

Vertical distribution of herpetofauna in the Rincon Mountains, Arizona

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Among the joys of herpetology in the sky islands of Arizona and Sonora is the way amphibian and reptile species are distributed along gradients of elevation. Species appear or disappear as one travels from low deserts to high mountains, along gradients of temperature, moisture, vegetation, and other key elements of their ecological niche.

Beginning in 2000, we had the privilege to work on a biological inventory effort of the Rincon Mountains in Saguaro National Park. One result was the publication “Herpetofauna of the Rincon Mountains, Arizona” (Flesch et al. 2010), which described species richness, distribution, and relative abundance among 46 species of amphibians and reptiles. That paper was based on approximately 4,000 observations during the warm seasons of 2001 and 2002 that resulted from surveys of randomly-located intensive plots, non-plot-based extensive surveys, and incidental observations. Here, we include a list of species observed during that study, updated with current taxonomy and species detected subsequently (Table 1).

Our paper did not include a key figure that summarized the elevational distribution of each species. This figure (shown here as Figure 1) was prepared and included in our initial submission to the journal, but was deleted during the editorial review process.

We offer this figure now because it is useful for understanding the distributional ecology of herpetofauna in the region, and as a baseline for monitoring potential distributional shifts driven by climate change. Such shifts have not been assessed in our region but could be occurring in the ~20 years since our work.

Several groups of congeneric species show clear segregation across elevation. This is no surprise, and can be gleaned from any good field guide. But field guides generally cover wide areas such as states (e.g., Holycross et al. 2022) or large parts of continents (e.g., Stebbins 2003) where the broad influence of latitude and regional climate can obscure local patterns. Among such relationships in our data, we note the vertical segregation among three species of spiny lizards (*Sceloporus magister*, *S. clarkii*, and *S. tristichus*), two horned lizards (*Phrynosoma hernandesi* and *P. solare*), and three rattlesnakes (*Crotalus atrox*, *C. cerberus*, and *C. tigris*). The associated horizontal distributions of those groups are shown in Figure 2. In contrast, we did not find vertical segregation among three whiptail lizard (*Aspidoscelis burti*, *A. sonorae*, *A. tigris*), or two whipsnake (*Masticophis flagellum* and *M. bilineatus*) species.

The growing body of evidence on the impacts of climate change on herpetofauna (e.g., Sinervo et al. 2010, Lara-Reséndiz et al. 2015, Flesch et al. 2017) has raised concerns for the long-term conservation of many species. While there is an expectation that some species in isolated mountain ranges such as the Rincóns will respond to a warming climate by shifting to higher elevations (Parmesan 2006), other species at the upper elevational limits of their range may be at risk of extirpation because there is nowhere further upslope to go. Our dataset provides an elevational snapshot of an entire community that has value for monitoring potential elevational shifts and identifying local refugia that are important for conservation and management in future studies of the herpetofauna of the Rincon Mountains.

Literature cited

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Table 1. Herpetofauna currently known to occur in and around the Rincon Mountain District of Saguaro National Park, Pima County, Arizona. Count shows observations during our study (2001–2002), but list includes subsequent observations by park staff and visitors. Taxonomy follows Holycross et al. (2022).

Class	Order/Suborder	Scientific Name	Common Name	# Seen	
Amphibia	Anura	<i>Anaxyrus punctatus</i>	Red-Spotted Toad	306	
		<i>Hyla arenicolor</i>	Canyon Treefrog	262	
		<i>Incilius alvarius</i>	Sonoran Desert Toad	262	
		<i>Rana yavapaiensis</i>	Lowland Leopard Frog	136	
		<i>Scaphiopus couchii</i>	Couch's Spadefoot	46	
Reptilia	Testudines	<i>Kinosternon sonoriense</i>	Sonora Mud Turtle	55	
		<i>Gopherus morafkai</i>	Sonoran Desert Tortoise	29	
	Lacertilia	<i>Aspidoscelus burti</i>	Giant Spotted Whiptail	7	
		<i>Aspidoscelus sonorae</i>	Sonoran Spotted Whiptail	331	
		<i>Aspidoscelus tigris</i>	Tiger Whiptail	75	
		<i>Callisaurus draconoides</i>	Zebra-Tailed Lizard	109	
		<i>Coleonyx variegatus</i>	Western Banded Gecko	46	
		<i>Cophosaurus texanus</i>	Greater Earless Lizard	107	
		<i>Crotaphytus collaris</i>	Eastern Collared Lizard	29	
		<i>Elgaria kingii</i>	Madrean Alligator Lizard	7	
		<i>Heloderma suspectum</i>	Gila Monster	45	
		<i>Holbrookia elegans</i>	Elegant Earless Lizard	8	
		<i>Phrynosoma hernandesi</i>	Greater Short-Horned Lizard	30	
		<i>Phrynosoma solare</i>	Regal Horned Lizard	22	
		<i>Plestiodon obsoletus</i>	Great Plains Skink	2	
		<i>Sceloporus clarkii</i>	Clark's Spiny Lizard	342	
		<i>Sceloporus magister</i>	Desert Spiny Lizard	126	
		<i>Sceloporus tristichus</i>	Eastern Fence Lizard	226	
		<i>Urosaurus ornatus</i>	Ornate Tree Lizard	783	
		<i>Uta stansburiana</i>	Common Side-Blotched Lizard	141	
		Serpentes	<i>Crotalus atrox</i>	Western Diamond-Backed Rattlesnake	79
			<i>Crotalus cerberus</i>	Arizona Black Rattlesnake	27
			<i>Crotalus molossus</i>	Western Black-Tailed Rattlesnake	26
			<i>Crotalus tigris</i>	Tiger Rattlesnake	36
			<i>Diadophis punctatus</i>	Ring-Necked Snake	1
			<i>Hypsiglena chlorophaea</i>	Desert Nightsnake	7
			<i>Lampropeltis knoblochi</i>	Madrean Mountain Kingsnake	3
			<i>Lampropeltis splendida</i>	Desert Kingsnake	2
			<i>Masticophis bilineatus</i>	Sonoran Whipsnake	20
	<i>Masticophis flagellum</i>		Coachwhip	16	
	<i>Micruroides euryxanthus</i>		Sonoran Coralsnake	1	
	<i>Pituophis catenifer</i>		Gophersnake	6	
	<i>Rhinocheilus lecontei</i>		Long-Nosed Snake	11	
	<i>Salvadora grahamiae</i>		Eastern Patch-Nosed Snake	5	
	<i>Salvadora hexalepis</i>		Western Patch-Nosed Snake	4	
<i>Sonora semiannulata</i>	Western Groundsnake		2		
<i>Thamnophis cyrtopsis</i>	Black-Necked Gartersnake		110		
<i>Trimorphodon lambda</i>	Sonoran Lyresnake		0		

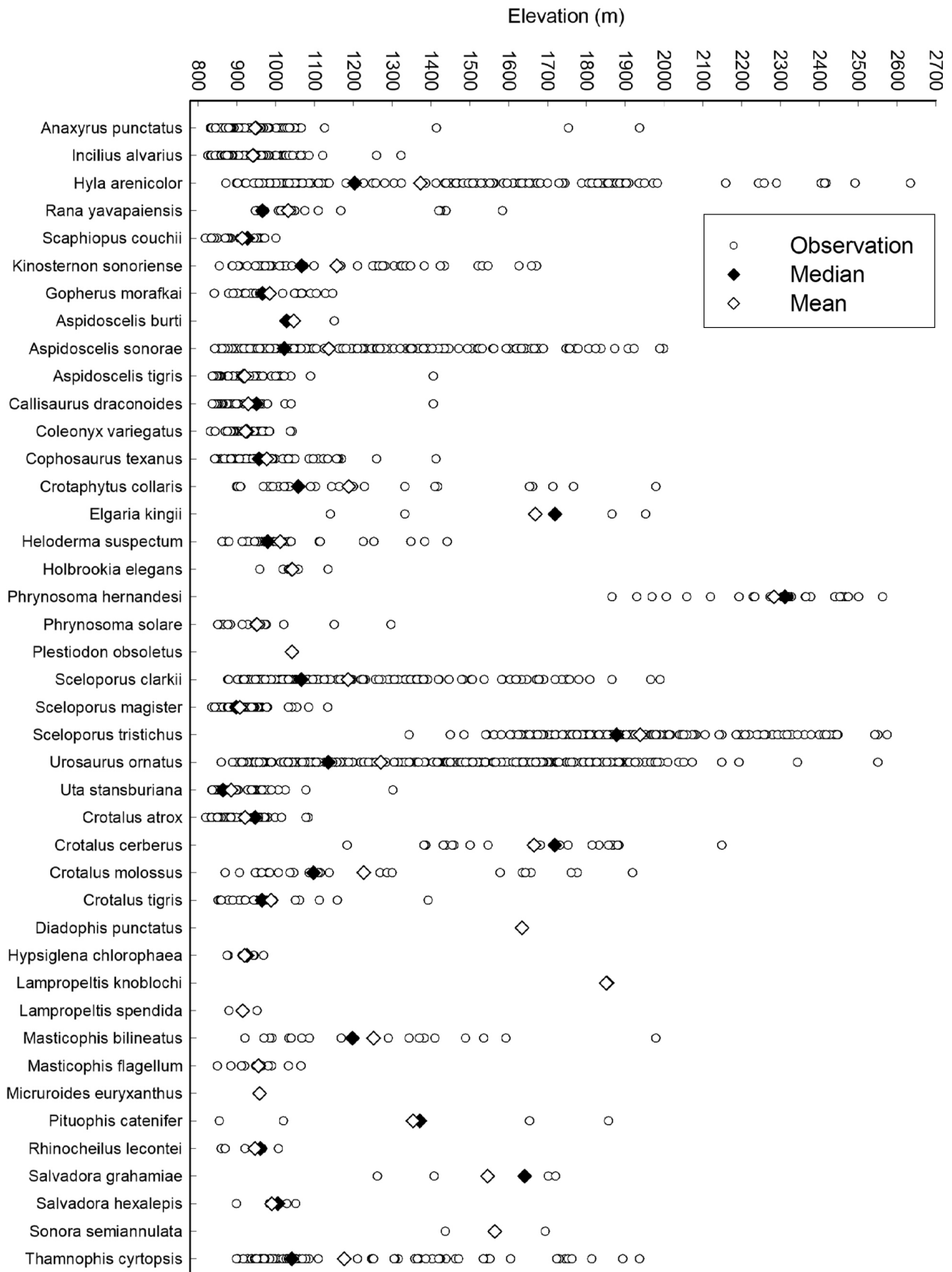


Fig. 1. Elevational distribution of 42 species of herpetofauna detected along an 1,800 m elevation gradient in Saguaro National Park, Rincon Mountain District, 2001–2002. Each circle is a single observation ($n = 3,944$). Taxonomy follows Holycross et al. (2022).

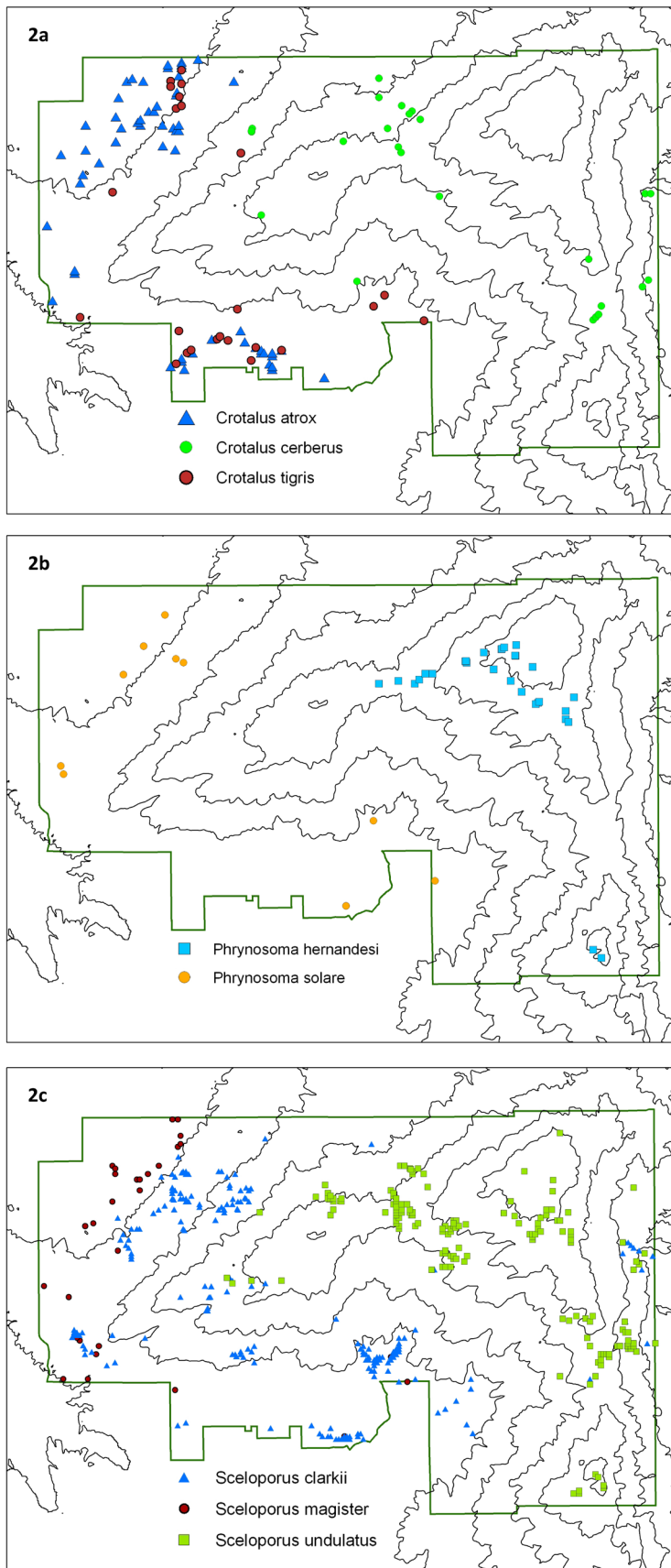


Fig. 2. Distribution of species in three genera that replaced one another across an elevational gradient in Saguaro National Park, Rincon Mountain District, Pima County, Arizona: **a)** *Crotalus atrox*, *C. cerberus*, and *C. tigris* (a fourth species, *C. molossus*, occurred at 869-1,918 m, which includes the range of these other species but is omitted for clarity); **b)** *Phrynosoma hernandesii*, *P. solare*; **c)** *Sceloporus clarkii*, *S. magister*, and *S. tristichus*. Elevational contours are shown in 300-meter intervals. Revised from Flesch et al. (2010).