*Journal of the Pennsylvania Academy of Science 66(1): 39-42, 1992.*

# RESEARCH NOTE

## DOES THE COLOR PATTERN OF TWO SPECIES OF TURTLES IMITATE DUCKWEED?[1]

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### ABSTRACT

**We propose that the spotted carapacial pattern of both Blanding's turtle (*Emydoidea blandingii*) and the spotted turtle (*Clemmys guttata*) imitates duckweed (family Lemnaceae). This relationship may be selectively advantageous in reducing vulnerability to predation. The range of duckweed is somewhat related to the range of both species of turtles, primarily in the east central United States. Duckweed extends northward beyond the range of both turtles and becomes quite rare along the western Great Plains where neither species of turtle occurs. Scarcity of lentic habitat, interspecific competition, winter temperatures and habitat suitability may also limit the distribution of both species of turtles. The presence of duckweed in some portions of the range of these two species of turtles may have some bearing on their color pattern but other factors in other areas may limit their distribution. [J PA Acad Sci 66(1):39-42, 1992]**

### INTRODUCTION

Natural selection is an important factor influencing the colors and patterns that animals evolve to avoid predators (Cott 1940, Endler 1978). Numerous studies bear out the adaptive significance of color and pattern in animals (see reviews by Curio 1976 and Endler 1978); however, little is known of the determinants of these traits (Endler 1978). Camouflage is imitation by an animal of its environment, either whole or in part (Pasteur 1982). Both Blanding's turtle *(Emydoidea blandingii)* and the spotted turtle *(Clemmys guttata)* possess a conspicuous yellow-spotted black carapace (Conant 1975). Pope (1967) proposed that the carapacial pattern of *E. blandingii* "blends with . . . aquatic vegetation." We propose that this cryptic pattern may be selectively advantageous in both *E. blandingii* and *C. guttata* as their carapacial patterns imitate the color and form of the floating-leaved duckweeds (family Lemnaceae, primarily *Lemna* and *Spirodela*). Herein, we compare the distribution of both species of turtles with that of the Lemnaceae of North America.

### MATERIALS AND METHODS

The distribution of duckweed was determined by compiling detailed distribution maps from published works. Those references which did not contain detailed distribution maps (i.e. contained a brief statement or map that portrayed duckweed as merely present or absent within a particular state or province) were not used. It was felt that such information was too scant to accurately portray distribution. The distribution of Blanding's and spotted turtles was determined by consulting major reviews of the respective species (Ernst 1972, McCoy 1973).

### RESULTS AND DISCUSSION

*Emydoidea blandingii* ranges from Nebraska east to southern Ontario and south to central Illinois. Disjunct

[1]Received for publication 20 May 1991; accepted 30 August 1991.

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populations occur in Nova Scotia, New York, Massachusetts, and other parts of New England (McCoy 1973). This type of geographic distribution is characteristic of biota inhabiting the Prairie Peninsula which occurred following the retreat of Wisconsin glaciation (Smith 1957). The distribution of floating-leaved plants in the duckweed family is partially congruent with the distribution of *E. blandingii* in that duckweed becomes scarce or absent at the western edge of the Great Plains (Barkley 1977, Van Bruggen 1976). Duckweed is scarce in the westernmost portion of Kansas (Gates 1940, Barkley 1977). *Emydoidea blandingii* does not occur west of central Nebraska (McCoy 1973). The distribution of duckweed in Colorado (Harrington 1954) and Wyoming (Porter 1965) is not extensive. Within the central portion of the Blanding's turtles range (Indiana, Illinois, and Michigan), duckweed is common (Deam 1940, Mohlenbrock 1970, Voss 1972). Duckweed is commonly found beyond the northern and southern borders of *E. blandingii* range in Minnesota and Missouri (Lakela 1965, Steyermark 1963) indicating that the distribution of this and other syntopic turtle species may be affected by other factors, including: interspecific competition (Gutzke and Packard 1987), temperature that overwintering hatchlings are exposed to (St. Clair and Gregory 1990), and overall habitat suitability (Ross and Anderson 1990). Duckweeds extend into Canada (Budd 1951) north to the limit of trees along Hudson's Bay, east to southern New Brunswick (Hinds 1986), and Nova Scotia and west to Alaska (Polunin 1959, Porslid 1980). Preston and McCoy (1971) and McCoy (1973) suggest a subrecent extinction in peripheral parts of the range of *E. blandingii* because of the northward retreat of marshland habitat since Wisconsin glaciation.

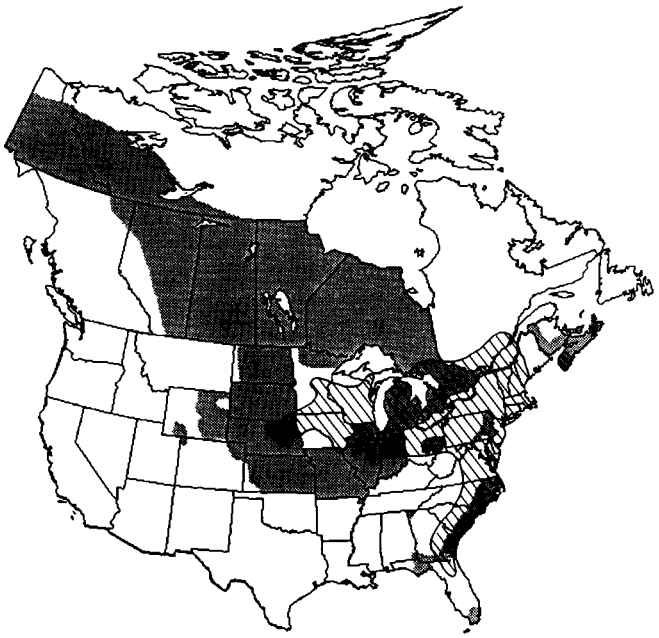

FIGURE 1. The stippled pattern shows the general distribution of the Lemnaceae (primarily *Lemna* sp. and *Spirodela* sp.) in North America. The composite range of the Blanding's turtle and spotted turtle is designated with diagonal lines. The range of the Lemnaceae extends north to the limit of trees in northern Canada. In Colorado, few scattered records exist; the Lemnaceae are absent from northwestern peninsular Florida. In western and eastern West Virginia, scattered records (N = 8) exist and in the Blue Ridge province, the Lemnaceae are sporadic. For applicable references, consult the text.

*Clemmys guttata* occurs from northwestern Illinois east to Maine and south to northern Florida (Ernst 1972). The species' range along the Coastal Plain of North and South Carolina, and Georgia (Martof *et al.* 1980) closely follows that of the Lemnaceae (Harrison and Beal 1964, Radford et al. 1968, Jones and Coile 1988). This may be related to the rarity of natural lentic habitat, necessary for the establishment of duckweed above the Fall Line in these states. Other species of turtles have been shown to be limited in distribution by the Fall Line (Tinkle 1959). *Clemmys guttata* is absent from the southern Appalachian Mountains (Ernst and Barbour 1972), but enters West Virginia at its easternmost county (Green and Pauley 1987). Duckweeds are essentially absent from much of the Appalachian Mountains in Pennsylvania (Wherry *et al.* 1979), West Virginia (Strausbaugh and Core 1978), and from the Blue Ridge province [Virginia southwest to Georgia (Wofford 1989)]. *Clemmys guttata* is absent from the Allegheny Plateau and Allegheny Mountains of Pennsylvania (McCoy 1982) where duckweed is absent. Duckweeds are absent from hilly unglaciated southeastern Ohio (Cusick and Silberhorn 1977) where both species of turtles are conspicuously absent (Conant 1951). However, in Indiana where duckweed is widely distributed (Deam 1940), *C. guttata* is limited to the northern portion of the state (Minton 1972). The spotted turtle is present throughout most of southern Michigan where duckweed is similarly distributed (but absent from the easternmost portion of the lower peninsula), but duckweed is also found in northern Michigan (Voss 1972) where *C. guttata* is absent (Harding and Holman 1990). In Florida, the turtle is present in disjunct populations in the northcentral portion (Iverson and Etchberger 1989) and the duckweeds are too (Clewell 1985). However, duckweed in abundant in the wetlands of southern Florida (Long and Lakela 1971) where *C. guttata* is conspicuously absent. Clearly, other factors affect the distribution of *C. guttata.*

In summary, in some portions of the range, the presence or absence of duckweed may have some bearing on the color pattern of *E. blandingii* and *C. guttata.* This hypothesis is circumstantially supported by the general congruence of each turtles distribution with that of the Lemnaceae. However, in other areas, other factors may be more critical and thus limit the species distributions. As Portmann (1959) noted, "color adaptation itself needs no proof, but its survival value does." Assuming that the color pattern of *C. guttata* and *E. blandingii* does mimic duckweed, what possible advantage would this confer to the turtles? Hatchlings of both species are extremely vulnerable to predation (Ernst 1976, Congdon *et al.* 1983, Frazer *et al.* 1990). Since juveniles and sub-adults of both species are patterned like adults, it is possible that the

duckweed-like pattern effectively conceals younger turtles from would-be predators. The annual probability of survival increases rapidly as turtles grow (Frazer *et al.* 1990), but adults are still vulnerable to predation (Seigel 1980, Emmons 1989). An alternative explanation is that the color pattern conceals the turtles from potential prey items. Since both species of turtles prey on small aquatic invertebrates such as snails, molluscs, dragonfly larvae, crayfish (Ernst 1976) or vertebrates (small fish, frogs, etc., Lagler 1943), perhaps concealing color patterns lessen the visibility of the turtles to these potential prey items.

## ACKNOWLEDGEMENTS

We thank Robert Freckmann, University of Wisconsin, Stevens Point, for assistance with botanical references. Manuscript preparation was supported by contract number DE-AC09-76SR00-819 between the United States Department of Energy and the University of Georgia, Savannah River Ecology Laboratory.

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