

Growth and Activity of *Sceloporus cowlesi* (Southwestern Fence Lizard)



FIG. 1. Drift fence of a trap array installed in the riparian forest along the middle Rio Grande in Valencia County, New Mexico containing native cottonwoods (*Populus deltoides wislizenii*) and exotic saltcedar (*Tamarix* spp.)



FIG. 2. Ventral view of male *Sceloporus cowlesi* captured in the riparian forest along the middle Rio Grande, Valencia County, New Mexico.

Lizards from the *Sceloporus undulatus* complex have been the subject of many studies on lizard ecology (Hager 2001; Rosenblum 2006; Rosenblum et al. 2007), behavior (Hein and Whitaker 1997; Robertson and Rosenblum 2009), and reproduction (Vinegar 1975; Robertson and Rosenblum 2010). However, genetic data (Leaché and Reeder 2002) support reallocation of the subspecies of the *S. undulatus* complex (e.g., *S. undulatus consobrinus*, *S. u. tristichus*, and *S. u. cowlesi*) as distinct species (e.g., *S. consobrinus*, *S. tristichus*, and *S. cowlesi*). One of these species, *S. cowlesi*, occupies a variety of terrestrial habitats spanning grasslands to montane conifer forests (Jones and Lovich 2009) over its range from central New Mexico to southwest Texas. Females lay eggs between mid-May and mid-August and clutch sizes vary from 7 to 9 eggs (Degenhardt et al. 1996). However, since much of the research on natural history of this species was published under the former species name, *S. undulatus*, there is little specific information on *S. cowlesi* from New Mexico. The purpose of this study was to estimate growth and seasonal activity for individuals marked from a population of this species in New Mexico.

Materials and methods.—We conducted the study in the riparian forest along the middle Rio Grande in Bernalillo, Valencia, and Socorro counties, central New Mexico, USA. The climate in this region is semiarid to arid (Tuan 1962). Our study sites occurred in forests (Fig. 1) containing native cottonwood (*Populus deltoides wislizenii*) and non-native saltcedar (*Tamarix chinensis* and *T. ramosissima*) and Russian Olive (*Elaeagnus angustifolia*). As part of a larger project to evaluate the effects of removal of non-native plants and fuels on herpetofauna (Bateman et al. 2008), we monitored relative abundance of lizards at 12 sites (approximately 20 ha each) spanning 140 km of river from Albuquerque (35.008380°N, 106.681805°W) to Bosque del Apache National Wildlife Refuge (33.805122°N, 106.859980°W) from 2000 to 2006.

We captured lizards using trap arrays of drift fences, pitfall traps (5-gallon, 18.9 liter buckets) with cover boards, and funnel traps. Except for a shortened trap season of only two months in 2000 to establish study sites, traps were open continuously from June to mid-September each year and were checked three days per week. Lizards were identified (by species and sex), weighed, measured (SVL and VTL), given a unique toe clip (Waichman 1992), and released.

Results.—During the seven-year study, we had 5,183 captures of 2,470 individual *S. cowlesi* (Fig. 2). Of the total captures, 41.6% occurred in pitfall traps, and 58.2% occurred in funnel traps. Lizard length (SVL and VTL), mass, and sex were determined for adults, hatchlings, and juveniles (Table 1). *Sceloporus cowlesi*

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hatchlings were active in May when we opened traps and the number of captures peaked during the beginning of September when traps were closed (Table 2). Conversely, adult activity in terms of total captures, showed an earlier trend, with peak activity at the beginning of June (Table 2).

Over 40% of marked lizards were recaptured and most sightings occurred during the summer of marking. For example, 270 lizards were recaptured within the summer of their first capture, 70 were recaptured two summers later, 14 were recaptured three summers later, and four were recaptured four summers later. One individual was recaptured five summers later. From these histories of recapture, we determined that growth rates were similar between male and female *S. cowlesi* (Fig. 3). Lizards reach adult size by their second summer, although some individuals attained 60 mm SVL at the end of their first summer (Fig. 3).

Discussion.—Growth curves for male and female *S. cowlesi* were similar, with hatchling and adult females having slightly larger SVLs than their male counterparts. Although sceloporine lizards can grow quickly after hatching (Sinero and Adolph 1994), females may not reproduce until the following year. For example, studies in Colorado found that female *S. undulatus* can attain reproductive sizes during their first summer a few months after hatching but do not reproduce until the following season (Ferner 1976; Gillis and Ballinger 1992). In this study, we documented that individual male and female lizards could reach > 50 mm SVL in their first season, corroborating results of previous studies demonstrating rapid growth in the first year. However, we could not determine reproductive status of these individuals in their second year. Interestingly, our average SVL for adult *S. cowlesi* is about 15 mm shorter than reported in Jones and Lovich (2009).

Ferguson and Snell (1986) reported that in the lab, second clutch hatchlings of *S. undulatus* had greater mass compared to

hatchlings from a first clutch. In our study, hatchlings captured in June had SVL > 40 mm and hatchlings captured in August had SVL < 30 mm. However, because hatchlings captured in June were

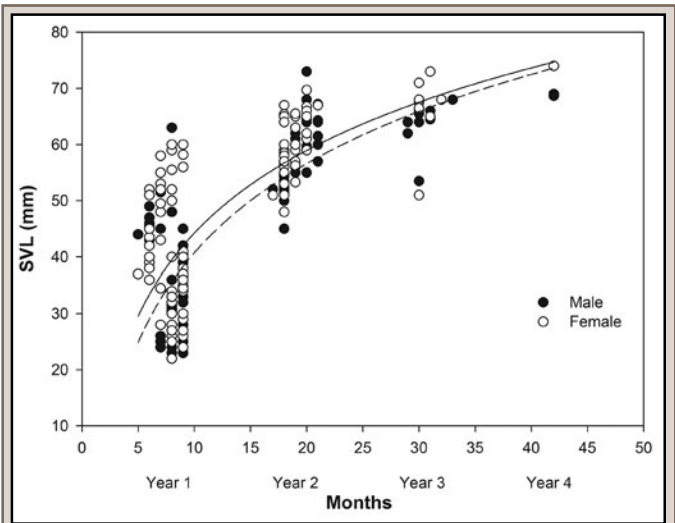


FIG. 3. Growth of male and female *Sceloporus cowlesi* captured as hatchlings from the riparian forest along the middle Rio Grande in central New Mexico. Months represent the number of months in four years, with months 0, 6, and 12 representing January, June, and December of Year 1, month 18 as June of Year 2, month 30 as June of Year 3, etc. Snout-vent length (SVL) of lizards is known from recaptures of uniquely marked individuals (63 males and 53 females) first encountered as hatchlings from 2000–2006. Individuals occur more than once in figure. Lines are fitted with a logarithmic curve (dashed line, $R^2 = 0.66$ for male; solid line, $R^2 = 0.56$ for female).

TABLE 1. Mean ($\pm$ SE) of morphological characteristics of *Sceloporus cowlesi* captured during 2000–2006 from the riparian forest along the middle Rio Grande in central New Mexico, USA. Data are summarized by captures of individuals < 3 g mass (hatchlings) and > 3 g mass (juveniles and adults). Because the data include recaptures, individuals may be represented more than once in the table. Number of captures (N) may vary because some lizards escaped before all measurements were recorded; therefore SVL, VLT, and mass may have different sample sizes.

Sex	Hatchling (< 3 g)				Juvenile, Adult (> 3 g)			
	N	Mean SVL (mm)	Mean VTL (mm)	Mean Mass (g)	N	Mean SVL (mm)	Mean VTL (mm)	Mean Mass (g)
Female	341/341/342	29.3 ($\pm$ 0.32)	37.2 ($\pm$ 0.57)	0.8 ($\pm$ 0.03)	2071/2070/2059	62.4 ($\pm$ 0.15)	79.9 ($\pm$ 0.33)	7.8 ($\pm$ 0.07)
Male	365	29.8 ($\pm$ 0.34)	37.9 ($\pm$ 0.65)	0.9 ($\pm$ 0.03)	2295/2291/2281	60.3 ($\pm$ 0.13)	79.6 ($\pm$ 0.35)	7.0 ($\pm$ 0.04)
Unknown	11	30.1 ($\pm$ 2.03)	33.8 ($\pm$ 4.39)	0.9 ($\pm$ 0.21)	5/5/4	43.8 ($\pm$ 9.46)	59.6 ($\pm$ 13.48)	7.0 ($\pm$ 2.29)

TABLE 2. Capture activity, including mean and range for SVL, of hatchling (< 3 g) and adult (> 3 g) *Sceloporus cowlesi* from the riparian forest along the middle Rio Grande in central New Mexico. Data are summarized by captures per time period for each year from 2000 to 2006. Individuals may occur more than once in table.

Time Period	Hatchling (< 3 g)			Adult (> 3 g)		
	N (% of total)	Mean SVL (mm)	Range SVL (mm)	N (% of total)	Mean SVL (mm)	Range SVL (mm)
1–15 June	19 (3.2%)	43.3	36–48	1149 (27.1%)	60.2	41–80
16–30 June	7 (1.2%)	42.9	36–51	1077 (25.4%)	60.8	43–80
1–15 July	2 (0.3%)	34.0	24–44	419 (9.9%)	60.2	46–79
16–31 July	28 (4.7%)	26.5	22–36	507 (11.9%)	61.0	25–79
1–15 August	112 (18.8%)	25.7	21–34	343 (8.1%)	62.6	23–78
16–31 August	207 (34.7%)	27.5	21–45	442 (10.4%)	63.6	21–78
1–15 September	222 (37.2%)	30.0	21–45	306 (7.2%)	63.5	25–79

likely hatched in May when traps were not yet open, we cannot directly compare sizes of early and late season hatchlings. Little is known of field longevity for *S. cowlesi*; however, during a two-year study in Texas, Tinkle and Ballinger (1972) found that *S. undulatus* (presumably *S. consobrinus* based on distribution) rarely survived to their second growing season. From the 116 hatchlings recaptured at least one time during the period of study, only two individuals were captured during their fourth growing season, or three years later.

Because of the classification change of small-bodied sceloporine lizards (Leaché and Reeder 2002), less is known about specific natural history characteristics of *S. cowlesi*, which occupies a smaller range compared to other members of the *S. undulatus* complex. Therefore, our results provide important natural history data for growth rates, longevity, and activity patterns of *S. cowlesi*. These data can offer future comparisons of sceloporine lizards from different geographic regions and species.

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