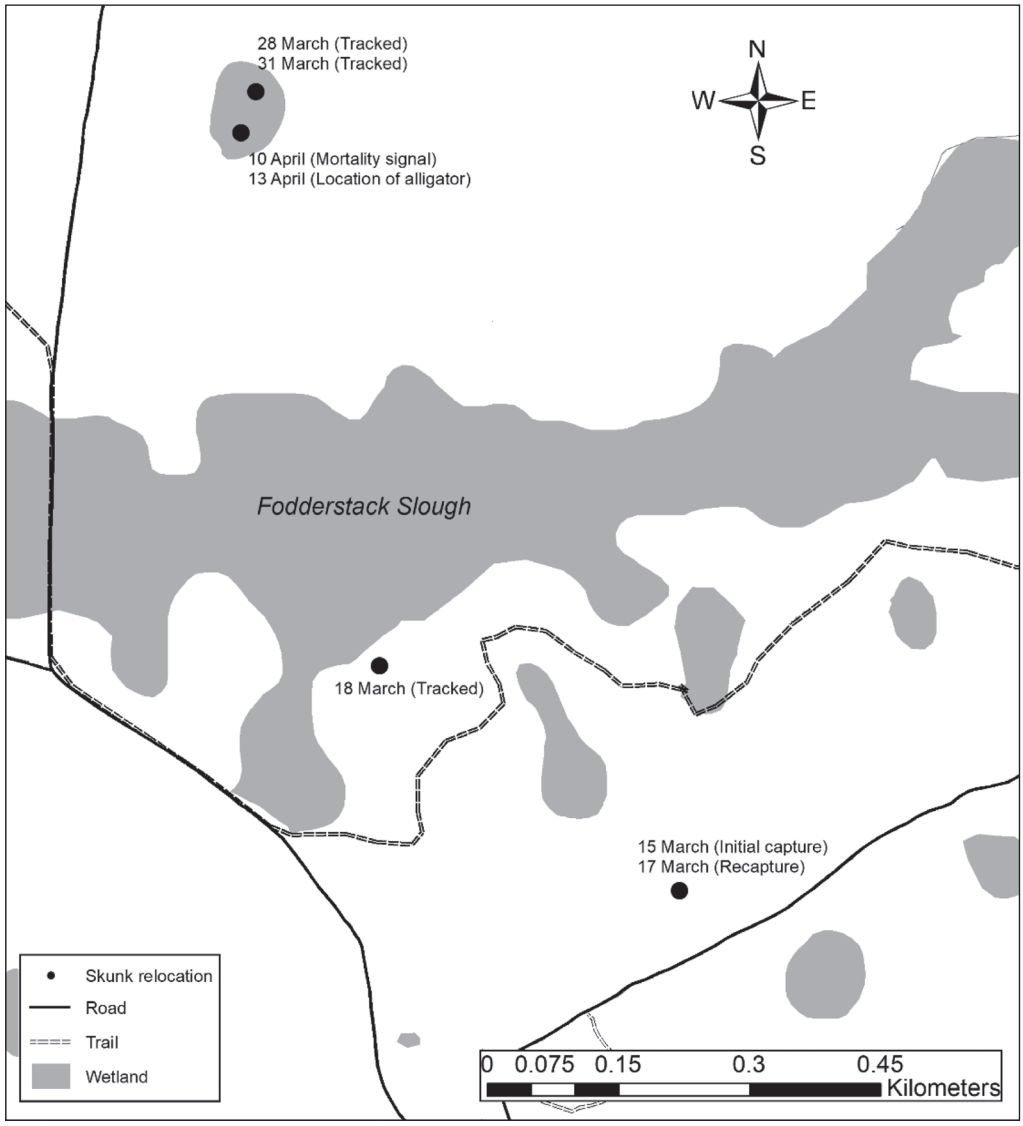

Figure 1. Locations where a radio-collared adult male Eastern Spotted Skunk was captured, relocated, and found dead inside of a deceased American Alligator between 15 March 2017 and 13 April 2017 at Three Lakes Wildlife Management Area, Osceola County, FL.

partially dry due to low water levels at the time (Fodderstack Slough; Fig. 1). The radio transmitter was not emitting a mortality signal; thus, we presumed that the Eastern Spotted Skunk was still alive. We tracked this Eastern Spotted Skunk subsequently on 31 March 2018 and found it to be essentially in the same location as 3 d prior, and concluded once again that the Eastern Spotted Skunk was likely resting in thick vegetation.

We tracked the Eastern Spotted Skunk for the final time on 10 April 2017 to the borrow pit once again, but this time the radio transmitter was emitting a mortality signal and appeared to be coming from the water near the southern edge of the pit, ~46 m from the Eastern Spotted Skunk's previous location. We mounted an exhaustive search the next day (11 April 2017) to recover the submerged radio transmitter. We manually searched through the submerged vegetation in water that was approximately 50 to 120-cm deep until we came across what we determined to be the leg of an Alligator protruding from a tussock of submerged vegetation about 90 cm deep. At this time, we were unable to determine if the Alligator was alive or dead, so we abandoned our search for the day. On 12 April 2017, we returned to determine if the Alligator had moved from its previous location, which it had not. On 13 April 2017, we determined that the Alligator was likely deceased, as the location of the collar did not appear to move and the mortality signal continued to transmit. At this point we were able to recover the Alligator (total length [snout to tail tip] = ~2.4 m) from the pit and confirmed that it was indeed dead (Fig. 2).

Although the Alligator smelled of decay, we documented no external signs of decomposition and noted no signs of physical trauma or injuries to the animal. Because of the remote location of the study site and the lack of a suitable facility nearby, we conducted a field necropsy ~6 h after we recovered the animal (with permission from Florida Fish

Figure 2. A deceased American Alligator that was removed from a borrow pit on 13 April 2017 at Three Lakes Wildlife Management Area, Osceola County, FL. This Alligator had consumed a radio-collared Eastern Spotted Skunk that had been tracked to the borrow pit on previous occasions. An external assessment of the animal suggested that it had no injuries or trauma.

and Wildlife Conservation Commission biologists at the site). We discovered in the Alligator's stomach a number of *Pomacea* sp. (apple snail) opercula, bits of woody material, and clumps of black and white fur, bones, and claws consistent with an Eastern Spotted Skunk. We also found 1 ear tag with a number matching that of the Eastern Spotted Skunk we had tracked to the pit. The radio transmitter was lodged in the esophagus of the Alligator, above the lower esophageal sphincter. The transmitter and its battery appeared completely intact with no leaking or corrosion present, and the transmitter indeed worked for months after the event without failing. Due to the circumstances of our discovery and the advanced state of decomposition of the Eastern Spotted Skunk in the Alligator's stomach, we were unable to determine whether the Eastern Spotted Skunk's cause of death was predation by the Alligator, or if the Eastern Spotted Skunk died from other causes and had been scavenged by the Alligator (Bangs 2014, Grigg and Kirshner 2015, Nifong et al. 2011, Webster et al. 2016). We were also unable to determine the time or cause of death of the Alligator from our necropsy. It is possible the Alligator had already consumed the Eastern Spotted Skunk on one of our previous occasions when we had tracked the Eastern Spotted Skunk to the borrow pit.

Alligators are known to be highly opportunistic predators, feeding on a wide variety of organisms. Numerous studies on the diet of Alligators have documented consumption of crustaceans, insects, fish, birds, arachnids, gastropods, amphibians, reptiles, and mammals (Fogarty and Albury 1968, Kellogg 1929, McNease and Joanen 1977, Valentine et al. 1972, Wolfe et al. 1987). However, to our knowledge, no Eastern Spotted Skunk species has ever previously been reported in the literature as a confirmed food item of Alligators. Although most of the ephemeral depression marshes across the dry prairie landscape at the site were dry when this event occurred, the borrow pit where we discovered the Alligator still had >1 m of standing water present at its deepest point. In 2017, we observed most Alligators at the study site in the slough (Fig. 1) ~400 m from the pit, but the slough was primarily dry during this event. It is possible the Eastern Spotted Skunk ventured closer to the inundated borrow pit than it would normally, due to the limited availability of water on the landscape, and was taken by the Alligator at the water's edge. Conversely, it is possible the Alligator encountered and preyed upon the Eastern Spotted Skunk as the latter traversed dry prairie habitat in search of water. Lastly, the possibilities exist that the Alligator discovered and scavenged the deceased Eastern Spotted Skunk, or that the Alligator hijacked the Eastern Spotted Skunk carcass after it was killed by another predator in an instance of interspecific kleptoparasitism (Platt et al. 2007).

Although we were unable to confirm the cause of mortality in the case of the Alligator, there are a number of possibilities as to how the Alligator died. First, it is possible that the Alligator died from an ailment unrelated to its consumption of the Eastern Spotted Skunk. Second, it is possible that the Eastern Spotted Skunk's transmitter became lodged in the esophagus of the Alligator, eventually leading to the asphyxiation of the animal. However, when necropsied, only the transmitter and zip-tie collar were still in the Alligator's esophagus and the esophagus was not obstructed, with the rest of the Eastern Spotted Skunk in an advanced stage of decomposition in the Alligator's stomach. Likewise, the Alligator appeared to be in a healthy condition externally (Fig. 2), and crocodilians can survive for long periods without feeding (Garnett 1986, Uriona et al. 2005), so it is unlikely that the animal starved to death.

Finally, there is the potential that the Alligator died from Eastern Spotted Skunk spray toxicosis; that the chemical components in the Eastern Spotted Skunk's spray led to the death of the Alligator when it was absorbed into the Alligator's body. All skunk species have the ability to deter potential predators by expelling a noxious spray, also referred to as skunk

musk, from a pair of glands situated around the anus (Wood 1999). This skunk spray contains oxidative compounds, including thiols, which can cause damage to the hemoglobin in red blood cells (Means 2013, Zaks et al. 2005). While all skunk spray contains thiols, there are some species-specific differences in the chemical composition of the spray (Wood et al. 2002). Ingestion of these compounds can lead to the development of Heinz body hemolytic anemia and methemoglobinemia, which can result in death (Zaks et al. 2005). Most animals that predate and eat skunks likely discriminate what portions of the skunk they consume, avoiding the animal's anal musk glands. However, Alligators are known to eat small prey items whole (Grigg and Kirshner 2015), and perhaps because they rarely encounter skunks, Alligators, are naïve to the potential danger of consuming them. As the Eastern Spotted Skunk decomposed in the stomach of the Alligator, it is possible the Alligator died as the oxidative compounds entered the bloodstream during digestion.

Reports of animals dying after being exposed to skunk spray are rare; however, there are 3 documented cases of Domestic Dogs exhibiting some combination of Heinz body anemia and methemoglobinemia after being sprayed by a skunk (Means 2013, Zaks et al. 2005). One of these dogs died as a result of its ailments, though a causal relationship between skunk spray exposure and the animal's death could not be confirmed (Means 2013). There are similar anecdotal reports of other dogs becoming sick or dying after exposure to skunk spray and with no other diagnosable disease or condition present. Additionally, one study found that a captive *Ailurus fulgens* Cuvier (Red Panda) developed Heinz body anemia and died after being sprayed by a skunk, and in vitro testing of skunk spray showed that it caused oxidative damage to canine, feline, and Red Panda red blood cells (Fierro et al. 2013).

Our discovery represents the first known occurrence of the consumption of a skunk species by any crocodilian. Although there are few conservation or management implications from our findings for either the Eastern Spotted Skunk or the American Alligator, our report adds novel information of the natural histories of both species. Our findings add another taxon to the list of known food items of American Alligators. Similarly, our discovery suggests that Eastern Spotted Skunks may be vulnerable to predation by American Alligators in areas where they are sympatric.

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