PRELIMINARY OBSERVATIONS ON THE GRAY-THROATED FORM OF *ANOLIS CAROLINENSIS* (REPTILIA: IGUANIDAE)

STEVEN P. CHRISTMAN

The green anole (*Anolis carolinensis*) is usually characterized by a throat fan (dewlap) that is colored pink or red. However, in southwestern Florida anoles have dewlaps ranging from pale gray to magenta. Duellman and Schwartz (1958, Bull. Fla. St. Mus., Biol. Sci. 3: 101-324) first reported this unique morphotype, and Thomas Krakauer in an unpublished study, delineated part of the southeastern boundary of the distribution. Conant (1975, A field guide to reptiles and amphibians of Eastern and Central North America, Boston, Houghton Mifflin Co.) subsequently noted its existence in southern Florida. Beyond the fact that it exists, however, very little appears to be known about the gray-throated anole. In this paper I present a preliminary geographic distribution of the gray-throated form of *Anolis carolinensis* and relate some qualitative observations made during the last several years.

METHODS

Anoles were collected from localities throughout southern Florida by noosing, shooting with rubber bands and by hand. Most specimens were released after examination of dewlap color, but approximately 50 were deposited in the Florida State Museum, Gainesville.

After acquiring a familiarity with the variation in dewlap colors, I constructed a reference chart consisting of eight color chips ranging from pale gray to bright red. The color chips were numbered one to eight, given arbitrary English names and related to the standard color terminology of Maerz and Paul (1950, A dictionary of color, 2nd Ed., New York, McGraw-Hill Book Co., Inc.) (Table 1). Under natural light in the field, I compared the dewlap color of adult male anoles with the reference chart and assigned a number corresponding to the appropriate color chip to each specimen. Intermediate values were used when necessary.

In addition to conducting the general survey of dewlap phenotypes throughout southern Florida, I examined in detail one area of intergradation between the gray-throated form and the typical red-throated form. In 1966 Krakauer (unpublished data) had determined the eastern limit of the gray-throated form, the western limit of the red-throated form and the width of the intergrade zone along the east-west oriented Loop Road (SR 94) in the Big Cypress National Preserve. I repeated his survey in 1972 and again in 1978 to determine if any changes in the distribution of the two forms had occurred. Three to eight adult males were collected (except in the 1978 survey—see below) at 0.8 km intervals along the Loop Road. The lizards were scored for dewlap color and released.

To determine if there were any obvious behavioral differences between the two forms, I kept several adults of each sex in the laboratory. Individual anoles were allowed to acclimate to the cages (0.9 x 0.9 x 1.2 m) and then other individuals were introduced, one at a time.

RESULTS AND DISCUSSION

Other workers (e.g., Duellman and Schwartz, 1958; Krakauer, unpublished) familiar with the unique anoles in southwestern Florida have

TABLE 1. Correspondence between Maerz and Paul (1950) color designators and the eight arbitrary dewlap colors used to classify individuals of *Anolis carolinensis* in southern Florida.

Reference chart color	Maerz and Paul	Population
1, pale gray	Plate 35; A-5	Gray-throated
2, darker gray	Plate 37; F-7	Gray-throated
3, dark magenta	Plate 46; G-5	Intermediate
4, reddish magenta	Plate 46; K-3	Intermediate
5, pink	Plate 1; I-7	Red-throated
6, red	Plate 4; K-10	Red-throated
7, dark red	Plate 5; L-8	Red-throated
8, bright red	Plate 3; L-12	Red-throated

usually referred to them as "green-throated." Actually, the skin between the dewlap scales in pure populations is some shade of gray. Typical *A. carolinensis* from the remainder of the range are characterized by red dewlap skin. Intermediate populations contain individuals with red, gray, purplish and magenta inter-scalar dewlap skin. In all specimens that I examined, the scales of the dewlap are green, regardless of the color of the interscalar area. When the skin is red the entire dewlap appears red, but when the skin is gray, the dewlap (under casual examination), appears to be some shade of green.

The geographic distribution of the gray-throated form of *Anolis carolinensis* as currently understood is shown in Figure 1. The minimal area where anoles consistently have gray dewlaps and the minimal area where red dewlaps occur exclusively are delineated. The unshaded area is inhabited by intermediate populations or populations of unknown status. Anoles from intermediate populations may have red, gray, magenta or purplish dewlaps, and all of these colors are sometimes represented at a single locality.

Anoles from Cape Sable and the Florida Keys have pink or red dewlaps. From Marco Island northward approximately 180 km along Florida's West Coast, anoles have gray dewlaps. Anoles from Everglades City in Collier County appear to be pure gray-throats, but specimens examined from nearby Chokoloskee Island included individuals with gray, magenta and even yellow dewlaps. Thus the situation in this region is not at all clear. A population of red-throated anoles occurs on Longboat Key in Sarasota County, and intermediate populations are known from south of there on the Englewood Peninsula. Since preparation of the range map, I have learned of an apparently pure population of gray-throated anoles from western Glades County (Steve Godley, pers. comm.). This locality falls within my unknown area and suggests a more extensive distribution of the gray-throated form than is indicated in Figure 1. As additional data

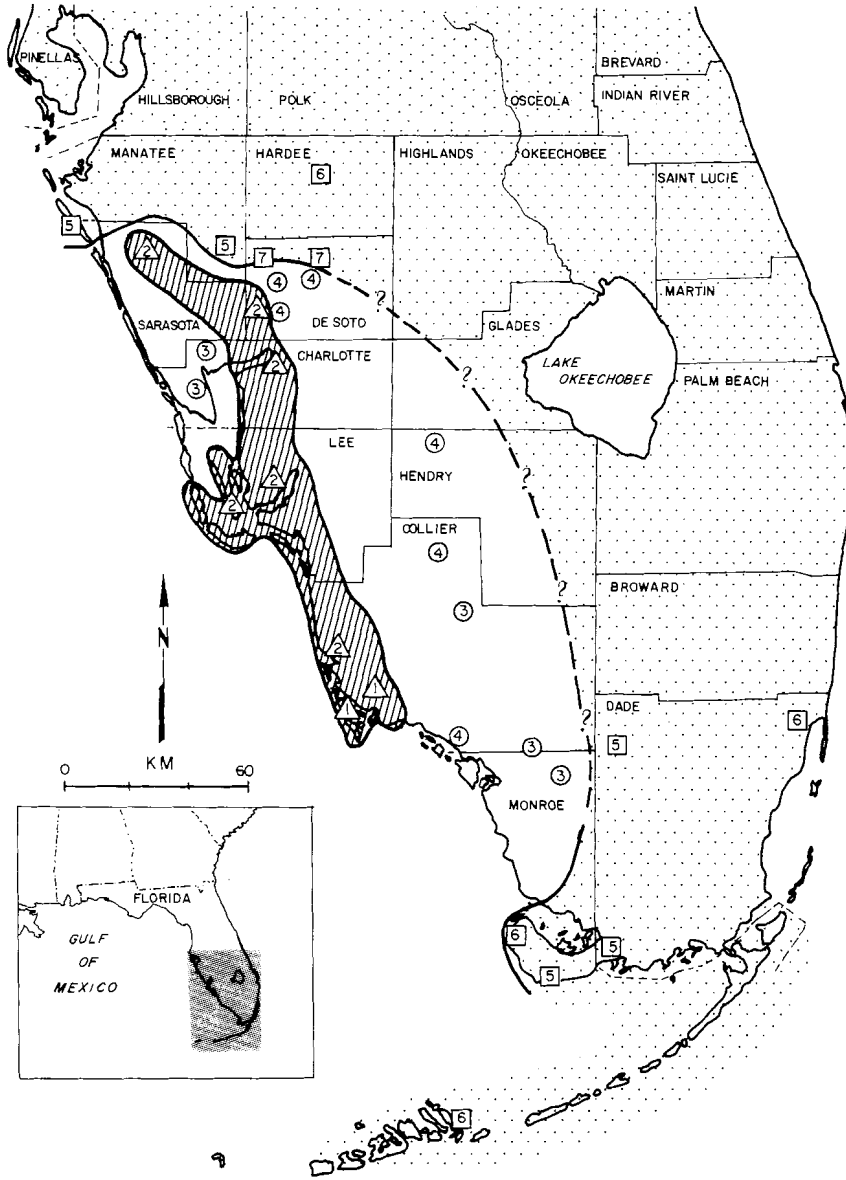

Fig. 1. Distribution of the gray-throated form of *Anolis carolinensis*. Hatching represents the minimal distribution of the gray-throated form and stippling the typical red-throated form. The unshaded area includes the zone of intergradation, the exact boundaries of which are not precisely known. Sampling localities are indicated by squares for red-throated populations, triangles for gray-throated populations and circles for populations with intermediate dewlap colors and/or both gray and red dewlaps. The numbers within the symbols refer to modal scores of dewlap colors based on samples ranging from three to 18 specimens.

become available, the unshaded (= unknown) area on Figure 1 will be reduced.

The zone of intergradation between the two morphs has not been defined clearly. The positions of the southwestern edge of the red-throated population and the eastern edge of the gray-throated population are approximate in some areas (Figure 1). Within the areas delineated for each morph, however, no exceptions are known. Although the boundaries of the intergrade zone are poorly understood, it is clear that its width is not uniform. In the De Soto-Manatee-Sarasota county area the intergrade zone is very narrow; near Horse Creek in De Soto County, populations of pure red-throated anoles occur within 5 km of populations exhibiting only gray dewlaps. To the south, however, the intergrade zone is apparently much wider (over 50 km).

Krakauer (unpublished) reported that the intergrade zone along Loop Road (SR 94, Monroe and Collier cos.) was approximately 5.6 km wide and that pure red-throated populations occurred as far west as Pinecrest, approximately 12.8 km west of the eastern intersection with US 41. I repeated Krakauer's survey in 1972 and found that red-throated anoles occurred only as far west as 8.8 km west of the eastern intersection with

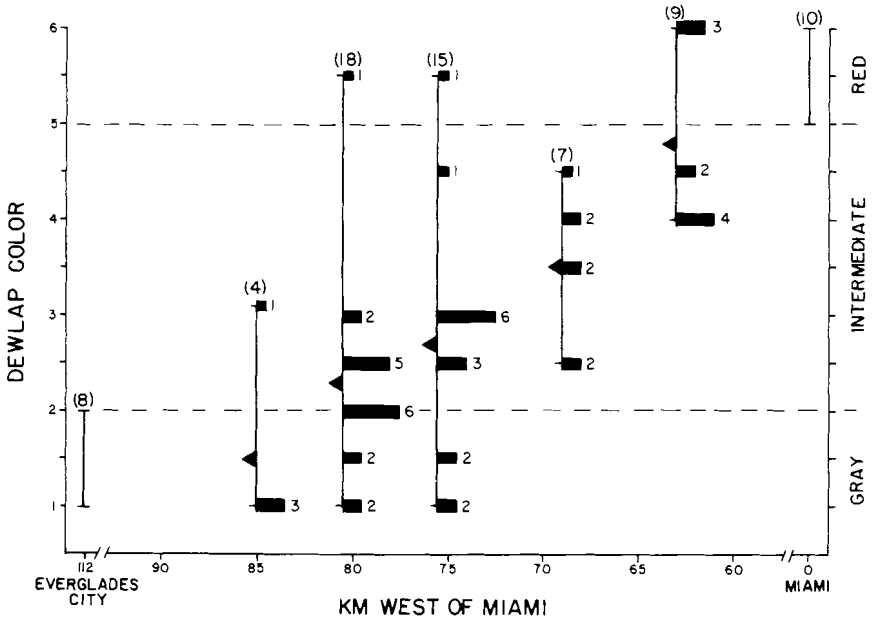

Fig. 2. Variation in dewlap color of *Anolis carolinensis* along an east-west transect from Miami to Everglades City, Florida in 1972. Dewlap color numbers as in Table 1; vertical lines = range; left-facing triangles = mean; horizontal bars and numbers = frequency of phenotype; bracketed numbers = sample size.

US 41 and that the intergrade zone was actually much wider. Populations of anoles with mixed dewlap colors and/or with purplish and magenta dewlaps occur from 8.8 km west of the Loop Road–US 41 eastern intersection to Monroe Station, some 60 km to the west. The discrepancies between the two studies are probably due to sampling errors, although possibly the intergrade zone has been widening at the expense of both morphotypes. The data now indicate that, except for the extreme eastern part, all of Loop Road lies within the zone of intergradation. Figure 2 summarizes the variation in dewlap colors of *A. carolinensis* along an east-west transect from Miami to Everglades City (including Loop Road) in 1972.

I attempted to repeat the Loop Road investigation in the spring of 1978. Although not mentioned by Krakauer and not noticed by me in 1972, *Anolis sagrei* now occurs along Loop Road. In fact, *A. sagrei* seems to have largely replaced *A. carolinensis* in this area, to the extent that I was unable to obtain sufficient samples of *carolinensis* in 1978. Although some *carolinensis* are still present, *sagrei* is now the dominant species.

The relationship between the red and gray-throated forms of *A. carolinensis* may vary geographically as evidenced by the shape of the intergrade zone: narrow in some areas and wide in others (Fig. 1). Nothing is known about possible isolating mechanisms between red- and gray-throated anoles, but such a pattern may indicate (1) geographic variation in reproductive compatibility between the two forms, (2) geographic variation in the strength of whatever environmental pressure selects for gray dewlaps, or (3) geographic variation in some aspect of the habitat which would lead to local variation in vagility and hence genetic mixing.

In the laboratory, interactions between individuals of *A. carolinensis* are not affected by dewlap color. Adult male gray-throated anoles acclimated in solitaire responded to introduced males with red dewlaps in the same way they responded to males with gray dewlaps (i.e., display followed by attack). Male gray-throated anoles displayed to and mounted females whether they were members of gray-throated or red-throated populations.

Although I have not quantified field observations, it appears that the two forms have different habitat preferences. Gray-throated anoles are most abundant on grasses, reeds and other vertical perches of small diameter. They usually perch facing downward and when disturbed, run down the perch to the ground. Red-throated anoles typically perch on larger sticks or tree trunks and often run up when alarmed.

Other differences between the two forms are suggested but have not been quantified. For instance, Sam R. Telford (pers. comm.) reported finding differences in morphology of *Plasmodium* (malaria) infections between the two forms. William Ingram (pers. comm.) analyzed some

morphological data which suggested differences in head shape, relative tail length and relative hind leg length between the two forms.

In a study of variation in 15 species of Florida snakes I recognized seven major patterns of geographic variation that accounted for over 60% of the combined variation in 100 characters (Christman 1975, Patterns of geographic variation in Florida snakes. Ph.D. Diss., Univ. Florida, Gainesville). The pattern of geographic variation exhibited by the gray-throated morph of *Anolis carolinensis* however, is unlike any pattern with which I am familiar, and is not correlated with any obvious ecological or historical factor. Furthermore, I know of no other taxon or phenotype with a similar distribution.

The gray-throated form of *Anolis carolinensis* probably deserves subspecific recognition. However, additional variational data should not be difficult to gather and it seems appropriate to await a more detailed study before formally describing this distinctive population.

National Fish and Wildlife Laboratory, 412 N.E. 16th Ave., Room 250, Gainesville, Florida 32601.

RECORD REVIEW

The Vocally Versatile Mockingbird.—Recorded and narrated by Samual A. Grimes, 1979. DY-23 of Droll Yankes, Inc., Foster, Rhode Island 02825. One 33 RPM record in jacket, monophonic. $7.00 plus $1.00 shipping.—All of us are familiar with the amazing vocal feats of the Mockingbird *(Mimus polyglottos)* which are characteristic of hot days and warm nights in the South. Sam Grimes has attempted to put onto one record the nature of Mockingbird song and to a large extent, he has succeeded. Side A begins a sequence of the songs and calls of 86 species of birds (mostly from the southeastern United States) as rendered by Mockingbirds and recorded by Grimes. Side B continues this list (beginning with Red-eyed Vireo; the break is not indicated on the record or jacket) and then presents some miscellaneous oddities (crickets, frogs, and a siren that was not distinct to me). The side ends with a selection of song repertoires from individuals in various parts of the species' range.

The album has several minor production flaws: the Mockingbird in the cover photograph is a catbird-gray; the species list on the jacket is inconsistent with regard to English names of the mimicked species (most follow the AOU Check-list and Supplements but listed are such things as Crested Flycatcher, Parula Warbler, and Trail's [*sic*] Flycatcher); and, most annoying, the record is not divided into bands which would allow a listener to find a particular section easily.

The heart of the album is the species list and there Grimes has done well. Most of the songs and calls are excellently performed and recorded. Background noise, which mars many field recordings, has been avoided or eliminated. The array of species is impressive (e. g., Black Rail, Ruby-throated Hummingbird) and most are mimicked with an accuracy that has to be heard to be believed (e. g., Chuck-will's-widow). The Downy Woodpecker is better represented by Grimes' Mockingbird than on the Peterson Field Guide album (eastern). I wish that Grimes had dealt with some of the natural-history aspects of Mockingbird song such as repertoire development and night singing, but that is a lot for one album. As it is, listeners will find that Grimes has provided plenty for their enjoyment.—ROBERT L. CRAWFORD.