

The effects of UVB lighting on growth in captive juvenile diamondback terrapins (*Malaclemys terrapin*)

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Abstract Conservation efforts for diamondback terrapins (*Malaclemys terrapin*), considered a vulnerable species, include head-start programs in which juvenile terrapins are raised in captivity until they are large enough to be released safely into the wild. As part of these efforts, we have been investigating various aspects of terrapin husbandry to help develop optimal conditions to raise terrapins in the laboratory. In this study we examined the effects of UVB lighting, which has been linked to the promotion of shell growth through vitamin D₃ synthesis. Our results indicate no significant difference in mass or carapace length between terrapins exposed to UVB lighting and the control group, although we noted three terrapins from the blocked-UVB group and one terrapin in the UV group exhibited abnormal carapace scutes. Our findings that while UVB lighting may have significant effects on growth, these effects may not be seen early on. Further studies will be needed to determine whether UVB exposure, early in life, has effects on growth in older terrapins.

Keywords *Malaclemys terrapin* • head-start program • juvenile growth • ultraviolet light

Introduction

Diamondback terrapins (*Malaclemys terrapin*) are brackish water turtles, native to the eastern and Gulf coasts of the United States. In recent decades, terrapin populations have declined due to habitat loss, collection for the food and pet trades, road mortality, crab pots, and climate change (see Rowe et al., 2020; Szerlag-Egger & McRobert, 2007; Wood, 1997; Woodland et al., 2017), and *M. terrapin* are currently classified as a “vulnerable” species by the International Union for the Conservation of Nature (IUCN, 2024).

Accordingly, head-start programs in which hatchlings are raised in captivity, then released into the wild (see Pritchard, 1980; Heppell, 1996; Burke, 2015), may help stabilize wild populations. As part of our yearly head-start program for *M. terrapin* from the New Jersey shore, we study factors that might influence growth in hopes of developing optimal captive husbandry practices (see Parks et al., 2024). In reptile husbandry, UVB exposure is essential for the synthesis of vitamin D₃, required for calcium absorption (Ferguson et al., 1996; Acierno et al., 2006), with inadequate UVB exposure leading to metabolic bone disease (Doneley et al., 2018). In this study, hatchlings were raised under two

lighting conditions – UVB or UVB blocked), to determine whether UVB exposure influences growth rates in juvenile diamondback terrapins.

Materials and Methods

Housing

Twenty-nine *Malaclemys terrapin* hatchlings, provided by Project Terrapin (Long Island Township, NJ) were randomly assigned to one of two treatment groups: UVB-blocked and UVB-unblocked.

Hatchlings were housed individually, in freshwater, in glass aquariums, with each terrapin given an area of 296.4 in², including a brick basking area of 178 cm². Each aquarium was equipped with a 75W incandescent bulb, along with a 24-inch Repti-Zoo T5 HO UVB light. In the UVB-blocked (control) tanks, the UVB light was wrapped in Mylar® film, allowing visible light to pass, but absorbing UVB. UVB irradiance and light intensity were measured using handheld

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UVAB meters (Table 1). Light ran on a 12:12 LD cycle. Terrapins were fed Mazuri® Aquatic Turtle Diet, provided daily *ad libitum*. Biweekly measurements included overall body mass (grams) and CSL (mm).

Statistical Analysis

Baseline measurements of mass and carapace straight length (CSL) between the control and experimental groups were assessed for normality (Shapiro–Wilk test) and homogeneity of variance (Levene’s test). A two-tailed independent samples t-test was then used to compare groups at the start of the study, and no significant differences were found.

To evaluate growth over the trial period, changes in mass and CSL were analyzed using Levene’s test to assess homogeneity of variance, followed by two-tailed independent samples t-tests to compare final outcomes between groups. All statistical analyses were performed using IBM SPSS Statistics Subscription (64-bit) for Microsoft Windows.

Results

There were no significant differences in initial body mass between terrapins assigned to the two lighting conditions (Blocked-UV: 166.8 ± 9.15 g vs. UV: 158.7 ± 8.93 g; $t(18) = -0.628$, $p = 0.538$). Similarly, initial carapace straight length (CSL) did not differ significantly between groups (Blocked-UV: 91.75 ± 1.93 mm vs. UV: 90.20 ± 2.07 mm; $t(18) = -0.547$, $p = 0.591$).

At the end of the trial, the change in body mass did not differ significantly between the UV-exposed and Blocked-UV groups (Blocked-UV: 42.57 ± 2.48 g vs. UV: 38.28 ± 2.54 g; $t(18) = -1.208$, $p = 0.243$). Likewise, the change in CSL was not significantly different between treatments (Blocked-UV: 56.45 ± 1.34 mm vs. UV: 55.00 ± 1.69 mm; $t(18) = -0.673$, $p = 0.510$).

Discussion

The purpose of head-start programs is to improve the survival of vulnerable species by raising hatchlings in captivity until they reach a size that reduces their risk of environmental threats (see Burke, 2015; Heppell et al., 1996). Once released, larger juveniles may have improved chances of surviving and contributing to wild populations. Successful examples,

include terrapins on Poplar Island in the Chesapeake Bay (Roosenburg & Kennedy, 2019) and Kemp’s ridley sea turtles (*Lepidochelys kempii*) (Burke, 2015).

In this study we compared the effects of UVB lighting on *M. terrapin* growth over 18-weeks. UVB lighting, considered essential in reptile husbandry because it enables vitamin D₃ synthesis, which is critical for calcium metabolism to support healthy bone and shell development (Ferguson et al., 1996; Acierno et al., 2006). Without sufficient UVB exposure, reptiles may be unable to absorb dietary calcium effectively, leading to poor mineralization, bone density loss, and metabolic bone disease (MBD) (Doneley et al., 2018). Numerous clinical studies have linked MBD in captive chelonians to low vitamin D₃ levels caused by inadequate UVB exposure (Mans & Braun, 2014; Acierno et al., 2006; Ferguson et al., 1996).

The time-frame of our study may have been too short to demonstrate the development of MBD. However, during the final measurement period, three terrapins from the blocked-UVB group and one from the UVB group exhibited minor indentations in their outer scutes, which may potentially be linked to a mismatch between high dietary intake and suboptimal vitamin D₃ synthesis (Acierno et al., 2006). Although these shell indentations did not affect growth, they warrant monitoring in future studies. Diagnostic tools such as radiography and serum calcium/vitamin D₃ testing could help identify subclinical MBD (Doneley et al., 2018) in young terrapins.

One notable limitation to our study was that UV irradiation was assessed using handheld meters at three basking heights (Table 1). While these readings confirmed that Mylar® film reduced UV exposure in the blocked group, it did not fully eliminate it—especially at lower basking levels where differences in UVAB irradiance between groups were relatively small (~15 $\mu\text{W}/\text{cm}^2$). This partial overlap in exposure may have reduced the experiment’s power to detect differences.

Table 1. UV Irradiance and Light Intensity at Different Basking Heights

Distance from UVB Bulb (centimeters)	Light Intensity (x10 Lux)	UVAB -Blocked Tanks ($\mu\text{W}/\text{cm}^2$)	UVAB- Unblocked Tanks ($\mu\text{W}/\text{cm}^2$)
28	320-400	20-30	30-35
22.2	460-510	25-30	35-40
16.5	650-720	30-35	50-55

Note: Light intensity and UVAB irradiance were measured using a handheld UVAB meter at three basking heights. Distances were measured from the UVB fixture to the center of the basking platform.

Conclusions

We found no effects of UVB radiation on growth in juvenile terrapins over an 18-month period. However, given its importance in preventing metabolic disorders, and from the fact that our final readings may have indicated early MBD, UVB radiation would still be recommended in the captive husbandry of *M. terrapin*.

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