Anolis angusticeps Hallowell, 1856

Holotype: ANSP 7789.

Type Locality: Cienfuegos, Cienfuegos Province, Cuba.

Geographic Range: Cuba; Isla de Pinos; Bahama Islands

Gray areas correspond to regions where *A. angusticeps* can be found.

Ecomorph: Twig Dwarf.

Close Retalives: *Anolis angusticeps* is a member of the carolinensis series. Its close relatives are *A. allisoni*, *A. brunneus*, *A. carolinensis*, *A. fairchildi*, *A. guazuma*, *A. isolepis*, *A. longiceps*, *A. maynardi*, *A. paternus*, *A. porcatus*, and *A. smaragdinus*.

Description: Dorsum grayish to brownish; patterns on body mostly longitudinal markings, not visible in dark phase. Ventral white or slightly yellowish. Whitish labial stripe to shoulder. Tail may have crossbands along its length. Dewlap orange, peach, or yellow.

Size small (SVL in males to 53 mm, in females to 47 mm); total loreals 14-44; scales between supraorbitals 0-3; 0-2 scales between interparietal and supraorbital semicircles; 8 postrostrals; 3-8 postmentals; suboculars not in contact with supralabials; ventrals smooth in transverse and diagonal rows; supradigital scales smooth; limbs short; tail round in cross section.

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Subspecies: 1. *Anolis angusticeps angusticeps* Hallowell, 1856: Cuba; Isla de Pinos.

2. *Anolis angusticeps oligaspis* Cope, 1894: Bahama Islands.

Natural History:

Sources: Garrido, O. H. 1975. Variacíon de *Anolis angusticeps* Hallowell (Lacertilia: Iguanidae) en el occidental de Cuba y en la Isla de Pinos. *Poeyana* 144:1-18.

The evolution of ecological performance in *Anolis* lizards

An important, yet rarely addressed issue in ecological and evolutionary physiology is whether performance capacity, as measured in the laboratory, and performance levels exhibited during natural behaviors, have co-evolved. A central focus of my research has been to address this issue by asking several questions: First, is laboratory performance always maximal? Second, do species with low maximal capacities compensate for their low capacities by using a greater percentage of their performance capacities than species with high maximal capacities? These issues have been examined both across species and ontogenetically in Caribbean *Anolis* lizards.

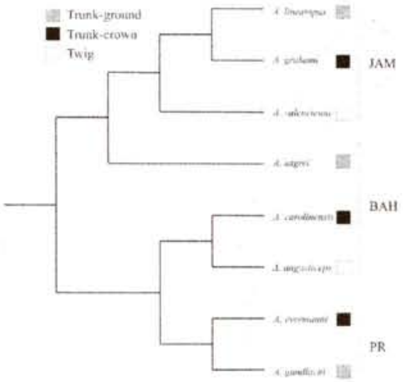

Fig. 1. A phylogenetic tree of eight species of *Anolis* lizards. The different symbols represent different ecomorphs. Thus, ecomorphs have evolved independently on different island systems. JAM=Jamaica, BAH=Bahamas, PR=Puerto Rico

The ecology, morphology, and behavior of Caribbean *Anolis* lizards have been studied extensively, but until recently, the relationship between locomotion and habitat use in these anoles has not been well understood. Within each of the Greater Antillean islands (e.g., Cuba, Hispaniola), largely independent radiations of *Anolis* have resulted in a series of ecologically and morphologically distinct forms, termed "ecomorphs" (trunk-ground, trunk-crown, twig, crown-giant, trunk and grass-bush, named for the portion of the habitat which they prefer). For example, the trunk-ground ecomorph has long hindlimbs, a long tail, and tends to occupy broad tree trunks close to the ground (< 1 m). By contrast, twig anoles have short hindlimbs, a short tail, and tend to occupy narrow surfaces higher in the canopy. I focused on eight anole species that are similar in size yet represent three ecomorph types (Fig. 1). The convergent evolution of ecomorphs provides enhanced statistical power for examining the evolution of ecological performance.

I first measured sprinting and jumping of all eight anoles during four behaviors, three in the field (escape from a threat, feeding, undisturbed locomotion) and one in the laboratory (maximal speed on a broad surface with sure footing). An initial test revealed that laboratory performance for both jumping and sprinting was significantly greater than for all three natural behaviors, with anoles using an average of about 90% of their maximal sprinting capacities during escape, 70% of maximum during feeding, and 33% during undisturbed locomotion. By contrast, the maximal jump distances in the field during feeding and undisturbed movements (the two activities in which they were most often used) were < 40% of the maximum performance elicited in the lab. Therefore, two key factors, the ecological context and the kind of performance, both markedly affect the levels of performance. These results also show that if one were to conduct a study of natural selection on maximal jumping ability as measured in the laboratory, one likely would find no correlation with Darwinian fitness, because anoles do not use their maximum jumping capacities in nature.

Phylogenetically informed, cross-species comparisons showed that for sprinting, performance capacity has evolved in positive correlation with both escape and feeding behavior; hence, performance capacity is a good predictor of performance in nature. However, this finding does not address whether species with low performance capacities compensate by using a greater fraction of their capacities in the field. One possibility is that each species will use a similar fraction of its maximal abilities for a particular behavioral task. This possibility might be correct if successful escape from a predator is a direct function of absolute speed. Alternatively, a species with a lower capacity could compensate by using a greater fraction of its performance capacity for a given task as compared to species with a higher capacity. This latter possibility would be more likely if a particular absolute speed facilitated escape from predators. In other words, animals may perform only to the lowest level needed for successfully escaping a predator. This idea was tested both among species that vary in performance capacity and for ontogenetic classes that also vary in performance capacity.

Fig. 2. A twig anole (*Anolis angusticeps*) from the Bahamas. Photograph by D. Irschick.

For escape performance (elicited by human approach) among species, the hypothesis of compensation is supported, as species with low sprinting capacities, such as twig anoles, tended to use nearly all of their capacities, whereas the more speedier trunk-ground anoles escaped by using as little of their performance capacities as possible. I also studied maximal laboratory and field speeds during escape, feeding, and undisturbed locomotion for juveniles, adult females, and adult males of the trunk-ground anole *Anolis lineatopus*. Maximal speed is generally correlated with size in *Anolis* lizards, such that adult males are significantly faster than adult females, which, in turn, are significantly faster than juveniles. In support of the hypothesis of compensation, juveniles used a greater fraction of their sprinting capacities in comparison to adult males and females during both escape and feeding. However, adult females did not use a significantly greater fraction of their sprinting capacities than adult males during either escape or feeding, despite the females having, on average, an 11% lower sprinting capacity than adult males. Overall, the available data seem to support the notion that performance-limited lizard species or ontogenetic classes compensate by using a greater fraction of their performance capacities in nature, but the hypothesis does not explain all the observed variation. One means of rigorously testing the hypothesis of compensation, and also determining which of the above metrics of performance (absolute speed, relative speed, percent maximal speed) is under selection would be to carry out a field study relating sprinting performance during different behaviors to Darwinian fitness among individuals of different sexes and sizes.

Fig. 3. A grass-bush anole (*Anolis bahorucoensis*) from Hispaniola. Photograph by D. Irschick.

Relevant literature:

Irschick DJ. 2000. Effects of behavior and ontogeny on the locomotor performance of a West Indian lizard *Anolis lineatopus*. **Functional Ecology.** 14:438-444.

Irschick DJ. 2000. Comparative and behavioral analyses of preferred speed: *Anolis* lizards as a model system. **Physiological and Biochemical Zoology**. 73:428-437

Irschick DJ, Macrini TE, Koruba S, Forman J. 2000. Ontogenetic differences in morphology, habitat use, behavior and sprinting capacity in two West Indian *Anolis* lizard species. **Journal of Herpetology**. 34:444-451

Irschick DJ, Losos JB. 1998. A comparative analysis of the ecological significance of locomotor performance in Caribbean *Anolis* lizards. **Evolution** 52:219-226

Macrini TE, **Irschick DJ.** 1998. An intraspecific analysis of trade-offs in sprinting performance in a West Indian lizard (*Anolis lineatopus*) **Biological Journal of the Linnean Society**. 63:579-591

Irschick DJ, Herrel A, VanHooydonck B, Huyghe K, Van Damme R. 2005. Locomotor compensation creates a mismatch between laboratory and field estimates of escape speed in lizards: A cautionary tale for performance to fitness studies. **Evolution (Cover)**. 59:1579-1587.