

The Green Anole (*Anolis carolinensis*)
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If you live in the southeastern United States, you might be lucky enough to have the green anole (*Anolis carolinensis*) sharing the yard and garden with you. This small and rather unassuming lizard can be found basking or scurrying about in its normal bush-and-tree habitat,



Fig. 1. Large territorial male during conspicuous display behavior

but it can also adjust to using decks, walls, and other human-made structures as part of its home range. The green anole is so named because it is usually bright green, though it can shift to brown when it is cold or socially stressed. The green anole is particularly noticeable during the breeding season (April - July), when territorial males frequently move about on patrol and advertise their domain with visual displays. These displays, consisting of head bobbing and the extension of an impressive pink throat fan (also called a dewlap), make the males quite conspicuous (Fig. 1, and see

<http://www.biol.vt.edu/faculty/jenssen/dispatterns.html>).

You might note these little lizards with a passing curiosity, but really not give them much more thought. However, the green anole deserves a much closer look because it has a very interesting social system.

Anolis carolinensis is a member of the largest genus of lizards, totalling more than 375 species. Almost all of these anoline species are found in the tropics. However, the green anole is one of the exceptions, being distributed as far north as southern Virginia and Tennessee, and eastward to central Texas and southeastern Oklahoma. The species is quite versatile and does well in most any subtropical climate. It even has a stronghold in Hawaii, where it was introduced in about 1950.

Sexual Dimorphisms

The green anole is sexually dimorphic; that is males and females have different expressions of a trait. For *A. carolinensis*, there are numerous sexually dimorphic traits.

Body size. – Male body length, as measured from the tip of the nose to the end of the trunk (i.e., snout–vent length, SVL), is about 15 % greater for males than for females (Fig. 2). Adult males range about 50–70 mm SVL, while adult females range about 40–60 mm SVL. A male-larger size dimorphism is usually the case in species where males fight for multiple females (i.e., polygyny), and this is the case for *A. carolinensis*. The bigger the male, the more females the male is able to guard (up to six females).



Fig. 2. Male above and female below showing sexual size dimorphism

Dewlap size. – The male dewlap is three times the area of the female dewlap. The male dewlap becomes disproportionately

larger with increasing body size (Fig. 3), and may be an honest indicator to other males as to how big a displaying male actually is. Because territorial males display frequently, the flash of a large dewlap may intimidate other males from approaching guarded females.

Activity. – Because males are competing with other males for the most mates, male territories can average about 70 m³ in habitat volume in which multiple females will be relatively clustered in small, overlapping home ranges of about 8 m³ of habitat per female. To effectively guard multiple females from male intruders, territorial males must consistently advertise their presence with conspicuous displays (100 display/hour) and patrol their large territories with frequent and extensive moves (28 perch shifts/hour and 27 m/hour). In contrast, females are not competing with other females for mates; instead they are lightly guarding small home ranges in habitat that is abundant in food and shelter. Therefore, females seldom display (12 times/hour) and do not move often (6 perch shifts/hour) or far (4 m/hour).

Mating System

The mating system of *Anolis carolinensis* fits that of **female-defense polygyny**. As longer daylengths and warmer weather occur in late February/early March, both sexes leave their winter retreats and disperse into springtime home ranges. Their feeding begins along with hormonal changes that lead to the initiation of reproductive behavior and reproduction. By late March/early April, males are moving to females with the intent of guarding multiple females from other males. This creates male-male competition for mates that continues for the four month breeding season.

Large territorial males defend on average about 3 females. Thus, for every large territorial male with three resident females, there are two smaller males with few or no females. The intense inter-male competition is not only expressed in frequent aggressive signaling, but can occasionally lead to fights over clumps of habitat that contain females (Fig. 4). These fights are most likely in April when territorial boundaries of large males are still in flux, but can also occur later in the breeding season when resident males are challenged by their territorial neighbors or by ambitious younger males seeking control of a new breeding territory.

Recent evidence suggests that a deeper complexity exists in the mating system. A female is not restricting her copulations to the large male patrolling her home range. Instead, the sequence of clutches by a female may be sired by more than one male. Paternity of resident female offspring has been assigned to three classes of males: 1) the large resident male; 2) neighboring large territorial males; and 3) female-sized males effectively hiding inside the large-male territories (i.e., covert males). Covert males are too small to compete directly with large patrolling males, but will be occasionally accepted by resident females if covert males co-occur

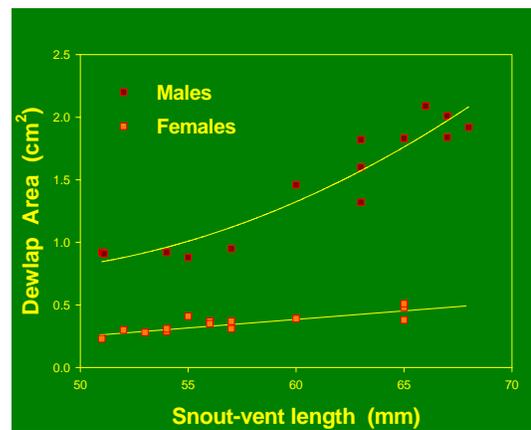


Fig. 3. Dewlap area plotted against SVL



Fig. 4. Jaw locked males engaged in ritualized combat

with resident females in a risky strategy of female-mimicry. Thus, on closer examination, the *A. carolinensis* mating scheme within a breeding season features polygyny among males and polyandry among females, resulting in a **Dominance Polygynandry** mating system (Schuster & Wade, 2003), where males assume behaviors that allow them to invade guarded female aggregations.



Fig. 5. Male taking a pre-copulatory neck hold

approaches, so that he might take a neck hold (Fig. 5). During these encounters, which are fairly brief (1–2 minutes), the male will decide whether he wants to copulate. About 70% of the time he does not take a neck hold, and will move off. When copulation does occur, the male and female will be occupied for 30–60 minutes. Females can store sperm and, should the territorial male disappear and no new male replace him, a female can continue to lay fertile eggs for the rest of the breeding season.

When laying an egg, a female will first dig a shallow hollow in the soil or mulch, usually on the ground, but occasionally above ground (e.g., in accumulated organic matter in the axil of a limb). She then backs into the depression, lays the egg, and covers the egg with surrounding material. No more parental care is given, and upon hatching 6–8 weeks later, the little neonate is on its own.

Energetics

Males expend much energy in territorial defense that includes patrol, aggressive signaling to neighboring males, and occasional chases or actual fights with intruders. Males lose body weight over the breeding season defending their harems. Feeding infrequently (about once/hour), they interrupt their patrol routine to literally “eat on the run.” As a consequence of high activity level and low food intake, many territorial males are displaced by other males when exhaustion sets in. Documented by one study (Ruby, 1984), 75% of males on breeding territories at the beginning of the breeding season were replaced during the 4-month breeding season. Breeding females, on the other hand, can be very inconspicuous because they infrequently display or aggressively engage a female neighbor (about once/8 hours). Low energy output on social activity is probably an advantageous trait, given their continuous production of single egg clutches over a 4-month period. After the breeding season (beginning in August), male and female activity profiles become similar because males are no longer territorial. Male rates of display and movement decrease to those of females, and male feeding rates triple (3 times/hour) as males put on lost weight and both sexes build energy reserves for the coming winter.

Reproduction

Unlike most kinds of lizards that lay one large clutch of eggs per year, anoline lizards lay a series of single-egg clutches. An *A. carolinensis* female will lay an egg about every week (4–7 days) during the 4-month breeding season. This means that a female may lay a total of 15–18 eggs for the summer. For each weekly clutch, a female first becomes sexually receptive, and will move to where the resident male can see her. The resident female signals that she is receptive by bending her neck when a male



Fig. 6. Hatchling

When the day lengths become short and air temperatures drop, the *A. carolinensis* population leaves its home ranges and seeks out winter retreats (e.g., root masses, rock crevices, even under house siding). On warm days in the winter, aggregations of males and females may emerge to bask, but they rarely feed or interact socially.

Husbandry

Should you consider holding *A. carolinensis* for observation, you should be aware of their needs in advance. For most people, green anoles need more than can be supplied, especially for long-term care. Here are some considerations. During the breeding season, do not house two males together. They are certain to fight and become stressed. A male with a couple females would work well. However, an all-female group will also bring out territorial interactions, even in the less aggressive females. Next, consider that the enclosure that is used almost certainly will be much more cramped than the approximate size of the natural home range; for a male, this is a volume of 12 feet high x 12 feet wide x 12 feet long (4 x 4 x 4 m). Anoles are arboreal, and I have seen them as high as 100 feet (33 m) up in mature hardwood forest habitat. Therefore, the more complex the perches, branches, and vegetation for climbing, basking, and hiding, the better. *Anolis carolinensis* needs heat (but not too much heat). Cage temperatures should cycle between about 23–35 C (73–95 F). Light intensity and quality are also important. A lighting combination of incandescent (for heat) and fluorescent (for brightness) that also includes some UV wavelengths works well, but is obviously not near the characteristics of actual sunlight. Water should be available by daily misting of vegetation, and from standing or dripping water sources (e.g., shallow dish of fresh water). Calcium lactate, especially for females during egg laying, and other mineral supplement are required. These can be dusted onto cultured food (e.g., crickets and mealworms) or onto field sweepings. It is important not to release prey (e.g., crickets) that are too large to be eaten because at night these insects will become active and chew on sleeping lizards. The most preferred food is soft-bodied, such as spiders and small caterpillars. Do not feed hard-bodied prey, such as sowbugs, beetles, or ants.

Clearly, the green anole is not just another dime store disposable pet. For many of us, the green anole gave us our first encounter with reptiles. More often than not, ignorance about its needs and habits has been to the anole's detriment. Ultimately, the slender beauty and curious social behavior of the green anole are best observed under natural conditions.

Sources for the above data can be found on my web site: <http://www.biol.vt.edu/faculty/jenssen/research.htm>

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