Rural Road Usage by Herpetofauna of the Southern Sonoran Desert Ecoregion

Variable sandsnake (*Chilomeniscus stramineus*); photo by Corey Shaw.

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Figure 1. The life history of Couch's spadefoot toad (*Scaphiopus couchii*) revolve around the North American Monsoon. Photo by Corey Shaw.

Beginning in 2018, our team set out to understand which factors influence herpetofauna (i.e., amphibian and reptile) nighttime usage on rural roads of the Sonoran Desert Ecoregion. In doing so, we have accumulated preliminary data of species localities and conditions. Such location "hotspots" can be used to guide conservation management initiatives and develop mitigation strategies, such as wildlife crossings or biodiversity corridor areas where new roads should be avoided. Collectively, we aim to advance scientific knowledge about herpetofauna usage of roads in rural Sonoran Desert ecoregions as well as offering invaluable information to managers and stakeholders to preserve these important ecosystems.

Our 2020 season has been active since April and we have been able to consistently accumulate data—despite the pitfalls of the global pandemic and slow-to-start monsoon precipitation in the region. So far this year, we have completed 37 surveys across five routes (three in the Tucson vicinity and two in the Phoenix area).

As everyone in southern Arizona is aware, the monsoon season has taken the unfortunate moniker "nonsoon" this year due to its late arrival, spotty distribution, and other seemingly irregularities. However, the early monsoonal thunderstorms always serve as the red-carpet event for a charismatic desert denizen: Couch's spadefoot toads (*Scaphiopus couchii*; Fig. 1). We have detected nine since 6 August and expect much more following metamorphosis of tadpoles into tiny toadlets. So far in 2020, we have encountered over 100 reptile and amphibian individuals, encompassing 20 species (Table 1). Most herpetofauna detections have been on paved road but some have been observed on unpaved roads (e.g., Ironwood Forest National Monument).

Figure 2. Western diamond-backed rattlesnakes (*Crotalus atrox*) are commonly found at night in the Sonoran Desert Ecoregion. Neonates (baby rattlesnakes) are usually first seen during the monsoon season. Photo by Corey

Our most frequently encountered species thus far comes as no surprise—western diamond-backed rattlesnakes (*Crotalus atrox*; Fig. 2). These renowned rattlesnakes shift their daily activity behavior during the hot summer to be more active at night, and thus increasing our odds of detection. Some are actively on the move whereas others are often motionless on the warm roads, likely absorbing residual heat from the waning warmth of the sun. The monsoon season is an exciting time because our chances of seeing a diverse array of species increases.

Herpetofauna are not the only creatures we see at night. We detect many other mammals and nocturnal birds at roughly a 3:1 ratio compared to herpetofauna. For the non-herpetofauna creatures, avifauna (i.e., birds) typically comprise nightjar relatives or owls that are sitting in the road or perched on a roadside object such as a post or Saguaro; we omit birds in flight. Jackrabbits and cottontails (i.e., lagomorphs) are commonly encountered and are usually busy moving across or along roads. By far our most encountered animal group are small rodents, mostly pocket mice and kangaroo rats but occasionally, packrats, ground squirrels, or

diurnal mice. When we detect a diurnal species, it is most often dead-on-road, unfortunately. Periodically, we encounter mesocarnivores such as foxes, bobcats, and badgers. Ungulates (e.g., cattle, deer, javelina) round out the final non-herpetofauna category. In 2020, we have already exceeded 300 of these "incidental" non-herpetofauna records on our surveys, with approximately 74% occurring on paved roads (Table 1). Albeit we do not systematically record invertebrate data, the monsoon season usually reveals some really cool nocturnal desert creatures (Fig. 3)!

Unfortunately, not all the animals we encounter are alive. We have encountered dead on road (DOR) animals as small as invertebrates (data not recorded) to as large as deer. Of our herpetofauna data, 46% were DOR. Of the alive individuals, 36% were active (i.e., actively moving) whereas 64% were inactive (e.g., resting, motionless). Likely due to a combination of resting on roads for thermoregulation and slow mobility, we encounter more deceased herpetofauna than other animal groups (χ^2_{Yates} = 23.4; $p < 0.001$; Table 2). For instance, DOR's encompassed only about 21% for all non-herpetofauna vertebrates; however, this percentage doubled since the dry spring surveys.


Sonoran Desert evening. Photo by Corey Shaw.

To bring more awareness about the important animals in the Sonoran Desert Ecoregion—especially recognition towards species that use roadways at night—we created a public science-communication profile on Instagram (sonoran_fauna). Posts include images of charismatic fauna and short summaries of their ecological and economical importance in hopes of reaching and educating a broader audience. We look forward to continued activity this monsoon season as well as animal egress (i.e., migration) back to wintering sites as the cooler weather returns. We are excited to see where the next leg of our research journey takes us.

Tables

Table 1. Herpetofauna (amphibian + reptile) and Incidental (non-herpetofauna vertebrates) detections between 17 April and 1 September 2020. Surveys spanned five routes between the Tucson and Phoenix region. Paved refers to paved road (e.g., asphalt); unpaved refers to unpaved roads (e.g., dirt, sand); and n is the total number of individuals. Amphibians = frogs/toads; Reptiles = lizards/snakes; Avifauna = birds; Lagomorphs = rabbits; Mesocarnivores = medium predators (e.g., badger, foxes); Small rodents = mice, rats, and squirrels; and Ungulates are hooved herbivores (e.g., deer, javelina, cattle).

Taxonomic Group	paved	unpaved	n
Amphibians	26	1	27
Reptiles	69	5	74
Avifauna	7	1	8
Lagomorphs	41	10	51
Mesocarnivores	1	4	5
Small rodents	170	61	231
Ungulates	6	2	8
	320	84	404

Table 2. Chi-square test with Yates correction comparing alive-on-road (AOR) encounters versus dead-on-road (DOR) encounters, split by herpetofauna (i.e., amphibians and reptiles) versus non-herpetofauna vertebrates (e.g., mammals, birds).

Taxonomic Group	AOR	DOR
Herpetofauna	55	47
Other vertebrates	240	63