Banisteria, Number 41, pages 80-84

Ophiophagy in Red-shouldered Hawks (*Buteo lineatus*), with the First Record of Eastern Wormsnakes (*Carphophis amoenus*) as Prey

Steven M. Roble

Virginia Department of Conservation and Recreation
Division of Natural Heritage
600 East Main Street, 24th Floor
Richmond, Virginia 23219

ABSTRACT

The Red-shouldered Hawk (*Buteo lineatus*) is a diurnal raptor that preys primarily on mammals, amphibians, and reptiles. A literature review reveals that documented prey includes at least 26 species of snakes, 17 of which inhabit Virginia. Observations and circumstantial evidence are presented to document predation by Red-shouldered Hawks on Eastern Wormsnakes (*Carphophis amoenus*) and Rough Greensnakes (*Opheodrys aestivus*) in a suburban residential neighborhood near Richmond, Virginia. These are apparently the first records of the Eastern Wormsnake in the diet of Red-shouldered Hawks. Given the abundance of this small, fossorial, and secretive reptile in some habitats in Virginia, it may be an important type of prey for local predators such as the Red-shouldered Hawk.

Key words: Red-shouldered Hawk, Eastern Wormsnake, ophiophagy, predation, raptor.

INTRODUCTION

The Red-shouldered Hawk (*Buteo lineatus*) is a diurnal raptor that preys primarily on mammals, amphibians, and reptiles (Howell, 1911; Nicholson, 1930; McAtee, 1935; Ernst, 1945; Stewart, 1949; Portnoy & Dodge, 1979; Janik & Mosher, 1982; Welch, 1987; Crocoll & Parker, 1989; Howell & Chapman, 1998; Dykstra et al., 2003). Comparing these and other studies, including their own, Strobel & Boal (2010) concluded that there is geographic variation in the diet of this raptor, with northern populations tending to feed more on mammals and less on amphibians and reptiles as compared to southern populations (the same conclusion was reached by Dykstra et al., 2008). Strobel & Boal (2010) also found that Red-shouldered Hawks in some areas (e.g., Strobel's [2007] study site in Texas) eat considerable quantities of invertebrates, although they account for only a small portion of the estimated total biomass consumed.

Among reptilian prey, snakes are the main group consumed by Red-shouldered Hawks. My literature review revealed that at least 26 species of snakes, 17 of which inhabit Virginia, have been reported as prey of Red-shouldered Hawks (Table 1). Many older studies of raptor food habits typically did not identify the snake prey beyond the level of genus or even simply "snake" (see summary of numerous studies in Sherrod, 1978), and thus are omitted from this table. The Eastern Gartersnake (*Thamnophis s. sirtalis*) was documented as prey of Red-shouldered Hawks in 11 of 12 detailed studies cited in this table (the lone exception being Stewart, 1949).

Smyth (1894) and Johnston (2000) summarized numerous prey records for Virginia raptors. Four of five Red-shouldered Hawk stomachs examined by Smyth contained food items, collectively including a spider, three grasshoppers, a crayfish, and two "spring lizards" (salamanders). Johnston's sample of 26 Red-shouldered Hawk stomachs contained small mammals (shrews, mice, rats, squirrels, and chipmunks), salamanders, a painted turtle, snake scales, crayfish, spiders, and various insects (especially grasshoppers). Mitchell & Fischer (2008) stated that there were only three documented records of hawks preying on snakes in Virginia, but they overlooked Johnston's (2000) report of a Rough Greensnake (*Opheodrys aestivus*) in the stomach of an immature male Broad-winged Hawk collected in Fairfax County. Mitchell (1994) listed hawks (*Buteo* spp.) as known predators of this snake in Virginia. Tupacz (1985) reported a predation event involving a presumed Red-bellied Watersnake (*Nerodia e. erythrogaster*) and a Red-shouldered Hawk in the Dismal Swamp (City of Suffolk).

OBSERVATIONS

For at least half of the past 18 years, a pair of Red-shouldered Hawks has nested on or near my mostly wooded suburban property in northern Chesterfield County, Virginia, within 5 km of the City of Richmond limits. During 2005 and 2006, the nest was located 13-15 m above the ground in the crotch of a white oak (*Quercus alba*) tree in the front yard. On the afternoon of 30 April 2005, my youngest son and I were observing the nest, which contained two nestlings that I estimated were several weeks old. Our observations were made using 7 x 35 binoculars and a spotting scope (20x magnification) from a location about 15 m from the base of the nest tree. At approximately 1715 h, both adult hawks returned to the yard, with one landing at the nest and the other in a nearby tree. The adult hawk at the nest then proceeded to feed one of the chicks an Eastern Wormsnake (*Carphophis amoenus*), readily identifiable by its brownish dorsum and pink belly, which I estimated was about 30 cm long. The chick swallowed the snake whole, using several gulping motions to do so. This is apparently the first documented record of Red-Shouldered Hawk predation on Eastern Wormsnakes.

The hawks nested in the same tree the following year. At approximately 2000 h on 10 June 2006, I found a relatively fresh dead adult Eastern Wormsnake (total length 25.5 cm) lying upside down at the base of the nest tree. There were no signs that the snake had been eaten, but apparent bruises were evident. Three young hawks had fledged about a week earlier but they were still returning occasionally to the nest and adjacent perches. The ground where the snake carcass was found was dry and lacked leaf litter or other cover objects, which is atypical of the habitat utilized by Eastern Wormsnakes. I surmise that the snake had been captured elsewhere by an adult hawk and was subsequently dropped from the nest or a nearby perch by that bird or one of its offspring.

Table 1. Documented snake prey of the Red-shouldered Hawk (excludes records of snake prey that were not identified to species).

Species (common name)[1]	Source[2]
**Carphophis amoenus* (Eastern Wormsnake)	This report
**Coluber constrictor* (North American Racer)	4, 15, 16, 18
Coluber flagellum (Coachwhip)	4, 18
**Diadophis punctatus* (Ring-necked Snake)	2, 4, 8
**Heterodon platirhinos* (Eastern Hog-nosed Snake)	18
**Lampropeltis calligaster* (Yellow-bellied Kingsnake)	18
**Lampropeltis getula* (Common Kingsnake)	4, 16
Micrurus fulvius (Harlequin Coralsnake)	10
**Nerodia erythrogaster* (Plain-bellied Watersnake)	13, 18
Nerodia rhombifer (Diamond-backed Watersnake)	18
**Nerodia sipedon* (Northern Watersnake)	2, 12, 14
**Opheodrys aestivus* (Rough Greensnake)	2, 16, 18, this report
**Opheodrys vernalis* (Smooth Greensnake)	9, 14
**Pantherophis alleghaniensis* (Eastern Ratsnake)	16
Pantherophis emoryi (Great Plains Rat Snake)	18
Pantherophis obsoletus (Texas Ratsnake)	18
Salvadora grahamiae (Eastern Patch-nosed Snake)	18
**Storeria dekayi* (Dekay's Brownsnake)	15
**Storeria occipitomaculata* (Red-bellied Snake)	14
Thamnophis marcianus (Checkered Gartersnake)	18
Thamnophis proximus (Western Ribbonsnake)	18
Thamnophis radix (Plains Gartersnake)	15
**Thamnophis sauritus* (Eastern Ribbonsnake)	1, 2
**Thamnophis sirtalis* (Common Gartersnake)	2, 3, 4, 5, 7, 8, 9, 11, 12, 14, 16, 17, 18
**Virginia striatula* (Rough Earthsnake)	18
**Virginia valeriae* (Smooth Earthsnake)	5

[1]Some authors reported snake prey using scientific and/or common names that refer to their subspecific classification; the names included here are the common names for the full species following Crother (2008). * = species that occur in Virginia.

[2]Sources: (1) Merriam, 1877; (2) Fisher, 1893; (3) Hershey, 1923; (4) McAtee, 1935; (5) Trautman, 1944; (6) Stewart, 1949; (7) Craighead & Craighead, 1956 (8) Root & DeSimone *in* Sherrod, 1978; (9) Portnoy & Dodge, 1979; (10) Jackson & Franz, 1981; (11) Janik & Mosher, 1982; (12) Bednarz & Dinsmore, 1985; (13) Tupacz, 1985; (14) Welch, 1987; (15) Ernst & Barbour, 1989; (16) Howell & Chapman, 1998; (17) Dykstra et al., 2003; (18) Strobel, 2007.

This pair of hawks did not nest in our yard during 2007-2010, but the same (presumably) or another pair nested in a different white oak tree near the back corner of our house in 2011. During the nesting season, I occasionally checked the ground below the nest tree for evidence of dropped or partially eaten prey items. I did not find any wormsnake carcasses that year, but a dead juvenile Rough Greensnake (total length 23.7 cm) was found at the base of this tree by my sons on 2 June 2011 and four days later I found a dead adult female Green Frog (*Lithobates clamitans*; snout-vent length 68 mm) lying upside down in our driveway within 8 m of the tree. I believe both of these specimens had been captured and killed by the hawks. Since moving to this residence in the fall of 1993, I had never previously observed a Rough Greensnake in our yard and had rarely encountered Green Frogs away from a perennial, first order stream at the back of the property.

DISCUSSION

Craighead & Craighead (1956) previously reported that Red-shouldered Hawks prey on Green Frogs. Fisher (1893) and McAtee (1935) were apparently among the first authors to report finding greensnakes (*Opheodrys* sp.) in the stomachs of Red-shouldered Hawks, but they did not identify the prey to species (i.e., distinguish between Smooth and Rough Greensnakes). However, the lone specimen (of 220 total Red-shouldered Hawk stomachs) examined by Fisher that contained a greensnake was collected in Alabama, so the prey item must have been a Rough Greensnake because it is the only species of *Opheodrys* that occurs in that state (Gibbons & Dorcas, 2005). More recently, Howell & Chapman (1998) recorded an instance of predation by a Red-shouldered Hawk on a Rough Greensnake in Georgia, and Strobel (2007), using extensive data obtained exclusively by means of video surveillance cameras, reported that this snake was by far the most frequent reptilian prey (included 14 species of snakes; Table 1) of this raptor during his study in Texas, accounting for 164 total predation events (two-thirds of all predation events in which the snake prey was identified to species).

Most published studies of the food habits of Red-shouldered Hawks were conducted in states outside of or near the edge of the range of the Eastern Wormsnake. The studies by Stewart (1949) and Janik & Mosher (1982) were conducted in Maryland, which is within the range of this snake, but the only snake prey identified to species by these authors were the Eastern Gartersnake and Smooth Earthsnake (*Virginia valeriae*). Among the confirmed snake prey of Red-shouldered Hawks, those that are most comparable in size and habits to the Eastern Wormsnake, which is one of the smallest and most fossorial snakes in eastern North America (Mitchell, 1994; Orr, 2006), are species of *Storeria* and *Virginia*. The Eastern Wormsnake possesses a sharp point or spine on the tip of the tail that may be used as a defensive weapon against some predators (Linzey & Clifford, 1981; Gibbons & Dorcas, 2005). Wormsnakes are seldom active on the ground surface (Mitchell, 1994; SMR, pers. obs.) and do not bask (Clark, 1970). Palmer & Braswell (1995) reported that Eastern Wormsnakes are surface active mostly at night and Barbour et al. (1969) observed that most movements by Eastern Wormsnakes at their study site were initiated in late afternoon or early evening, with no movements initiated between midnight and 0300 h. Tennant & Bartlett (2000) believed that Eastern Wormsnakes are crepuscular and noted an instance where multiple individuals of this species were observed crawling erratically across a lawn during a rainy afternoon, attracting the attention of several songbirds (mostly American Robins, *Turdus migratorius*) in the process and resulting in one predation event by a Blue Jay (*Cyanocitta cristata*).

Studies by Barbour et al. (1969), Russell & Hanlin (1999), and Orr (2006) suggested that Eastern Wormsnakes are relatively sedentary, either moving short distances between successive captures or exhibiting site fidelity (i.e., captured under the same cover object multiple times). Despite its secretive habits, the Eastern Wormsnake can be a locally abundant species (Ernst et al., 1997; Willson & Dorcas, 2004), attaining densities exceeding 200 individuals per hectare in some parts of northern Virginia. It is by far the most common species of snake on my property, accounting for more than 90% of my observations over the past 19 years. The snakes have almost always been found under cover objects, such as leaf litter, rocks, logs, bark, boards, and flower pots, but occasionally were dug up during gardening activities.

Crocoll (1994; repeated by Dykstra et al., 2008) stated that the foraging behavior of Red-shouldered Hawks is not well studied. He cited published and unpublished sources indicating that the species hunts diurnally, usually from a perch in the forest canopy, although it also utilizes man-made structures such as poles, fences, and hay piles. Nicholson (1930) summarized its behavior thusly "The method of hunting food by this hawk is perching alertly on posts, dead trees, or stubs, out in the open, watching patiently by the hour for its prey, be it some luckless mouse, snake, or frog." Crocoll (1994) further noted that this raptor may search for prey by flying low over open habitats, snatch prey from the water surface, or hunt from the ground (where they

have been observed capturing small mammals emerging from their burrows; Coward, 1985). Stevenson & Anderson (1994) stated that Red-shouldered Hawks locate prey while in flight or from perches (fences, utility poles, and wires) and indicated that they usually fly directly to seize their prey. Johnsgard (1990) reported that aerial searching was probably the primary foraging method of this hawk, supplemented by searching from perches, whereas Dykstra et al. (2008) wrote "This hawk generally hunts from a perch, waiting for its prey to reveal itself and then swooping down to snatch it from the ground or water surface." Apparently, Red-shouldered Hawks in my neighborhood occasionally capture surface-active Eastern Wormsnakes that they detect from perch sites or while flying, or else they are searching in leaf litter and under easily-movable cover objects for this prey species. However, to my knowledge no one has ever observed Red-shouldered Hawks employing the latter type of hunting behavior, which seems unlikely. Several studies (e.g., Fisher, 1893; McAtee, 1935; Stewart, 1949; Craighead & Craighead, 1956) found one or more moles, another secretive type of vertebrate that is rarely observed above ground, in the stomachs of Red-shouldered Hawks. Perhaps the hawks locate moles and wormsnakes in a similar manner. Given the abundance of Eastern Wormsnakes in some habitats in Virginia, it may be an important type of prey for local predators such as the Red-shouldered Hawk.

ACKNOWLEDGEMENTS

I thank my sons Ben and Tim for sharing their observations with me, and Gary Graves for his encouragement and comments on the manuscript.

LITERATURE CITED

Barbour, R. W., M. J. Harvey, & J. W. Hardin. 1969. Home range, movements, and activity of the Eastern Worm Snake, *Carphophis amoenus amoenus*. Ecology 50: 470-476.

Bednarz, J. C., & J. J. Dinsmore. 1985. Flexible dietary response and feeding ecology of the Red-shouldered Hawk, *Buteo lineatus*, in Iowa. Canadian Field-Naturalist 99: 262-264.

Clark, D. R., Jr. 1970. Ecological study of the worm snake *Carphophis vermis* (Kennicott). University of Kansas Publications, Museum of Natural History 19: 85-194.

Coward, S. J. 1985. Opportunistic feeding behavior in Red-shouldered Hawks. Oriole 50: 38-39.

Craighead, J. J., & F. C. Craighead, Jr. 1956. Hawks, Owls, and Wildlife. Stackpole Book Company, Harrisburg, PA and Wildlife Management Institute, Washington, DC. 443 pp. (reprinted in 1969 by Dover Publications Inc., New York)

Crocoll, S. T. 1994. Red-shouldered Hawk (*Buteo lineatus*). No. 107 *In* A. Poole & F. Gill (eds.), The Birds of North America. Academy of Natural Sciences, Philadelphia, PA and American Ornithologists' Union, Washington, DC. 20 pp.

Crocoll, S. T., & J. W. Parker. 1989. The breeding biology of Broad-winged and Red-shouldered Hawks in western New York. Journal of Raptor Research 23: 125-139.

Crother, B. I. (committee chair). 2008. Scientific and standard English names of amphibians and reptiles of North America north of Mexico, with comments regarding confidence in our understanding. 6th Edition. Herpetological Circular 37, Society for the Study of Amphibians and Reptiles. 86 pp.

Dykstra, C. R., J. L. Hays, & S. T. Crocoll. 2008. Red-shouldered Hawk (*Buteo lineatus*). No. 107 *In* A. Poole (ed.), The Birds of North America Online. Cornell Laboratory of Ornithology, Ithaca, NY. http://bna.birds.cornell.edu/bna/species/107 (accessed 15 January 2012)

Dykstra, C. R., J. L. Hays, M. M. Simon, & F. B. Daniel. 2003. Behavior and prey of nesting Red-shouldered Hawks in southwestern Ohio. Journal of Raptor Research 37: 177-187.

Ernst, C. H., & R. W. Barbour. 1989. Snakes of Eastern North America. George Mason University Press, Fairfax, VA. 282 pp.

Ernst, C. H., S. C. Belfit, S. W. Sekscienski, & A. F. Laemmerzahl. 1997. The amphibians and reptiles of Ft. Belvoir and northern Virginia. Bulletin of the Maryland Herpetological Society 33: 1-62.

Ernst, S. G. 1945. The food of the Red-shouldered Hawk in New York state. Auk 62: 452-453.

Fisher, A. K. 1893. The hawks and owls of the United States in relation to agriculture. U.S. Department of Agriculture, Division of Ornithology and Mammalogy, Washington, DC. Bulletin No. 3. 210 pp. (reprinted in 1974 by Arno Press, New York)

Gibbons, W., & M. Dorcas. 2005. Snakes of the Southeast. University of Georgia Press, Athens, GA. 253 pp.

Howell, A. H. 1911. Birds of Arkansas. U.S. Department of Agriculture, Biological Survey Bulletin 38. Washington, DC. 100 pp.

Howell, D. L., & B. R. Chapman. 1998. Prey brought to Red-shouldered Hawk nests in the Georgia Piedmont. Journal of Raptor Research 32: 257-260.

Jackson, D. R., & R. Franz. 1981. Ecology of the Eastern Coral Snake (*Micrurus fulvius*) in northern peninsular Florida. Herpetologica 37: 213-228.

Janik, C. A., & J. A. Mosher. 1982. Breeding biology of raptors in the Central Appalachians. Raptor Research 16: 18-24.

Johnsgard, P. A. 1990. Hawks, Eagles, and Falcons of North America. Smithsonian Institution Press, Washington, DC. 403 pp.

Johnston, D. W. 2000. Foods of birds of prey in Virginia. I. Stomach analyses. Banisteria 15: 3-15.

McAtee, W. L. 1935. Food habits of common hawks. Circular 370, U.S. Department of Agriculture, Washington, DC. 36 pp.

Merriam, C. H. 1877. A review of the birds of Connecticut, with remarks on their habits. Transactions of the Connecticut Academy of Arts and Science 4: 1-150.

Mitchell, J. C. 1994. The Reptiles of Virginia. Smithsonian Institution Press, Washington, DC. 352 pp.

Mitchell, J. C., & G. Fischer. 2008. Predation stalemate: Red-tailed Hawk (*Buteo jamaicensis*) versus Eastern Ratsnake (*Pantherophis alleghaniensis*). Banisteria 31: 54-56.

Nicholson, D. J. 1930. Habits of the Florida Red-shouldered Hawk. Wilson Bulletin 42: 32-35.

Orr, J. M. 2006. Microhabitat use by the Eastern Worm Snake, *Carphophis amoenus*. Herpetological Bulletin 97: 29-35.

Palmer, W. M., & A. L. Braswell. 1995. Reptiles of North Carolina. University of North Carolina Press, Chapel Hill, NC. 412 pp.

Portnoy, J. W., & W. E. Dodge. 1979. Red-shouldered Hawk nesting ecology and behavior. Wilson Bulletin 91: 104-117.

Russell, K. R., & H. G. Hanlin. 1999. Aspects of the ecology of worm snakes *Carphophis amoenus* associated with small isolated wetlands in South Carolina. Journal of Herpetology 33: 339-344.

Sherrod, S. 1978. Diets of North American Falconiformes. Journal of Raptor Research 12: 49-121.

Smyth, E. A., Jr. 1894. Notes on the feeding habits of the common hawks and owls of Virginia. Bulletin of the Virginia Agricultural and Mechanical College 3: 23-39.

Stevenson, H. M., & B. H. Anderson. 1994. The Birdlife of Florida. University Press of Florida, Gainesville, FL. 892 pp.

Stewart, R. E. 1949. Ecology of a nesting Red-shouldered Hawk population. Wilson Bulletin 61: 26-35.

Strobel, B. N. 2007. Nest site selection and nestling diet of the Texas Red-shouldered Hawk *Buteo lineatus texanus* in south Texas. M.S. thesis, Texas Tech University, Lubbock, TX. 85 pp.

Strobel, B. N., & C. W. Boal. 2010. Regional variation in diets of breeding Red-shouldered Hawks. Wilson Journal of Ornithology 122: 68-74.

Tennant, A., & R. D. Bartlett. 2000. Snakes of North America: Eastern and Central Regions. Gulf Publishing Company, Houston, TX. 588 pp.

Trautman, M. B. 1944. The birds of Buckeye Lake, Ohio. University of Michigan, Museum of Zoology Miscellaneous Publications No. 44. 466 pp.

Tupacz, E. G. 1985. Field notes: *Nerodia erythrogaster* (Redbelly Watersnake) and *Buteo lineatus* (Red-shouldered Hawk). Catesbeiana 5(2): 15.

Welch, R. J. 1987. Food habits of the Red-shouldered Hawk in Wisconsin. Passenger Pigeon 49: 81-91.

Willson, J. D., & M. E. Dorcas. 2004. Aspects of the ecology of small fossorial snakes in the western Piedmont of North Carolina. Southeastern Naturalist 3: 1-12.