

**SUPPLEMENTAL INFORMATION**

**EFFICACY OF LOW-SPEED ROAD CRUISING FOR LIZARD  
DETECTION AT TWO SITES IN ARIZONA, USA**

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**TABLE S1.** Lizard species that two of us (LLCJ and JCR, pers. obs.) combined have seen on or adjacent to roads, alphabetically and by family, then species, primarily in the American Southwest, which has the highest biodiversity of lizards in the USA (Jones and Lovich 2009), plus limited observations elsewhere (e.g., few observations during brief time in Florida, which has mostly nonnatives). Many of these species were sought along roads during photographic excursions for a field guide of lizards of the American Southwest (Jones and Lovich, *op. cit.*), or at the Marijilda and Bajada study sites. Endemism refers to USA distribution. Taxonomy and nomenclature generally follow de Quieroz et al. (2017), and state abbreviations are national standards.

Family	English name	Scientific name	States		Comments
			observed	Observer	
Agamidae	Peter's Rock Agama	<i>Agama picticauda</i>	FL	LLCJ	Nonnative. Commonly seen from roads.
Anguidae	Island Glass Lizard	<i>Ophisaurus compressus</i>	FL	LLCJ, JCR	
Anniellidae	San Diegan Legless Lizard	<i>A. stebbinsi</i>	CA	LLCJ, JCR	State endemic. Incidental on roads.
Corytophanidae	Brown Basilisk	<i>Basiliscus vittatus</i>	FL	LLCJ	Nonnative.

Crotaphytidae	Great Basin	<i>Crotaphytus</i>	AZ, NV	LLCJ	
	Collared Lizard	<i>bicinctores</i>			
	Eastern Collared Lizard	<i>C. collaris</i>	AZ, CO, NM, TX, UT	LLCJ, JCR	
	Sonoran Collared Lizard	<i>C. nebrius</i>	AZ	LLCJ, JCR	State endemic.
	Baja California Collared Lizard	<i>C. vestigium</i>	CA	LLCJ	State endemic.
	Blunt-nosed Leopard Lizard	<i>Gambelia sila</i>	CA	LLCJ	State endemic.
	Long-nosed Leopard Lizard	<i>G. wislizenii</i>	AZ, CA, NV	LLCJ, JCR	
Dactyloidae	Green Anole	<i>Anolis carolinensis</i>	FL, LA, TX	LLCJ, JCR	
	Brown Anole	<i>A. sagrei</i>	FL	LLCJ	Nonnative.
Eublepharidae	Texas Banded	<i>Coleonyx brevis</i>	NM, TX	LLCJ, JCR	

	Gecko				
	Western Banded	<i>C. variegatus</i>	AZ, CA,	LLCJ, JCR	
	Gecko		NV, UT		
Gekkonidae	Madagascar Giant	<i>Phelsuma grandis</i>	FL	LLCJ	Nonnative.
	Day Gecko				
Helodermatidae	Gila Monster	<i>Heloderma</i> <i>suspectum</i>	AZ	LLCJ, JCR	Usually seen crossing roads, rather than on the edge.
Iguanidae	Desert Iguana	<i>Dipsosaurus</i> <i>dorsalis</i>	AZ, CA, NV	LLCJ, JCR	
	Green Iguana	<i>Iguana iguana</i>	FL	LLCJ	Nonnative. Frequently seen from roads
	Common Chuckwalla	<i>Sauromalus ater</i>	AZ, CA, NV	LLCJ, JCR	Commonly seen in boulder habitat along roads.
Leiocephalidae	Northern Curlytail Lizard	<i>Leiocephalus</i> <i>carinatus</i>	FL	LLCJ	
Phrynosomatidae	Zebra-tailed Lizard	<i>Callisaurus</i> <i>draconoides</i>	AZ, CA, NV,	LLCJ, JCR	

Greater Earless Lizard	<i>Cophosaurus texanus</i>	AZ, NM, TX	LLCJ, JCR	
Elegant Earless Lizard	<i>Holbrookia elegans</i>	AZ	LLCJ, JCR	
Common Lesser Earless Lizard	<i>H. maculata</i>	AZ, NM, TX	LLCJ, JCR	
Banded Rock Lizard	<i>Petrosaurus mearnsi</i>	CA	LLCJ, JCR	State endemic. Cryptic. On boulders and rock faces adjacent to roads.
Blainville's Horned Lizard	<i>Phrynosoma blainvillii</i>	CA	LLCJ, JCR	State endemic.
Texas Horned Lizard	<i>P. cornutum</i>	AZ, NM, TX	LLCJ, JCR	
Pygmy Short-horned Lizard	<i>P. douglasii</i>	OR	LLCJ	
Goode's Horned Lizard	<i>P. goodei</i>	AZ	LLCJ, JCR	State endemic

Greater Short-horned Lizard	<i>P. hernandesi</i>	AZ, NM	LLCJ, JCR	
Flat-tailed Horned Lizard	<i>P. mcallii</i>	AZ, CA	JCR	
Round-tailed Horned Lizard	<i>P. modestum</i>	AZ, NM, TX	LLCJ, JCR	
Desert Horned Lizard	<i>P. platyrhinos</i>	AZ, CA	LLCJ, JCR	
Regal Horned Lizard	<i>P. solare</i>	AZ	LLCJ, JCR	
Twin-spotted Spiny Lizard	<i>Sceloporus bimaculosus</i>	AZ, NM, TX	LLCJ	May be considered <i>S. magister</i> or hybrids, at least in some areas.
Clark's Spiny Lizard	<i>S. clarkii</i>	AZ	LLCJ, JCR	
Prairie Lizard	<i>S. consobrinus</i>	TX	LLCJ	
Southwestern	<i>S. cowlesi</i>	AZ, NM,	LLCJ, JCR	

Fence Lizard		TX		
Blue Spiny Lizard	<i>S. cyanogenys</i>	TX	LLCJ	State endemic.
Sagebrush Lizard	<i>S. graciosus</i>	CA, UT	LLCJ, JCR	
Yarrow's Spiny Lizard	<i>S. jarrovii</i>	AZ	LLCJ, JCR	Primarily adjacent to roads traversing rocky areas.
Desert Spiny Lizard	<i>S. magister</i>	AZ, CA	LLCJ, JCR	
Canyon Spiny Lizard	<i>S. merriami</i>	TX	LLCJ	State endemic. Primarily adjacent to roads traversing rocky areas.
Western Fence Lizard	<i>S. occidentalis</i>	CA, OR, WA	LLCJ, JCR	
Texas Spiny Lizard	<i>S. olivaceous</i>	TX	LLCJ	State endemic.
Granite Spiny Lizard	<i>S. orcutti</i>	CA	LLCJ, JCR	State endemic. Primarily adjacent to roads traversing rocky areas. .
Crevice Spiny Lizard	<i>S. poinsettii</i>	NM, TX	LLCJ	Primarily adjacent to roads traversing rocky areas.

Plateau Fence Lizard	<i>S. tristichus</i>	AZ, UT	LLCJ	
Eastern Fence Lizard	<i>S. undulatus</i>	TX	LLCJ, JCR	
Yellow-backed Spiny Lizard	<i>S. uniformis</i>	CA, NV, UT	LLCJ	
Rose-bellied Lizard	<i>S. variabilis</i>	TX	LLCJ	State endemic.
Striped Plateau Lizard	<i>S. virgatus</i>	AZ	LLCJ, JCR	
Long-tailed Brush Lizard	<i>Urosaurus graciosus</i>	CA	JCR	Uncommonly detected from roads.
Ornate Tree Lizard	<i>U. ornatus</i>	CA, AZ, NM, TX	LLCJ, JCR	
Coachella Fringe-toed Lizard	<i>Uma inornata</i>	CA	LLCJ, JCR	State endemic. Seen along roads through dunes or across sandy washes.
Colorado Desert Lizard	<i>U. notata</i>		LLCJ, JCR	State endemic. Seen along roads



	Fringe-toed Lizard				through dunes or across sandy washes.
	Yuman Desert	<i>U. rufopunctata</i>		LLCJ, JCR	State endemic. Seen along roads
	Fringe-toed Lizard				through dunes or across sandy washes.
	Mojave Fringe-toed Lizard	<i>U. scoparia</i>	CA, AZ	LLCJ, JCR	Seen along roads through dunes or across sandy washes.
	Mohawk Dunes	<i>U. thurmanae</i>	AZ	LLCJ, JCR	State endemic. Seen along roads
	Fringe-toed Lizard				through dunes or across sandy washes.
	Common Side-blotched Lizard	<i>Uta stansburiana</i>	AZ, CA, NM, NV, UT, TX	LLCJ, JCR	
Scincidae	Great Plains Skink	<i>Plestiodon obsoletus</i>	AZ	LLCJ	Rarely detected on roads.
	Common Five-lined Skink and/or Southeastern Five-lined Skink	<i>P. fasciatus</i> and <i>P. inexpectatus</i> , respectively	TX	LLCJ	

	Broad-headed Skink	<i>P. laticeps</i>	TX	LLCJ	
Teiidae	Giant Ameiva	<i>Ameiva ameiva</i>	FL	LLCJ	Nonnative.
	Gray Checkered Whiptail	<i>Aspidoscelis dixonii</i>	AZ	LLCJ	Generally considered pattern class of <i>A. tessellata</i> .
	Chihuahuan	<i>Aspidoscelis</i>	AZ, NM,	LLCJ	
	Spotted Whiptail	<i>exsanguis</i>	TX		
	Gila Spotted Whiptail	<i>A. flagellicauda</i>	AZ	LLCJ	Generally recognized a junior synonym of <i>A. sonorae</i> .
	Common Spotted Whiptail	<i>A. gularis</i>	TX	LLCJ	
	Little White Whiptail	<i>A. gypsi</i>	NM	LLCJ	State endemic. Generally considered pattern class of <i>A. inornata</i> .
	Orange-throated Whiptail	<i>A. hyperythra</i>	CA	LLCJ	State endemic.
	Little Striped	<i>A. inornata</i>	AZ	LLCJ, JCR	Includes <i>A. arizonae</i> and <i>A. pai</i> (state

Whiptail				endemics, if recognized as distinct).
Laredo Whiptail	<i>A. laredoensis</i>	TX	LLCJ	State endemic.
Marbled Whiptail	<i>A. marmorata</i>	AZ, NM, TX	LLCJ	
New Mexico Whiptail	<i>A. neomexicana</i>	NM, TX	LLCJ	
Colorado Whiptail	<i>A. neotesselata</i>	CO	LLCJ	State endemic.
Checkered Whiptail				
Plateau Spotted Whiptail	<i>A. scalaris</i>	TX	LLCJ	State endemic.
Six-lined Whiptail	<i>A. sexlineata</i>	NM, TX,	LLCJ	
Racerunner		FL		
Sonoran Spotted Whiptail	<i>A. sonorae</i>	AZ, NM	LLCJ, JCR	
Giant Spotted Whiptail	<i>A. stictogramma</i>	AZ	LLCJ, JCR	

Common	<i>A. tessellata</i>	NM, TX	LLCJ
Checkered Whiptail			
Tiger Whiptail	<i>A. tigris</i>	CA, AZ	LLCJ, JCR
Desert Grassland Whiptail	<i>A. uniparens</i>	AZ	LLCJ, JCR
Plateau Striped Whiptail	<i>A. velox</i>	AZ	LLCJ

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Xantusiidae	Sandstone Night Lizard	<i>Xantusia gracilis</i>	CA	LLCJ	State endemic. Few roads in habitat of very restricted range.
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**TABLE S2.** Lizard inventories from other studies, showing detections from roads. Methods are summarized in Appendix 1; for example, the study of Jason Jones was nocturnal only, while that of Roger Repp was diurnal only, and both studies by Persons and Nowak were both. Numbers from Persons and Nowak (2007) include their unpublished (pers. comm.) estimates of detections en route to survey sites. Shaded cells are not applicable because species does not occur in area, was not reported, or was not detected by any method during inventories. It is noteworthy that all daytime road detections were incidental, because road tallies were recorded only while accessing sites to survey by other means. English names listed in Table S1.

<b>Species</b>	J. Jones (unpubl. data)	Persons and Nowak (2006)	Persons and Nowak (2007)	R. Repp (unpubl. data)
<i>Aspidoscelis tigris</i>	0	19	24	1,085
<i>Callisaurus draconoides</i>	11	72	22	7,539
<i>Coleonyx variegatus</i>	226	38	14	
<i>Crotaphytus bicinctores</i>	0	67	8	
<i>Dipsosaurus dorsalis</i>	3	6		261
<i>Elgaria multicarinata</i>		0	0	
<i>Gambelia wislizenii</i>	0	14	19	71

<i>Heloderma suspectum</i>	0			64
<i>Phrynosoma platyrhinos</i>	18	54	30	
<i>P. solare</i>				106
<i>P. gilberti</i>		0		
<i>Sauromalus ater</i>	0	8	0	
<i>Sceloporus graciosus</i>		3		
<i>S. magister</i>				1,049
<i>S. occidentalis</i>		37	0	
<i>S. uniformis</i>	9	26	16	
<i>Uma scoparia</i>		0	0	
<i>Urosaurus graciosus</i>	3		0	
<i>Uta stansburiana</i>	19	0	32	1,352
<i>Xantusia vigilis</i>	12	1	0	
N species detected	8	13	9	8
Total detections	301	379	173	11,527

**TABLE S3.** Qualitative summary of likely detectability of native continental USA families of lizards from roads, with taxa-specific comments and selected references, primarily based on a cursory literature review. Nonnative taxa are not included due to a general lack of information. Taxonomy and nomenclature are primarily from de Quieroz et al. (2017). For road use (in appropriate habitat and conditions), “+” is likely, “-“ is unlikely, and “±” is somewhere in between, with an explanation. Most references are documentation of surface-active lizard species detected on or next to roads, but some references are negative data (i.e., species that are rarely surface active near roads), or general natural history information that helps explain why they are not commonly encountered on or near roads. In references, LLCJ = senior author (pers. observ.); JCR = 2<sup>nd</sup> author (pers. observ.); JJ = Jason Jones (pers. comm.); P/N = Trevor Persons and Erika Nowak (pers. comm., based on 2007); RR = Roger Repp (pers. comm.).

<b>Family</b>	<b>N. spp.</b>	<b>Road use</b>	<b>Comments</b>	<b>References</b>
Amphisbaenidae	1	-	Highly fossorial, arenicolous, best detected by specialized search, although <i>Rhineura floridana</i> is sometimes driven to the surface by heavy rains.	Campbell and Christman 1982; Conant and Collins 1998; Bartlett and Bartlett 1999.
Anguidae	9	±	<i>Elgaria</i> and <i>Gerrhonotus</i> are only occasionally detected by road due to their subsurface,	<i>Elgaria</i> : Brehme 2003; Rutherford and Gregory 2003; LLCJ. <i>Ophisaurus</i> : Bartlett

			detritus-inhabiting affinities. Best detected by COS and sometimes WS. Although <i>Ophisaurus</i> is fossorial and cryptic, they are detectable on road surfaces, especially under certain environmental conditions, such as after rains.	and Bartlett 1999; Aresco 2005; Shwiff et al. 2007; Beane et al. 2010; Kelly et al. 2017; Dylan Kelsch (pers. comm.); Bryce Street (pers. comm.); George Ward (pers. comm.); LLCJ.
Anniellidae	5	-	Highly fossorial, often arenicolous or under cover; best detected by specialized search, although they may be surface active in late afternoon or early evening and are occasionally found on roads.	Klauber 1932; Germano and Morafka 1996; Brehme et al. 2013; Stebbins 2003; JCR; LLCJ.
Crotaphytidae	8	+	All <i>Crotaphytus</i> are conspicuous and detectable from roads. All <i>Gambelia</i> are cryptic, but detectable from roads, often on the berm, but sometimes the road surface.	This study; Parker and Pianka 1976; Warrick et al. 1998; Cornett 2006; Persons and Nowak 2006; Germano 2009, 2019; Ivanyi 2009; Mahrtdt and Beaman 2009; Garrett et al. 2018; Ryberg et al. 2019; JJ; JCR; LLCJ; P/N; RR.
Dactyloidae	1	+	Although <i>Anolis carolinensis</i> can be detected	Aresco 2005; Irschick et al. 2006; Beane et al.



			alongside roads in eye-level vegetation, roadside structures, and sometimes the ground, WS would likely be more productive due to the species' arboreal and cryptic nature.	2010; Weber 2016; JCR; LLCJ.
Eublepharidae	4	+	All species detectable at night on road surfaces, especially paved. <i>Coleonyx reticulatus</i> may also be seen in roadcuts. Most papers on RC for snakes do not include lizards, including eublepharids, although they have long been known to be easily detectable from roads at night.	Klauber 1939, 1945; Smith 1946; Stebbins 1954, 2003; Seifert and Murphy 1972; Easterla and Reynolds 1975; Fritts et al. 1982; Conant and Collins 1998; Persons and Nowak 2006; Jones and Lovich 2009 (accounts for all four species); Bartlett 2012; Sullivan 2012; JJ; JCR; LLCJ; P/N.
Gekkonidae	1	±	Nocturnal, cryptic, and saxicolous habitat usually not near roads. However, where roads do pass habitat, <i>Phyllodactylus nocticolus</i> is sometimes detected on the road surface at night.	Klauber 1939; Stebbins 1954; Cornett 2006; Lemm 2006.
Helodermatidae	1	+	Usually detected on or from roads or walking	This study; Beck 2005, 2009; Smith et al.

			visual surveys when surface active.	2010; Willson 2016; Farrar et al. 2017; Paredes 2017; LLCJ; RR.
Iguanidae	2	+	<i>Dipsosaurus</i> easily seen on berms, roadways, and adjacent edge. <i>Sauromalus</i> easily detectable if road traverses or borders steep boulder and cliff habitats.	<i>Dipsosaurus</i> : This study; Lemm 2009; Sullivan and Vernon 2015; Jones 2020; RR. <i>Sauromalus</i> : Miller and Stebbins 1964; Stebbins 2003; Persons and Nowak 2006; JCR; LLCJ.
Phrynosomatidae	50	+	All <i>Phrynosoma</i> can be detected from roads, paved or unpaved, which may be the easiest way to target them. They are often on the road surface, so more detectable on paved roads. Often seen morning, late afternoon, early evening, and after rains. Most <i>Sceloporus</i> (except probably <i>S. arenicolus</i> , <i>S. grammicus</i> , and <i>S. slevini</i> ) found on berms, road surface, or adjacent structures. <i>Sceloporus cyanogenys</i> near	<i>Phrynosoma</i> : This study; Rorabaugh et al. 1987; Muth and Fisher, unpubl. report; Fair and Henke 1997; Henke and Montemeyor 1998; Sherbrooke 2002; Brehme 2003; Stebbins 2003; Moeller et al. 2005; Jones and Lovich 2009 (eight species accounts); Inslee 2010; Hubbard et al. 2016; Willson 2016; JJ; JCR; LLCJ; P/N; RR. <i>Sceloporus</i> : This study; Shwiff et al. 2007; Davenport and Scott 2009;

			bridges and culverts. Sand lizards ( <i>Callisaurus</i> , <i>Cophosaurus</i> , and <i>Holbrookia</i> , <i>Uma</i> ), <i>Urosaurus ornatus</i> , and <i>Uta</i> easily detected by RC. <i>Petrosaurus</i> is cryptic, but detectable on roadside boulders and cliff faces. <i>Urosaurus graciosus</i> less detectable on roads, usually requiring specialized search, although it has been documented on roads at night and occasionally on open ground or on boulders.	Gibbons et al. 2009; Jones and Lovich 2009 (five species accounts); Brehme et al. 2013; Hibbitts and Hibbitts 2015; Kaunert and McBrayer 2015; Hubbard et al. 2016; Sullivan 2012; Tucker et al. 2014; Kelly et al. 2017; Kiehne 2019; JCR; JJ; LLCJ; P/N; RR. Sand lizards: Stebbins 1954; Tanner and Krogh 1975; Omanski 2014; Hibbitts et al. 2019; JJ; LLCJ; P/N; RR. <i>Urosaurus</i> : This study, Lemm 2006; Rau 2009; LLCJ. <i>Uta</i> : This study; Persons and Nowak 2006; Brehme 2013; JJ; JCR; LLCJ; P/N; RR. <i>Petrosaurus</i> : LLCJ.
Scincidae	14	±	Most USA skinks are cryptic and fossorial, so only occasionally detected on roads. They generally require COS, pitfall traps, or funnel	This study; Brehme 2003; Aresco 2005; Niemiller 2005; Coleman et al. 2008; Persons and Nowak 2006; Brazeau and Hecnar 2018;

			traps associated with drift fences, or sand raking, but are sometimes surface active, especially after rains. Some eastern heliothermic species ( <i>Plestiodon fasciatus</i> , <i>P. inexpectatus</i> , and <i>P. laticeps</i> ) can be detected adjacent to roads.	LLCJ; P/N.
Teiidae	18	+	Most teiids are detectable from roads and there are many species documented using roads in the literature and from personal observations, but it is unclear if they are better detected by walking visual surveys. There are likely species- and location-specific factors. More research is needed on more taxa in more locations.	This study; Ditmars 1907; Bellis 1964; Parker 1972; Etheridge et al. 1983, 1986; Walker 1987; Walker et al. 1991; Paulissen and Walker 1998; Paulissen et al. 2001; Gibbons et al. 2009; Jennings 2009; Persons and Wright 2009; Brehme et al. 2013; Osmanski 2014; Kelly et al. 2017; JCR; JJ; LLCJ; P/N; RR.
Xantusiidae	5	-	Generally cryptic and/or nocturnal, requiring specialized searches, especially COS and night-lighting boulder areas. <i>Xantusia vigilis</i> , <i>X.</i>	Brehme 2003; Cornett 2006; Persons and Nowak 2006; Bezy 2009; JJ; LLCJ.

			<i>henshawi</i> , and <i>X. gracilis</i> are sometimes detected on or near roads at night in appropriate habitat.	
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**TABLE S4.** Parameters of four RC studies that included lizard detection, provided by colleagues.

	<b>Jason Jones (unpubl. data)</b>	<b>Persons and Nowak 2006</b>	<b>Persons and Nowak 2007 (plus pers. comm.)</b>	<b>Roger Repp (unpubl. data)</b>
Locality	Mojave Desert, Nevada	Death Valley National Park, California, Nevada	Mojave National Preserve, California	Sonoran Desert, Arizona
Time of day	Night	Day and night	Day and night	Day
Time period	2019	2002-2004	2004-2005	2000-2016
Design	Three passes on eight paved or dirt roads	Incidental day driving to survey sites, plus night RC.	Incidental day driving to survey sites, plus night RC.	Incidental day driving to survey sites
Speed	32-48 kph	Day: > 40 kph; night 20- 30 kph	Night: 20-30 kph; day faster	Paved: up to 100 kph
Effort	Estimate 9,743 km, but some data unreported	Indeterminable	Indeterminable	Average 841 person-hours/year
Source of	Counted	Counted	Counted for night, but	Estimated from total tallies

detection

numbers

estimated from tallies for across all years

day

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**FIGURE S1.** Baja California Collared Lizard (*Crotaphytus vestigium*). This elusive and wary species was easily observed and photo-vouchered *in situ* from a vehicle during an RC survey in southern California. (Photographed by Lawrence L. C. Jones).



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