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Perch Color Preference in Juvenile Green Tree Pythons, *Chondropython viridis*

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Green tree pythons, *Chondropython viridis*, are polymorphic for color as juveniles, commonly being primarily yellow or brown until becoming mostly green at about 1 year of age. We tested the hypothesis that the different morphs arose as a result of selection for differential background matching, yellow morphs selecting light-colored backgrounds, and brown morphs selecting dark-colored backgrounds. Twelve yellow and eight brown morphs were placed repeatedly in individual testing enclosures and allowed to choose between black and white or yellow and brown halves of a t-perch. Trials showed that both color morphs preferred dark over light perches. We tentatively suggest that individuals chose dark-colored perches for purposes of concealment.

Key words: coloration, crypticity

INTRODUCTION

In this paper, we investigate whether two color morphs of the green tree python, *Chondropython viridis*, preferentially select differently colored perch sites.

Chondropython viridis displays several different juvenile color morphs [Cogger, 1975; Engelmann and Obst, 1982]. At the Dallas Zoo, two breeding pairs each produce young that are dimorphic for color, one morph being predominantly brown, the other being mostly yellow. A single clutch may consist of both color morphs, and the genetics of the system are unknown. The juvenile coloration changes to the predominantly green adult coloration at the age of about 1 year. We hypothesized that yellow and brown morphs would select light and dark perches, respectively.

MATERIALS AND METHODS

On 4 May 1988, 26 *Chondropython viridis* hatched at the Dallas Zoo (15 yellow and 11 brown morphs) from a single clutch. The hatchlings were raised individually

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TABLE 1. Responses of all snakes to trials run in the morning and afternoon*

	Dark	Light	Center
AM (0700–1200 h)	196	103	33
PM (1200–1700 h)	117	54	18

*G = 0.43; df = 2; $P > 0.05$.

in 3.8 l jars. Hatchlings were raised in the presence of two perches, one light (white or yellow) and one dark (black or brown) placed within their individual enclosures. Ambient temperature varied from 24–29°C, and the light regime varied from 10L: 14D to 14L:10D, according to seasonal light fluctuations in Dallas, Texas. After 165 days, 20 snakes (12 yellow and 8 brown morphs) were feeding regularly on newborn mice (*Mus musculus*). We began experimental trials on this group at this time.

In perch choice experiments, snakes were placed on the bottom of individual testing enclosures (76 l galvanized steel cylinders) containing centrally placed t-perches. The perches were made of wooden dowels 10 mm in diameter and were 325 mm high, with a crossbar 200 mm wide. Each crossbar was painted black or brown on one side of the central pole and white or yellow on the other side. Paint was flat luster quick drying enamel (Yellow/Pantone 113U, Brown/Pantone 478U, Black/ White not assigned spectral code; Pantone Color Formula Guide, 1963, 1985; Pantone Inc., Moonachie, NJ). Successive trials using black and white or brown and yellow perches were run on individual snakes, with these two color combinations being presented to individual snakes in a random order on successive days. The enclosures were covered with black plastic shade screen to prevent escape and to reduce outside distractions. Light levels inside the enclosures were measured at approximately 55 lumens/sq m, qualitatively similar to the light present at ground level in a tropical rain forest on a sunny day.

Chondropython viridis assume an ellipsoidal coil when at rest with the head in the center of the ellipsoid. As soon as this coil type was assumed, the snake's position (brown, black; center; or yellow, white) on the perch was recorded. A snake was recorded as being in the center of the perch if less than 75% of its body was on either side of the central pole. Snakes not assuming an ellipsoidal coil after 2 h were returned to their jars and not scored. No animal was tested more than once a day. Snakes in any obvious stage of ecdysis were eliminated from testing until the ecdysis cycle was complete. Snakes were not tested for at least 2 days after feeding. Testing enclosures were disinfected and thoroughly rinsed following each trial in an attempt to eliminate conspecific odors and pathogens. The data were analyzed using G-tests for homogeneity [Sokal and Rohlf, 1981].

RESULTS

To investigate the possibility that snake behavior changed during the day, tests conducted in the morning (0700–1200 hr) were compared to those run in the afternoon (1200–1700 hr). They were not found to be significantly different (Table 1; $G = 0.43$, $df = 2$, $P > 0.05$), so all trials were combined in subsequent tests. There was no significant difference in the response of snakes to brown and yellow or black and white t-perches (Table 2; $G = 3.91$, $df = 2$, $P > 0.05$), so data were pooled

TABLE 2. Responses of all snakes to trials run on brown and yellow or black and white t-perches*

	Dark	Light	Center
Brown-yellow t-perch	136	81	19
Black-white t-perch	162	70	29

*$G = 3.91$; $df = 2$; $P > 0.05$.

across perch types, scoring choices as dark, light, or center. There was no statistically detectable difference in the response of brown or yellow morphs to experimental trials (Table 3; $G = 1.00$, $df = 2$, $P > 0.05$), so we analyzed data without regard to snake color morph. G-tests showed that snakes preferred not to perch over the center pole ($G = 163.33$, $df = 2$, $P < 0.001$), possibly because the center pole disturbed the snake's typical resting position. Snakes preferred a dark over a light perch ($G = 49.03$, $df = 1$, $P < 0.001$). In fact, all snakes, regardless of their own color, chose dark more often than light perches.

DISCUSSION

Evidence for the evolution of background matching coloration to avoid predation exists [Isely, 1938; Mueller, 1968; Kettlewell, 1955, 1956; Sumner, 1934; Dice, 1947; Tordoff, 1980; Andrén and Nilson, 1981; Whittle et al., 1976; Gotmark, 1987; Annett, 1989; Kaufman, 1974a,b, 1975; Endler, 1980], but many studies simply show a correlation of a species' coloration with its background [Sheppard, 1951; Giesel, 1970; Cain and Sheppard, 1950; Johnston, 1981; Kats and Van Dragt, 1986; Gibbons and Lillywhite, 1981; Fernandez and Collins, 1988; Norris and Lowe, 1964; Lillywhite et al., 1977; Endler, 1982; Nevo, 1973] and infer an anti-predation advantage. Most studies that show a link between an animal's coloration and the color of its normal habitat have been done in fairly homogeneous environments, such as temperate forests or deserts [however, see Hughes and Mather, 1986; Henderson, 1990; Nevo, 1973; Endler, 1978, 1980, 1982]. We believe that the process of background matching may be different in heterogeneous environments, such as tropical rain forests. Several alternatives to our original hypothesis remain to be tested: 1) There is a thermoregulatory advantage to perching on dark rather than light perches; 2) snakes are seeking seclusion or cover and are using dark colors as a cue; 3) hydration needs may be better served in darker areas. We shall discuss each alternative in turn and present a hypothesis below in an effort to explain the seemingly increased incidence of polymorphism in more heterogenous habitats.

In the present study, both morphs preferred to sit on dark perches (2 to 1) over light perches. In this sense, brown snakes chose the ''correct'' (or background matching) perch color, while the yellow morphs chose a contrasting or non-background matching perch color. The most parsimonious explanation is to assume that, since both color morphs preferred dark over light perches, both morphs seek out dark perches for a common reason, and that it is not true that brown morphs choose to match their backgrounds whereas yellow morphs do not choose to do so.

Green tree pythons may have evolved behavior causing them to seek out dark perches for a presumed thermoregulatory advantage. However, in our experimental

TABLE 3. Comparison of responses of brown and yellow color morphs*

	Dark	Light	Center
Brown morphs	116	59	21
Yellow morphs	186	95	25

*G = 1.00; df = 2; $P > 0.05$.

chambers, dark and light perches were similar in temperature. In measuring objects in the field, we found that most items, whether light or dark, had equilibrated to ambient temperature. In fact, we found that surface temperatures of natural perching surfaces were more often affected by material composition (such as wood or stone) than by color. Therefore, we conclude that green tree pythons cannot predict temperature of a perch by color or shade alone.

We also considered that our experimental subjects chose darkened areas because such areas may provide concealment for ambushing prey or avoiding predators or may reduce water loss. In our visually stark chambers, there were no places for snakes to hide, and inherited behavioral patterns may have caused the snakes to choose dark perches over light perches because darkened areas of any kind may offer the possibility of seclusion and water conservation. Our experimental design precludes us from accepting this hypothesis and from disentangling the predator avoidance, prey ambush, and hydration postulates.

Although a full review of color polymorphism in snakes is beyond the scope of this paper, many snakes are known to be polymorphic as juveniles and/or adults: *Bothriechis schlegelii* [Campbell and Lamar, 1989], *Atheris squamiger* [Pitman, 1974; personal observations], *A. hispida* [Pitman, 1974], *Corallus enhydris* [Henderson, 1988, 1990], *C. annulatus* [Blody and Mehaffey, 1989], *Trimeresurus mcgregori* [personal observations], and *Boiga cynodon* [Smith, unpublished data]. Many of these snakes are known to be ambush predators, all are from heavily vegetated tropical environments, and all are known to be primarily arboreal. These observations suggest that polymorphism in these arboreal tropical snakes from several different phylogenetic groupings may have a similar ecological explanation. Other instances of color polymorphism, such as dark color morphs of *Thamnophis sirtalis* [Blanchard and Blanchard, 1940] and *Vipera berus* [Andrén and Nilson, 1981] appear to be due to possible thermoregulatory advantages of dark coloration in temperate zone climates.

Background matching is important for animals from habitats that are homogeneous in coloration, as animals that do not match their background may be obvious to predators or to prey. However, in highly heterogeneous backgrounds such as tropical rain forests, selection on prey coloration by predators may be quite different. Prey animals in these habitats may appear inconspicuous against their multicolored background over a wide range of colors and may therefore better fit into the overall environmental mosaic of a rain forest setting. It may be that coloration is selectively neutral over a wide range of colors in heterogeneous environments (i.e., the different morphs appear to the predator as equally random samples of the background pattern [Annett, 1989]).

It is possible that background matching might occur under alternative circumstances, and the next logical step for follow-up research would be an experiment involving multiple conditions and more naturalistic enclosures. Further observations of the natural history of this species would also be illuminating. It would also be interesting to test a convergent species such as the Emerald tree boa, *Corallus canina*.

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