

Predation on Northern Diamondback Terrapins (*Malaclemys terrapin terrapin*) by Bald Eagles (*Haliaeetus leucocephalus*) along the Atlantic Ocean and Delaware Bay Coasts of New Jersey

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Abstract

Between 1999 - 2002, and again in 2010, skeletal remains were collected from 20 bald eagle (*Haliaeetus leucocephalus*) nests scattered throughout New Jersey. Fourteen of these nests contained turtle shells. Of these, five adjacent to rivers, lakes or swamps contained shells of only *Sternotherus odoratus* (the stinkpot or common musk turtle), a strictly freshwater species of very small adult size (maximum known carapace length = 13.7cm). Five other nests (located adjacent to salt marshes along Delaware Bay, as well as Great Bay on New Jersey's Atlantic coast) contained only northern diamondback terrapin (*Malaclemys terrapin terrapin*) shells, two had shells of both diamondback terrapins and common musk turtles, and one had shells of both terrapins and juvenile snapping turtles (*Chelydra serpentina*). The majority of the terrapin shells that could be confidently sexed (N=24) represent males (N=20), which are much smaller than adult females in this sexually dimorphic species. Measurable terrapin shells ranged in size from 9.2 to 17.1 cm in carapace length (though only one exceeded 12.9 cm in length). Bald eagles are clearly exercising strong size selection when preying upon terrapin populations.

Introduction

Skeletal remains of prey organisms was collected from 20 different bald eagle (*Haliaeetus leucocephalus*) nests in New Jersey between 1999-2002 and again in the spring of 2010. Fourteen of these nests contained turtle shells representing three different species: northern diamondback terrapins (*Malaclemys terrapin terrapin*); stinkpots, or common musk turtles (*Sternotherus odoratus*); and snapping turtles (*Chelydra serpentina*). Most of the nests are located in southern New Jersey (Fig. 1).

Methods

Staff and volunteers working for the New Jersey Endangered and Nongame Species Bald Eagle Project collected the skeletal remains either in May, during the bald eagle banding season, or in the fall (October/November) after the young eagles fledged the nest and before the adults returned for the next breeding season. Bones were retrieved both from within nests and also at the bases of trees in which nests are located. Although this report focuses only on the turtle species represented, there are in addition remains of six different kinds of mammals (muskrat, woodchuck, gray squirrel, eastern cottontail rabbit, and Virginia deer), at least eleven different species of birds (based on both bones and feathers), and nine species of fish that have been recovered from these bald eagle nest sites.

Results

Complete or partial turtle shells were retrieved from eleven different bald eagle nests. Three of these nests were visited twice: Galloway (in 1999 and 2001); Greenwich (in 2000 and 2010); and Lake Lenape (2000 and 2002). On all occasions when these nest sites was surveyed, turtle shell material was recovered. Hence the Galloway, Greenwich, and Lake Lenape nests are listed twice in Table 1, resulting in the recovery of 78 turtle shells from 14 nests. Of this shell sample, 50 specimens represented diamondback terrapins, 24 represented stinkpots, and 4 represented snapping turtles. It is not surprising that the majority of the predated turtles were diamondback terrapins since nearly all of the nests containing turtles were located near coastal salt marshes.

Stinkpots are represented by 17 complete carapaces plus an additional seven that are too broken to measure. The measurable specimens range in size from 7.7 to 10.7 cm in length and are adults, as evidenced by the tight sutures between adjacent shell bones and the loss of a prominent midline keel on the carapace, which is characteristic of juveniles (Ernst et al., 1994).

Snapping turtles were found only in the Galloway (1999) nest. All were juveniles. Only the largest of these (Fig. 2) could be measured. Its midline carapace length is 12.4 cm, comparable in size to the shell of a typical adult male diamondback terrapin. The other three largely disarticulated snapping turtle shells in this nest represent much smaller individuals.

Most of the measurable diamondback terrapin shells (20 of 24) represent males. These range in shell length from 9.9 to 14.0 cm (Table 2). Only four specimens can be confidently identified as females, three of them being juveniles and one being an adult. Diamondback terrapins are a sexually dimorphic species (Fig. 3), with adult females (carapace length ranging from 13.5 to 20 plus cm) being considerably larger than mature males (which rarely reach 14.0 cm in carapace length).

In addition to the specimens listed in Table 2, there are five other terrapin shells not included because they have no locality information associated with them. Three of these are males, with carapace lengths of 11.0, 11.9 and 12.4 cm, while the other two are females with carapace lengths of 11.2 (=juvenile) and 17.0 cm (=adult). Counting these, the total terrapin sample is 50 individuals.

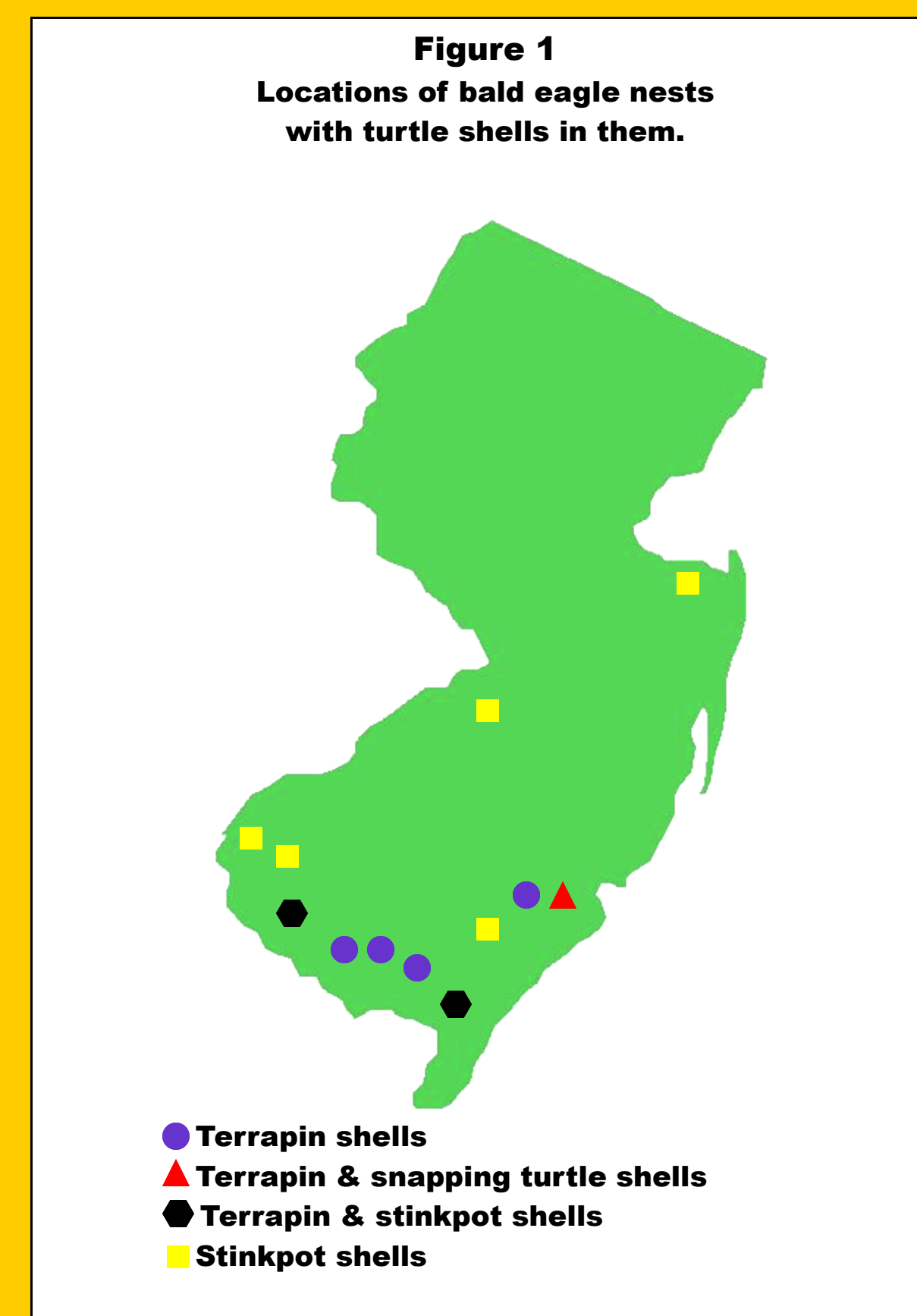


Table 1
Inventory of turtle skeletal remains from New Jersey bald eagle nests (1999 - 2002 and 2010)

Date	Locality	Turtle Species Represented
5/21/1999	Belleplain	Diamondback terrapins (N=1) Stinkpots (N=3)
10/7/1999	Nantuxent B	Diamondback terrapins (N=6)
10/28/1999	Galloway	Snapping turtles (N=4) Diamondback terrapins (N=5)
11/3/1999	Alloways B	Stinkpots (N=4)
11/3/1999	Mannington D	Stinkpots (N=4)
10/2000	Lake Lenape	Stinkpots (N=2)
10/5/2000	Greenwich	Diamondback terrapins (N=3) Stinkpots (N=1)
10/5/2000	Navasink	Stinkpots (N=8)
2001	Galloway	Diamondback terrapins (N=5)
5/6/2002	Ft. Dix	Stinkpots (N=1)
5/6/2002	Lake Lenape	Stinkpots (N=1)
4/21/2010	Greenwich	Diamondback terrapins (N=10)
4/21/2010	Greenwich B	Diamondback terrapins (N=5)
4/28/2010	Wheaton Island	Diamondback Terrapins (N=7)
N nests = 14		N turtles = 70

Table 2
Midline carapace lengths of diamondback terrapin shells from New Jersey bald eagle nests (1999 - 2001 and 2010)
*In addition to the specimens listed here, there are shell remains too fragmentary to measure representing an additional 14 terrapins.

Nest Locality	Shell Length (cm)	Sex
Belleplain (1999)	10.5	Male
Galloway (1999)	10.8	Male
	11.8	Male
	12.1	Male
	14.0	Male
Galloway (2001)	9.9	Male
	12.5	Male
	12.6	Male
Greenwich (2000)	11.6	Male
	12.6	Male
	12.8	Female
	17.1	Female
Nantuxent B (1999)	9.2	Female
	11.7	Male
	11.8	Male
	12.8	Male
	12.9	Male
Greenwich (2010)	10.1	Male
	11.4	Male
	12.4	Male
	10.3	Female
	10.8	Female
Greenwich B (2010)	10.9	Male
	11.5	Male
Wheaton Island (2010)	10.1	Male
N terrapins = 28 and 17 partial shells		Total N = 45



Discussion

In eastern North America, nesting bald eagles from Ontario to Florida have been reported to include turtles of at least eight different species (mud, musk, painted, spotted, snapping, soft-shelled and box turtles, as well as diamondback terrapins) in their diet (Clark, 1982). This is the first documentation of bald eagle predation on turtles not only in New Jersey but also more generally in the Delaware Bay and mid-Atlantic coastal regions.

Previous reports about turtle predation by bald eagles have not focused on the size of specimens taken. Almost all turtle shells found in New Jersey nests are of small individuals. Except for two adult female specimens, all the diamondback terrapin shells represent males (which, at maturity, are always considerably smaller than females) or juvenile females falling within the size range of adult males. The snapping turtles are all very young individuals with poorly ossified shells. The only one that can be measured falls within the size range of adult male terrapins. Stinkpots are one of the smallest species of North American turtles. The record maximum carapace length for this species is 13.7 cm (Ernst et al, 1994). Our sample of measurable stinkpot shells (N=17) has a mean carapace length of 9.2 cm. In comparison, our sample of measurable male terrapin shells (N=16) has a mean carapace length of 11.8 cm, 2.6 cm greater than that of the stinkpots.

Thus, New Jersey bald eagles are selectively preying upon either species of very small size (stinkpots) or upon small individuals of larger species (terrapins and snapping turtles). The fact that two large female terrapin shells were taken by bald eagles is quite interesting. Clearly, bald eagles are capable of taking turtles of considerably larger size than they routinely do. Why they don't prey upon larger-sized turtles more often is an interesting question that remains to be answered.

There has been a dramatic increase in New Jersey's bald eagle population since 1999-2002, when there were nearly 30 active nests. In 2009, 84 active eagle nests were monitored (Smith and Clark, 2009). Increased numbers of nesting pairs of eagles undoubtedly are resulting in increased eagle predation of terrapins, a "Species of Special Concern" in New Jersey. However, the numbers of terrapins preyed upon by bald eagles is negligible compared to other sources of terrapin mortality (e.g. the large numbers of nesting female terrapins killed annually by motor vehicles and the large-scale drowning of both sexes and all sizes of terrapins in commercial crab traps; Wood, 1997, and Wood and Herlands, 1997).

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