Possible Costs of Conspicuous Dimorphic Coloration of Hatchling Male Collared Lizards (*Crotaphytus collaris*): Increased Risk of Predation?

Authors: Kendall L. Wilson-Henson, Justin Agan, and Dr. Stanley Fox
Department of Integrative Biology

Abstract

I am studying a species of lizards called Eastern Collared Lizard (Crotaphytus collaris collaris). I will be monitoring a single population that is located on the outside edges of Stillwater, Ok. I investigate the abnormal pre-productive coloration of male hatchlings. My main question is if these orange bars relate to the over all fitness of the males. My study explores the pros and cons associated with hatchlings having these bars based on how predators react to these bars. Since the bars stand out against the lizards natural habitat I assume this will lead to a heavier predation rate by Coachwhip snakes (Masticophis flagellum). My hypothesis is that Coachwhips will predate the male hatchlings with vivid orange bars more than drab colored hatchlings. These bars are important, because they show themselves before the hatchling reach an age of production. Their appearance, before productive age, is highly confusing since animals should not display sexual dimorphism during non-sexual years. Dimorphism is the occurrence of gender specific formations found in one species.

Introduction

I plan to work with a species of lizard called the Eastern Collared Lizard (*Crotaphytus collaris*). These lizards are common to Oklahoma and other arid areas. I will be studying the unusual pre-productive coloration that the hatchling males have (Husak and Fox 2004). These coloration are what make these male hatchlings unique. These bright orange bars that appear before they are sexually active, and could cause potential bonding pairs with female hatchlings. This coloration is called a dimorphic coloration. Dimorphism is the occurrence of gender specific formations found in one species. This coloration is highlighted in Fig. 1, see orange arrows, along with the black collar that gives them their name, see black arrow. As you can see the orange bars are very vivid compared to their normal coloration that would blend in with their soundings as a deter to predation. As supported by Husak (2006) male hatchling models where attacked more based on their vivid coloration meaning they lose some of their camouflage when having such vivid coloration. Which would result in male hatchlings being predated more often by Coachwhips (Masticophis flagellum), seen in Fig. 2, then drab males.

I will focus on the negative effect the bright, conspicuous orange bars have on the hatchlings caused by possible increased risk of predation. Specifically I will be using Coachwhip snakes (*Masticophis flagellum*) to run trials that test whether the male hatchlings with the orange coloration are attacked more readily than the drab colored lizards. I hypothesize that males with orange coloration will in fact be more heavily predated than drab colored lizards.
I support this hypothesis with previously recorded work. If this hypothesis is positively supported than it would open a new mindset of sexual dimorphism study.

Coachwhips were chosen for this experiment based on Husaks (2006) study over predator attacks on multiple Collared lizard populations using clay model

*=Mentor

representations. Fig. 2 shows an image of the Coachwhip. These snakes are a top predator of Collared lizards in the Stillwater area. Having a natural predator from the area we will be taking the lizards from will provide a better guarantee of success in getting a predatory reaction from the Coachwhips.

Figure 1 - The black arrow points to the black collar that gives these lizards their name. The orange arrow points to the orange bars, which are a dimorphic display, that are the subject of my research. These bars are such a hot topic due to the fact that they show themselves before the hatchlings reach an age of puberty.

Figure 2 - We will use five Coachwhips per trial group. Each Coachwhip will have the ability to choose between two male hatchlings. The Coachwhips will not be able to harm the hatchlings nor will they have prolonged stress since the trial will only run thirty minutes long.

Methods

Hypothesis: My specific question is whether the bright orange coloration of male hatchlings has a negative effect on the hatchlings by increasing their predation rate. I will test this by doing trials involving Coachwhip snakes. These trials will focus on the predatory aspect of Coachwhips. If this sexual dimorphism has a predation cost then it could lower fitness of the brightly colored males.

Methods for capture: Since I will be handling wild lizards I must use tools to safely capture and handle these hatchlings. I have chosen to follow the example of Dr. Stanley Fox and will use the noose method. This method is a quick, effective, and safe way to capture specific lizards from a distance. Using a noose also allows me to capture the hatchling as soon as I make visual contact.

The noose does not harm, hurt, or choke the lizards due to the size of their jaw bones. Still, the hatchlings will not be left on the noose string for less than a few seconds. Once the hatchling has been captured, it will be placed in a mesh bag that allows for safe, easy transportation. Location data is collected from the original sighting spot; not the catch spot. Along with location data I will note the time of original sighting. This will allow me to keep a record of the amount of time the hatchling is placed under stress. Keeping time records will also allow me to track the trial days without keeping a hatchling in a stressed environment for longer than necessary.

Methods for Monitoring Populations: Since I must monitor and conduct trials on one population that holds many generations of old and new individuals. This means I will stress extensive identification methods. Being able to identify a specific lizard will allow me to conduct trials without repeating hatchling subjects

I will use paint patterns or color coding as a quick visual identification. The picture in Fig. 3 shown above is an example of the color coding that I will use to identify all collard lizards. Secondly, I will use toe clips as a permeant identification. Both of these identifications are specific to each population. When a lizard is taken from a site, I will record is location using number

coordinates and location diagrams. This will allow me to return the hatchlings to the exact location. This need for preciseness is mandated by the territorial social organization that collard lizards display. Another reason for this arises from keeping the hatchlings in specific trial groups for testing being done by other researchers.

Methods for trials: Oklahoma State University will be utilized to provide lab space, resources, and data for the research over collared lizards. I will be monitoring one population that is located on the outside edges of Stillwater, OK. I will be taking male hatchling pairs from this population for these trials. They will be taken to the area where five cages that are 5'x5' in diameter, as seen in Fig. 4, house the naive Coachwhips. These hatchling pairs will be placed in separate secure aquariums that will be placed on opposite corners of the cage in shaded areas to regulate the lizards stress. When not using live hatchlings we will conduct the trials with clay models. Both of these methods will allow the snake to have a neutral area and two choose areas where the secure aquariums will be placed. This will allow us to monitor a Coachwhip's reaction without it being able to touch or harm the hatchling pairs.

We will be running the five trials with the same pair for thirty minutes total. Once the trials are over, the pairs will be placed back into the population at the same exact locations within inches of where they were originally found. These trials will be repeated multiple times until I have gained conclusive data from them. Since a person cannot be present continuously for all trials, the trials will be conducted in the presence of a video recorder. This will allow me to have permanent records of the trials for later analysis.

Figure 3 - This image shows how the color coding will allow for quick visual identification to lower stress on the lizards. This method will be used alongside the toe clipping. Each toe clipping combination corresponds with each color coding. Color coding, with non-toxic paint, allows for easy identification of lizards that have already be used in trials. Although the color coding nor the toe clips effect the current trials.

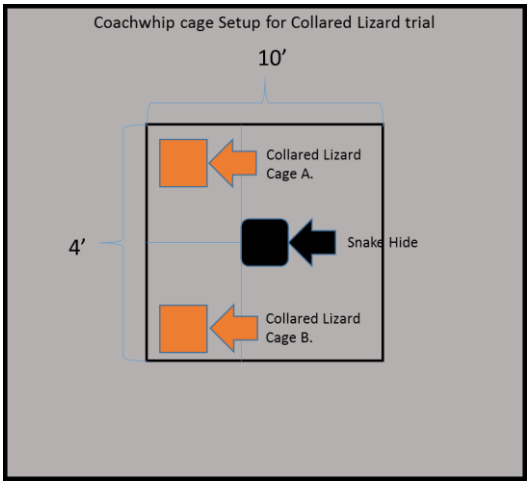

Figure 4 - This cage setup outlines how the Coachwhips cage will allow for us to house the lizards in secure aquariums with in the Coachwhips cage. This diagram also shows how the cage will be broken up into three separate areas (using tape) to help secure visual line within cage.

Expected Results

If the Coachwhip shows aggressive behaviors towards the male hatchlings with orange bars over the drab colored males then it will show that this coloration could cause male hatchlings to not survive till reproductive age. This would show the struggle between sexual selection and natural selection in the balance of population

survival. This would also disprove the idea that the orange coloration is a replication of the orange coloration that gravid females display. These finding would have high implication in studying these pre-productive sexual dimorphisms.

Discussion

The ways my trials could fail is if the Coachwhip does not show interest in either subject. This might be caused by the smell of paint on the lizards, or could be due to overfeeding of the snake. Both of these cases are caused by human error.

If the Coachwhip show higher interest and predation reaction to the drab hatchlings, this would indicate that my original hypothesis is incorrect. I would then need to go back and re-evaluate the hatchling coloration hypothesis. However, Husak (2006) supports my proposed hypothesis. There is the chance that even with supporting data by Husak (2006) these trials will not support my hypothesis or even give any relevant data at all.

If the results do support my hypothesis then it could lead onto new areas of study. If the data does support my hypothesis I would love to see a long term behavioral study to prove or disprove the potential for pair bonding caused by the orange coloration.

Acknowledgements

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