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RED-SHOULDERED HAWK (*Buteo lineatus*) PREDATION OF TURTLES IN CENTRAL FLORIDA

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Abstract.—Red-shouldered Hawks (*Buteo lineatus*) are known to take a variety of reptilian prey, but only three chelonian species have been reported. We documented *B. lineatus* depredating eight additional turtle species at a central Florida location. Chelonian prey selection in this study appears to be limited by species presence and abundance, prey size, and energetic costs.

In the United States, reptiles have been widely documented in the diets of raptors (Accipitridae, Cathartidae, Falconidae, Strigidae, and Tytonidae) and Ross (1991) provided an extensive review of the literature published through 1990. A diverse range of species representing six of the seven families of chelonians (Chelonidae, Chelydridae, Emydidae, Kinosternidae, Testudinidae, and Trionychidae) that occur in the United States has been documented in the diets of these raptors (Ross 1991, Toland 1991). Only the Dermochelyidae (leatherback turtle) is excluded, although Tomillo et al. (2010) observed predation of hatchlings by Crested Caracara (*Caracara cheriway*) on a Costa Rican beach.

Red-shouldered Hawks (*Buteo lineatus*) predate a wide range of reptilian species (Ross 1991). Strobel and Boal (2010) reviewed 12 dietary studies of Red-shouldered Hawks across the eastern United States and found that 3–31% of their total diet consisted of reptiles. Turtles previously documented within the diet of the Red-shouldered Hawk include common snapping turtle (*Chelydra serpentina*; Stewart 1949, Jacobs and Jacobs 2002), western painted turtle (*Chrysemys picta belli*; Welch 1987), and common musk turtle (*Sternotherus odoratus*; Kimmel and Fredrickson 1981). This note further documents

chelonophagy by Red-shouldered Hawks and significantly expands the list of known prey species.

Methods

Study site.—(Sanford, Seminole County, Florida, USA; 28.75531 N, -81.27415 W); An active Red-shouldered Hawk nest was located at an estimated height of 10 m in a live oak (*Quercus virginiana*) with an approximated canopy width of 25 m. A retention pond (~0.5 ha), drainage ditch, and Seminole County Road 427 bordered the site. The immediate surrounding area was a mixture of woods, agricultural land, old field, and housing developments.

Field methods.—The study site was visited intermittently from 3 April to 11 June 2010. The ground was thoroughly searched for turtle remains from the nest tree trunk to 3 m beyond the canopy edge. Although a few non-turtle prey items were observed, they were neither recorded nor collected. Turtle remains were bagged and stored for later examination. Although the hawks were never observed grasping or consuming a turtle, we strongly believe that the remains could not have been from any other raptorial predator. Agonistic behavior and interspecific territoriality is common among raptors and has been well documented by numerous researchers (Janes 1985). Also, many of the remains were found directly under the active nest. The surrounding habitat (beyond boundary described above) was randomly searched throughout the study for evidence of turtle predation and no specimens were found that indicated the remains were from any potentially sympatric predators (e.g., Red-tailed Hawk, *Buteo jamaicensis*; Barred Owl, *Strix varia*; Great Horned Owl, *Bubo virginianus*; raccoon, *Procyon lotor*; North American river otter, *Lontra canadensis*; coyote*, Canis latrans*).

Laboratory methods.—All collected material was cleaned, and carapaces and plastra were reassembled when possible. Hatchlings and a single juvenile turtle were found disarticulated, or dried and distorted, thereby rendering them immeasurable. Specimens were identified to species/subspecies. Maximum carapace length (CL) and maximum plastron length (PL) was recorded to the nearest 0.1 mm. All specimens were deposited in the Chelonian Research Institute collection (PCHP 14117–14153).

Results

Thirty-seven turtles representing 10 species within five families (Chelydridae, Emydidae, Kinosternidae, Testudinidae, and Trionychidae) were identified (Table 1). Specimens ranged from hatchling to adult age classes. Mean CL for 25 measurable specimens was 78.1 mm (range: 35.7–112.7 mm). The single measurable specimens of striped mud turtle (*Kinosternon baurii*) and Florida mud turtle (*Kinosternon subrubrum steindachneri*) had maximum CLs of 55.7 mm and 74.2 mm respectively. The 14 measurable specimens of loggerhead musk turtle (*Sternotherus minor minor*) had a mean CL of 88.5 mm (range: 63.4–112.7 mm). The nine measurable specimens of common musk turtle (*S. odoratus*) had a mean CL of 64.8 mm (range: 35.7–86.8 mm). Six species, common snapping turtle (*C. serpentina*), Florida chicken turtle (*Deirochelys reticularia chrysea*), Florida red-bellied cooter (*Pseudemys nelsoni*), red-eared slider (*Trachemys scripta elegans*; non-native), gopher tortoise (*Gopherus polyphemus*),

Table 1. Inventory of 37 turtle specimens collected from 3 April to 11 June 2010 under a Red-shouldered Hawk nest tree in Sanford, Florida. Maximum carapace lengths (25 measurable specimens) and plastron lengths (28 measurable specimens) are presented.

Chelonian Research Institute Catalog #	Family/Species	Carapace Length (mm)	Plastron Length (mm)
	Family: Chelydridae		
PCHP 14117	*Chelydra serpentina*	—	—
PCHP 14118	*Chelydra serpentina*	—	—
	Family: Emydidae		
PCHP 14119	*Deirochelys reticularia chrysea*	—	—
PCHP 14120	*Pseudemys nelsoni*	—	—
PCHP 14121	*Trachemys scripta elegans*	—	—
	Family: Kinosternidae		
PCHP 14122	*Kinosternon baurii*	—	92.6
PCHP 14123	*Kinosternon baurii*	55.7	49.8
PCHP 14124	*Kinosternon subrubrum steindachneri*	74.2	63.1
PCHP 14125	*Sternotherus minor minor*	80.7	56.2
PCHP 14126	*Sternotherus minor minor*	74.7	55.9
PCHP 14127	*Sternotherus minor minor*	85.0	56.8
PCHP 14128	*Sternotherus minor minor*	93.2	67.2
PCHP 14129	*Sternotherus minor minor*	106.2	75.3
PCHP 14130	*Sternotherus minor minor*	—	67.3
PCHP 14131	*Sternotherus minor minor*	79.5	53.6
PCHP 14132	*Sternotherus minor minor*	93.0	64.4
PCHP 14133	*Sternotherus minor minor*	91.0	67.0
PCHP 14134	*Sternotherus minor minor*	63.4	44.5

Table 1. (Continued) Inventory of 37 turtle specimens collected from 3 April to 11 June 2010 under a Red-shouldered Hawk nest tree in Sanford, Florida. Maximum carapace lengths (25 measurable specimens) and plastron lengths (28 measurable specimens) are presented.

Chelonian Research Institute Catalog #	Family/Species	Carapace Length (mm)	Plastron Length (mm)
PCHP 14135	*Sternotherus minor minor*	112.7	80.9
PCHP 14136	*Sternotherus minor minor*	103.7	78.4
PCHP 14137	*Sternotherus minor minor*	98.4	69.7
PCHP 14138	*Sternotherus minor minor*	94.2	66.7
PCHP 14139	*Sternotherus minor minor*	63.6	43.8
PCHP 14140	*Sternotherus odoratus*	—	55.1
PCHP 14141	*Sternotherus odoratus*	72.2	58.0
PCHP 14142	*Sternotherus odoratus*	64.8	46.3
PCHP 14143	*Sternotherus odoratus*	—	—
PCHP 14144	*Sternotherus odoratus*	66.7	44.5
PCHP 14145	*Sternotherus odoratus*	35.7	26.5
PCHP 14146	*Sternotherus odoratus*	50.9	35.0
PCHP 14147	*Sternotherus odoratus*	73.2	57.7
PCHP 14148	*Sternotherus odoratus*	68.5	49.0
PCHP 14149	*Sternotherus odoratus*	86.8	62.9
PCHP 14150	*Sternotherus odoratus*	64.4	44.8
PCHP 14151	*Sternotherus odoratus*	—	—
	Family: Testudinidae		
PCHP 14152	*Gopherus polyphemus*	—	—
	Family: Trionychidae		
PCHP 14153	*Apalone ferox*	—	—

and Florida softshell turtle (*Apalone ferox*) for which there were no measurable specimens were all determined to be either hatchlings or juveniles.

Discussion

Jacobs and Jacobs (2002) reported the breeding range size of Red-shouldered Hawks varies from 60–339 ha. The Red-shouldered Hawks at our study site predated nine of the 12 (75%) native turtle species (plus the non-native *T. s. elegans)* available within their expected breeding range. Red-shouldered Hawks can adapt to variations in available prey due to geography (Strobel and Boal 2010) and seasonal and climatic change (Bednarz and Dinsmore 1985). Although dietary composition may shift temporally, turtles in the diet of the hawks in our study would be expected, as many species are visible and abundant (TJW, personal observation) within the habitats surrounding the nest site. Despite previously published reports of turtles in the diets of Red-shouldered Hawks (Stewart 1949, Kimmel and Fredrickson 1981, Welch 1987, Jacobs and Jacobs 2002), our limited observations suggest that turtles are taken opportunistically as prey and may be more prevalent in their diet than previously known. The hawks at our study site may have chosen them due to optimal hunting conditions: a select vantage point overseeing an aquatic habitat supporting an abundance of turtles.

This note documents two additional families (Testudinidae and Trionychidae) in the diet of the Red-shouldered Hawk. Further, it adds eight new species (*D. r. chrysea*, *P. nelsoni*, *T. s. elegans*, *K. baurii*, *K. s. steindachneri*, *S. m. minor*, *G. polyphemus*, and *A. ferox*) to the list of known prey items. Species that occur in the region, but were not documented as predated include the spotted turtle (*Clemmys guttata*), peninsula cooter (*Pseudemys floridana peninsularis*), and Florida box turtle (*Terrapene carolina bauri*). *Clemmys guttata* is considered rare and the closest known locality is approximately 7.7 km away from our study site (Barnwell et al. 1997), which is well beyond the maximum breeding range size for Red-shouldered Hawks reported by Jacobs and Jacobs (2002). *Pseudemys f. peninsularis* is common in the region and the waters adjacent to the nest site (TJW, personal observation). It is possible that no remains from any age class of this species were found due to our short collection period and small sample size. *Terrapene c. bauri* is also locally common (TJW, personal observation), but juveniles are highly cryptic (Dodd 2001) and adults may prove difficult to dispatch due to their ability to fully close their hinged plastrons (making them virtually impenetrable to predators).

We suggest that chelonian prey selection in this study is limited by species presence and abundance, prey size, and energetic costs (Jaksić and Carothers 1985). The location of the nest tree immediately adjacent to aquatic turtle habitat (retention pond and drainage ditch) offered a strong vantage point of abundant chelonian prey. The fact that *S. m. minor* and *S. odoratus* are often the most abundant species present within aquatic habitats (Bancroft et al. 1983, Meylan et al. 1992) would explain why those species represented 40.5% and 32.4% of the prey items recovered respectively. The Red-shouldered Hawks at this site only predated hatchling and juvenile age classes of species that reach large adult size (*C. serpentina*, *D. r. chrysea*, *P. nelsoni*, *T. s. elegans*, *G. polyphemus*, and *A. ferox*); only *G. polyphemus* is terrestrial. Comparison of the longest prey item in this study, a 112.7 mm *S. m. minor*, to two similar-sized specimens of the same subspecies (109.6 mm/200 g and 115.1 mm/230 g) from north-central peninsular Florida (Peter A. Meylan, unpublished data) allowed us to estimate a weight for our specimen. A general assumption that our 112.7 mm specimen fell between those two weights suggests an approximated weight of 215 g. Craighead and Craighead (1969) reported the average weight of Red-shouldered Hawks to be 550 g for males (n = 25) and 701 g for females (n = 24), so the largest food item in our study could have constituted approximately 39.1% and 30.7% of an average hawk's weight respectively. We suggest that greater shell dimensions and heavier weights of larger turtles would make them difficult to impossible to grasp and carry (let alone kill), and as such are limiting factors restricting predation of larger species to smaller age classes. A dearth of information in the literature regarding prey size of Red-shouldered Hawks prevents us from making further inferences. Juxtaposition of the nest and surrounding aquatic habitats may be advantageous to a sit and wait mode of hunting as compared to the higher energetic cost of active search (Jaksić and Carothers 1985).

We encourage researchers to collect data related to predation of turtles by raptors and other predators. This information would contribute to further understanding the importance of turtles within the dynamics of food webs.

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