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**Reproductive characteristics of two syntopic lizard species,  
*Sceloporus gadoviae* and *Sceloporus jalapae* (Squamata:  
Phrynosomatidae), from Tehuacán Valley, Puebla, México**

Aurelio Ramírez-Bautista

*Universidad Autónoma del Estado de Hidalgo, Pachuca, Hidalgo, México*

América L. Ortiz-Cruz

*Universidad Nacional Autónoma de México, México City, México*

Ma. Del Coro Arizmendi

*Universidad Nacional Autónoma de México, México City, México*

Jorge Campos

*Universidad Nacional Autónoma de México, México City, México*

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REPRODUCTIVE CHARACTERISTICS OF TWO SYNTOPIC LIZARD SPECIES,  
*SCELOPORUS GADOVIAE* AND *SCELOPORUS JALAPAE*  
(SQUAMATA: PHRYNOSOMATIDAE),  
FROM TEHUACÁN VALLEY, PUEBLA, MÉXICO

Aurelio Ramírez-Bautista<sup>1</sup>, América L. Ortíz-Cruz<sup>2</sup>,  
Ma. Del Coro Arizmendi<sup>2</sup>, and Jorge Campos<sup>2</sup>

**ABSTRACT.**—We studied the reproductive characteristics of 2 syntopic lizard species, *Sceloporus gadoviae* and *Sceloporus jalapae* (Phrynosomatidae). Specimens of *S. gadoviae* ( $N = 105$ ) and *S. jalapae* ( $N = 41$ ) were collected in a tropical arid forest from Tehuacán Valley, Puebla, México. Males of *S. gadoviae* reached sexual maturity at the same snout-vent length (SVL; 45.0 mm) as *S. jalapae*, and a similar pattern occurred in females of both species (SVL; 41.0 and 42.0 mm, respectively). Males of *S. gadoviae* exhibited reproductive activity throughout the year, with a longer activity during the dry (November to May) and part of the wet season (June to September). In contrast, reproductive activity in *S. jalapae* males occurred during the wet season (July to September). Females of *S. gadoviae* showed continuous reproduction, whereas females of *S. jalapae* exhibited seasonal reproduction. Mean SVL of sexually mature females was higher for *S. gadoviae* ( $\bar{x} \pm s_{\bar{x}} = 50.4 \pm 0.52$ ) than for *S. jalapae* ( $46.0 \pm 0.54$ ,  $P < 0.0001$ ). Mean clutch size for *S. gadoviae* was lower ( $3.9 \pm 0.14$  eggs) than for *S. jalapae* ( $5.6 \pm 0.43$ ). There was no significant correlation between snout-vent length of females and clutch size of *S. gadoviae* ( $r^2 = 0.22$ ,  $P > 0.05$ ) or *S. jalapae* ( $r^2 = 0.48$ ,  $P > 0.05$ ). Our study suggests that although both species inhabit the same environment, they have different reproductive characteristics.

**Key words:** *Sceloporus gadoviae*, *Sceloporus jalapae*, Mexico, reproductive cycle, clutch size, Reptilia, Sauria, Phrynosomatidae.

Descriptive studies have been conducted on squamate reproduction in many different environments of Mexico, such as temperate high elevation (Guillette 1982, Ramírez-Bautista et al. 1998, 2002), tropical rain forest (Benabib 1994), and tropical dry forest (Ramírez-Bautista and Vitt 1997, 1998, Lemos-Espinal et al. 1999), but very few studies have been conducted in tropical arid habitats (Ramírez-Bautista 2003). These studies have provided data to allow contextualization of the reproductive patterns in each environment. For example, reproduction of many lizard species from seasonal tropical and temperate environments is cyclical (Guillette 1982, Ramírez-Bautista and Vitt 1997, 1998), with courtship, mating, and copulation occurring at the onset of the rainy season (Ramírez-Bautista and Vitt 1997). Egg production and incubation usually occur at the onset of the rainy season, with hatchlings emerging at the end of the rainy season (Ramírez-Bautista and Vitt 1998). Seasonal reproductive activ-

ity has been associated with rainfall, temperature, and photoperiod (Marion 1982, Ramírez-Bautista et al. 1998).

Variation in reproductive characteristics within and among populations also is associated with seasonal and annual environmental fluctuations (Ballinger 1977, Benabib 1994). Environmental factors such as food availability, precipitation, and temperature can affect growth rates, survivorship, clutch size, clutch frequency, and age and size at maturity (Ballinger 1977, Dunham 1982, Benabib 1994). During the past 2 decades, studies have shown that a portion of life history variation among species is historical (Dunham and Miles 1985, Vitt 1992). That is, related species tend to be more similar in life history characteristics than unrelated ones (Miles and Dunham 1992, Valdéz-González and Ramírez-Bautista 2002). For example, SVL at sexual maturity, clutch and egg size, and clutch frequency in the genus *Sceloporus* are more similar within species

<sup>1</sup>Corresponding author: Centro de Investigaciones Biológicas, Universidad Autónoma del Estado de Hidalgo, A.P. 1-69 Plaza Juárez, C.P. 42001, Pachuca, Hidalgo, México.

<sup>2</sup>Unidad de Biología, Tecnología y Prototipos (UBIPRO), FES-Iztacala, Universidad Nacional Autónoma de México. Av. de los Barrios s/n, Los Reyes Iztacala, Tlalnepantla, Estado de México C.P. 54090, A.P. 314, México City, México.

groups (*scalaris*, *spinosus*, *torquatus*) than between them (Valdéz-González and Ramírez-Bautista 2002). However, many of the data used in these conclusions were based on lizard species of small and medium size from the wet tropics and temperate regions (Guillette 1982, Benabib 1994, Ramírez-Bautista et al. 2002). At present, few studies exist on reproductive patterns from tropical arid lizards (Ramírez-Bautista 2003). Thus, one might suspect that the often extreme seasonality of temperate regions could result in reproductive cycles and patterns different from those that might be observed in tropical arid environments (Tinkle et al. 1970).

Although the life histories of several species of *Sceloporus* have been intensively studied (Benabib 1994, Valdéz-González and Ramírez-Bautista 2002), little has been published on reproductive characteristics of the Mexican endemic species *Sceloporus gadoviae* and *S. jalapae* from Tehuacán Valley, Puebla, México (Ramírez-Bautista 2003). *Sceloporus gadoviae* belongs to the *gadoviae* group, and *S. jalapae* to the *jalapae* group (Wiens and Reeder 1997).

In this study we focused on male and female reproductive characteristics of the small-sized lizard species *S. gadoviae* and *S. jalapae*. We addressed the following questions: (1) Do males and females become sexually mature at the same size? (2) Do males and females differ in morphological traits? (3) What is the annual reproductive cycle for these species? (4) How large are their clutches? (5) Is clutch size related to female size? (6) Are reproductive characteristics of both species similar to other populations and other spiny lizards of similar body size? This study adds to a growing body of data for groups of species that have been relatively underrepresented in large comparative studies.

#### MATERIALS AND METHODS

This study was conducted at Tehuacán Valley, Puebla, near Zapotitlán Salinas, México (18°07'18"N, 97°39'06"W) at an elevation of 1420 m. The climate is dry and temperate, with most precipitation occurring during the summer months (June–September); the dry season is from November to May. Mean annual temperature is 21°C (range 17°–24°C), and precipitation is 450 mm (García 1981). Dominant vegetation consists of thorn forest, xero-

phytic brushland, deciduous tropical forest, and columnar cacti (Dávila et al. 1993).

We collected data for *S. gadoviae* (72 females and 33 males) and *S. jalapae* (24 females and 17 males) from January to December, except March and April (for *S. gadoviae*) and January, April, June, October, and December (for *S. jalapae*) during the period 1999–2002. Because samples were often small for individual months and varied considerably among years, we pooled the data to describe general annual reproductive characteristics. We measured snout-vent length (SVL) of the lizards to the nearest 1.0 mm, after which they were sacrificed and fixed with 10% formalin and subjected to gonadal examination.

During the gonadal examination of females, we counted the number of vitellogenic follicles or oviductal eggs and recorded the length and width of left and right vitellogenic follicles or freshly ovulated eggs to the nearest 0.1 mm. Length and width of the gonads were used to obtain follicular and egg volume (V) using the formula for volume of an ellipsoid (Selby 1965):

$$V = 4/3\pi a^2b,$$

where *a* is half the shortest diameter and *b* is half the longest diameter. The smallest female (considering SVL) with either the largest vitellogenic follicles or oviductal eggs was used to estimate minimum size at maturity. Clutch size was determined by counting eggs in the oviduct or vitellogenic follicles of adult females during the reproductive season (Ramírez-Bautista et al. 2000, 2002). We calculated a Pearson's product-moment correlation coefficient to test for a relationship between clutch size and SVL of females.

Males were recorded as sexually mature if they contained enlarged testes and convoluted epidymides typically associated with sperm production (Goldberg and Lowe 1966). Data on lizard SVL and organ volume were transformed to log (base 10) for linearized regressions. Because organ volume usually varies with SVL, we first calculated regressions of log<sub>10</sub>-transformed organ volume data against log<sub>10</sub> of female SVL. For regressions that were significant (indicating a body size effect), we calculated residuals from the relationship of organ volume to SVL (all variables log<sub>10</sub>-transformed) to produce SVL-adjusted variables.

We used these residuals to describe the organ volume and reproductive cycles (for *S. gadoviae*). This technique maintains variation because of extrinsic factors while minimizing the confounding effect of individual variation in SVL (Valdéz-González and Ramírez-Bautista 2002). We performed 1-way ANOVA on the organ volumes (with month as the factor) to determine whether significant monthly variation existed, including only those months for which  $N \geq 3$  (Ramírez-Bautista et al. 2000).

Variables used to test sexual size differences were snout-vent length (SVL, mm), head length (HL, mm), forearm length (FL, mm), and tibia length (TL, mm) of females and males. Residuals of SVL regressions were calculated for these morphological variables. We then used these residuals to examine sexual size differences between mature males and females, and performed a Mann-Whitney *U*-test on HL, FL, and TL. We used a cutoff of  $P < 0.05$  to assess statistical significance. Results are expressed as untransformed mean  $\pm s_{\bar{x}}$ . Statistical analyses were performed with StatView IV (Abacus Concepts 1992). Specimens are deposited at the Colección Nacional de Anfibios y Reptiles (CNAR), Universidad Nacional Autónoma de México in México City.

## RESULTS

### Body Size and Sexual Maturity

In *S. gadoviae* sexually mature males ranged in size from 45.0 to 73.0 mm SVL, and females ranged from 41.0 to 67.0 mm SVL, whereas the range in *S. jalapae* was 45.0–62.0 mm SVL and 42.0–50.0 mm SVL, respectively (Table 1). Males of both *S. gadoviae* ( $Z = -4.75$ ,  $P < 0.0001$ ) and *S. jalapae* (Mann-Whitney *U* test,  $Z = -2.70$ ,  $P = 0.001$ ) were larger in SVL than females (Table 2). Mean SVL of females was higher in *S. gadoviae* than in *S. jalapae* females ( $Z = -4.89$ ,  $P < 0.0001$ ), and the males exhibited a similar pattern ( $Z = -3.84$ ,  $P < 0.0001$ ). Males of *S. gadoviae* also had larger HL ( $Z = -5.25$ ,  $P < 0.0001$ ), FL ( $Z = -4.85$ ,  $P < 0.0001$ ), and TL ( $Z = -4.19$ ,  $P < 0.0001$ ) than females (Table 2), and the same pattern was observed in *S. jalapae* for HL ( $Z = -4.38$ ,  $P < 0.0001$ ), FL ( $Z = -4.16$ ,  $P < 0.0001$ ), and TL ( $Z = -4.49$ ,  $P < 0.0001$ ).

### Male Reproductive Cycle

There were significant positive relationships between male  $\log_{10}$  SVL and  $\log_{10}$  testes volume ( $r^2 = 0.65$ ,  $F_{1,31} = 55.7$ ,  $P < 0.0001$ ,  $N = 33$ ),  $\log_{10}$  fat body mass ( $r^2 = 0.13$ ,  $F_{1,31} = 4.32$ ,  $P < 0.05$ ), and  $\log_{10}$  liver mass ( $r^2 = 0.29$ ,  $P < 0.001$ ) in *S. gadoviae*. In contrast, in *S. jalapae* there were no relationships between male  $\log_{10}$  SVL and  $\log_{10}$  testes volume ( $F_{1,15} = 0.125$ ,  $P > 0.05$ ) or  $\log_{10}$  fat body mass ( $F_{1,12} = 0.462$ ,  $P > 0.05$ ), but there was a significant positive relationship between male  $\log_{10}$  SVL and  $\log_{10}$  liver mass ( $F_{1,11} = 36.53$ ,  $P < 0.0001$ ). ANOVAs on the residuals of these regressions revealed significant variation among months in testes volume ( $F_{9,23} = 2.35$ ,  $P < 0.05$ ), but not in fat body mass ( $F_{9,23} = 0.759$ ,  $P > 0.05$ ) or liver mass ( $F_{9,18} = 0.655$ ,  $P > 0.05$ ) for *S. gadoviae* (Fig. 1). For *S. jalapae*, variation was not significant among months for testes volume ( $F_{3,13} = 2.55$ ,  $P > 0.05$ ), fat body mass ( $F_{1,13} = 1.55$ ,  $P > 0.05$ ), or liver mass ( $F_{3,9} = 1.78$ ,  $P > 0.05$ ). In *S. gadoviae*, testicular volume increased from January through July and again in October, November, and December (Fig. 1). In contrast, testicular volume in *S. jalapae* increased in July ( $\bar{x} = 14.0 \pm 4.4 \text{ mm}^3$ ), August ( $\bar{x} = 20.6 \pm 4.3 \text{ mm}^3$ ), and September ( $\bar{x} = 34.2 \pm 11.5 \text{ mm}^3$ ).

### Female Reproductive Cycle

There was a significant linear relationship between female  $\log_{10}$  SVL and  $\log_{10}$  gonadal volume ( $r^2 = 0.21$ ,  $F_{1,69} = 16.0$ ,  $P < 0.0005$ ),  $\log_{10}$  fat body mass ( $r^2 = 0.11$ ,  $F_{1,69} = 5.69$ ,  $P < 0.005$ ), and  $\log_{10}$  liver mass ( $r^2 = 0.23$ ,  $F_{1,67} = 3.75$ ,  $P < 0.05$ ) in *S. gadoviae*, but not in *S. jalapae* ( $r^2 = 0.07$ ,  $r^2 = 0.13$ ,  $r^2 = 0.06$ , all  $P > 0.05$ , respectively). ANOVAs on residuals of these regressions revealed significant variation among months on gonadal volume ( $F_{10,60} = 4.32$ ,  $P < 0.0001$ ), fat body mass ( $F_{10,60} = 8.81$ ,  $P < 0.0001$ ), and liver mass ( $F_{10,58} = 2.55$ ,  $P < 0.05$ ) in *S. gadoviae* (Fig. 2). In contrast, in *S. jalapae* only gonad volume varied significantly among months ( $F_{6,15} = 3.25$ ,  $P < 0.05$ ).

*Sceloporus gadoviae* females have continuous reproduction. The average female gonadal volume began to increase in October and continued until July of the following year; volume then decreased from July to October (Fig. 2). In contrast, reproductive activity in *S. jalapae*

TABLE 1. Reproductive characteristics of *Sceloporus gadoviae* and *S. jalapae* from Tehuacán Valley. Mean  $\pm s_{\bar{x}}$  (range, sample size).

Characteristics	<i>S. gadoviae</i>	<i>S. jalapae</i>
Maximum reproductive activity of males	November–July	July–September
Maximum reproductive activity of females	January–December	May–September
Vitellogenic follicles	3.9 $\pm$ 0.19 (2–5, <i>N</i> = 14)	3.2 $\pm$ 0.49 (2–4, <i>N</i> = 5)
Oviductal eggs	3.9 $\pm$ 0.14 (2–5, <i>N</i> = 21)	5.6 $\pm$ 0.43 (4–8, <i>N</i> = 10)
Oviductal egg volume (mm <sup>3</sup> )	263.9 $\pm$ 17.0 (170.4–501.6, <i>N</i> = 20)	172.4 $\pm$ 10.7 (120.1–198.7, <i>N</i> = 9)
Vitellogenic follicles (mm <sup>3</sup> )	56.0 $\pm$ 12.1 (3.2–142.6, <i>N</i> = 17)	17.4 $\pm$ 9.3 (3.9–40.6, <i>N</i> = 4)
Neonates SVL (mm)	25.0	23.0
Adult male SVL (mm)	57.5 $\pm$ 1.3 (45.0–73.0, <i>N</i> = 33)	49.3 $\pm$ 1.1 (45.0–62.0, <i>N</i> = 17)
Adult female SVL (mm)	50.4 $\pm$ 0.52 (41.0–67.0, <i>N</i> = 72)	46.0 $\pm$ 0.54 (42.0–50.0, <i>N</i> = 24)

TABLE 2. Mean values ( $\pm 1 s_{\bar{x}}$ ) of morphological characteristics (HL = head length, FL = femur length, and TL = tibia length) of sexually mature females (*N* = 72) and males (*N* = 33) of *Sceloporus gadoviae* and *S. jalapae* (*N* = 24 and 17, respectively). We used the Mann-Whitney U test ( $P < 0.001 = *$ ,  $P < 0.0001 = **$ ) in determining differences between the sexes for each species.

Characteristics	<i>S. gadoviae</i>				<i>S. jalapae</i>			
	Males	Females	Test	<i>P</i>	Males	Females	Test	<i>P</i>
HL (mm)	13.5 $\pm$ 0.24	12.0 $\pm$ 0.08	<i>Z</i> = -5.25	**	11.3 $\pm$ 0.14	9.8 $\pm$ 0.09	<i>Z</i> = -4.38	**
FL (mm)	14.4 $\pm$ 0.27	13.1 $\pm$ 0.15	<i>Z</i> = -4.85	**	12.2 $\pm$ 0.15	10.2 $\pm$ 0.10	<i>Z</i> = -4.16	**
TL (mm)	12.9 $\pm$ 0.36	10.7 $\pm$ 0.09	<i>Z</i> = -4.91	**	10.8 $\pm$ 0.17	9.0 $\pm$ 0.14	<i>Z</i> = -4.49	**
SVL (mm)	57.5 $\pm$ 1.3	50.4 $\pm$ 0.52	<i>Z</i> = -4.75	**	49.3 $\pm$ 1.1	46.0 $\pm$ 0.54	<i>Z</i> = -2.70	*

seems to be seasonal; gonadal volume increased in May ( $\bar{x}$  = 24.2  $\pm$  2.3 mm<sup>3</sup>), July ( $\bar{x}$  = 92.5  $\pm$  53.5 mm<sup>3</sup>), August ( $\bar{x}$  = 157.0  $\pm$  15.8 mm<sup>3</sup>), and September ( $\bar{x}$  = 109.6  $\pm$  52.1 mm<sup>3</sup>) in females with vitellogenic follicles or oviductal eggs. Females of *S. gadoviae* were found with oviductal eggs from January to December, but with a maximum egg production from May to September. In contrast, females of *S. jalapae* were found with vitellogenic follicles and oviductal eggs from March to September.

#### Clutch Size

Mean clutch size of vitellogenic follicles of *S. gadoviae* was not different from that of oviductal eggs (*Z* = -1.42,  $P > 0.05$ ; Table 1). Considering both egg classes, mean clutch size was 3.9  $\pm$  0.11 eggs (range 2–5, *N* = 35; Table 1). In contrast, in *S. jalapae* females the mean clutch size of vitellogenic follicles was different from that of oviductal eggs (*Z* = -2.69,  $P = 0.005$ ; Table 1). Clutch size was higher in *S. jalapae* than in *S. gadoviae* (*Z* = -3.35,  $P < 0.005$ ). Clutch size was not related to female SVL in *S. gadoviae* ( $r^2 = 0.22$ ,  $F_{1,33} = 1.67$ ,  $P > 0.05$ ) nor in *S. jalapae* ( $r^2 = 0.48$ ,  $F_{1,4} = 0.90$ ,  $P > 0.05$ ). However, total egg mass in

females was significantly correlated with female SVL in *S. gadoviae* ( $r^2 = 0.69$ ,  $F_{1,19} = 17.1$ ,  $P < 0.001$ ) and *S. jalapae* ( $r^2 = 0.72$ ,  $F_{1,9} = 8.81$ ,  $P < 0.01$ ). Three of 21 *S. gadoviae* females (14.3%) had both vitellogenic follicles and oviductal eggs at the same time, suggesting that females of this species might lay 2 or more clutches during the reproductive season, but this was not the case with females of *S. jalapae*. Egg production for *S. gadoviae* occurred throughout the year, but the peak was from May to September, while the peak for *S. jalapae* was from July to September.

The volume of vitellogenic follicles of *S. gadoviae* was different from that of oviductal eggs (*Z* = -5.18,  $P < 0.0001$ ); a similar pattern was observed for *S. jalapae* (*Z* = -2.78,  $P < 0.005$ ; Table 1).

#### DISCUSSION

*Sceloporus gadoviae* and *S. jalapae* males reached sexual maturity at the same size, and both species showed sexual dimorphism, whereby males were large than females. This is common among other species of the genus *Sceloporus* (Fitch 1978, Benabib 1994, Ramírez-Bautista and Gutiérrez-Mayén 2003). Males of

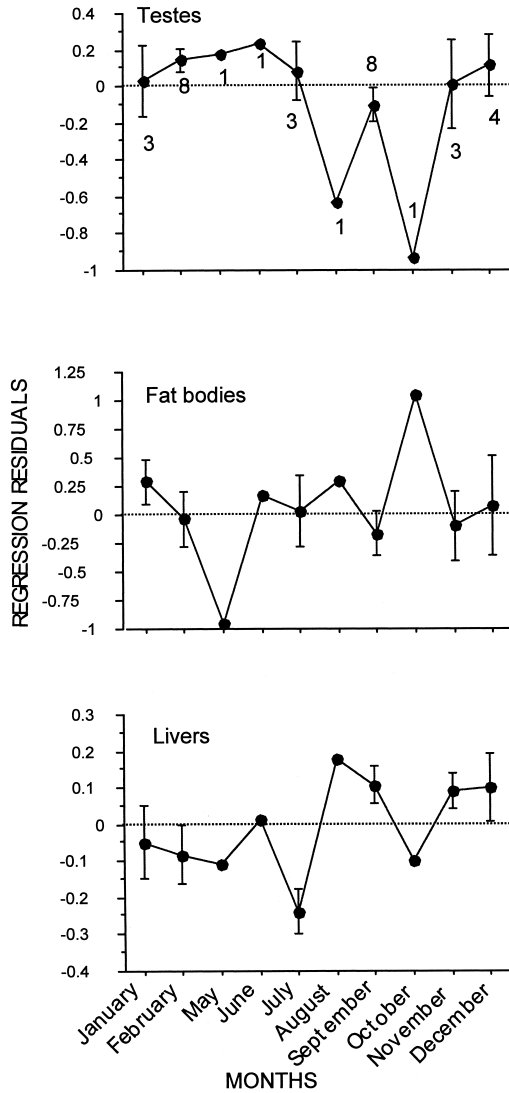


Fig. 1. Male testes, fat body, and liver cycles of *Sceloporus gadoviae* from Tehuacán Valley, Puebla, México. Data are mean ( $\pm 1 s_{\bar{x}}$ ) residuals from a regression of  $\log_{10}$  testes volume ( $\text{mm}^3$ ), liver mass (g), fat body mass (g) against  $\log_{10}$  SVL.

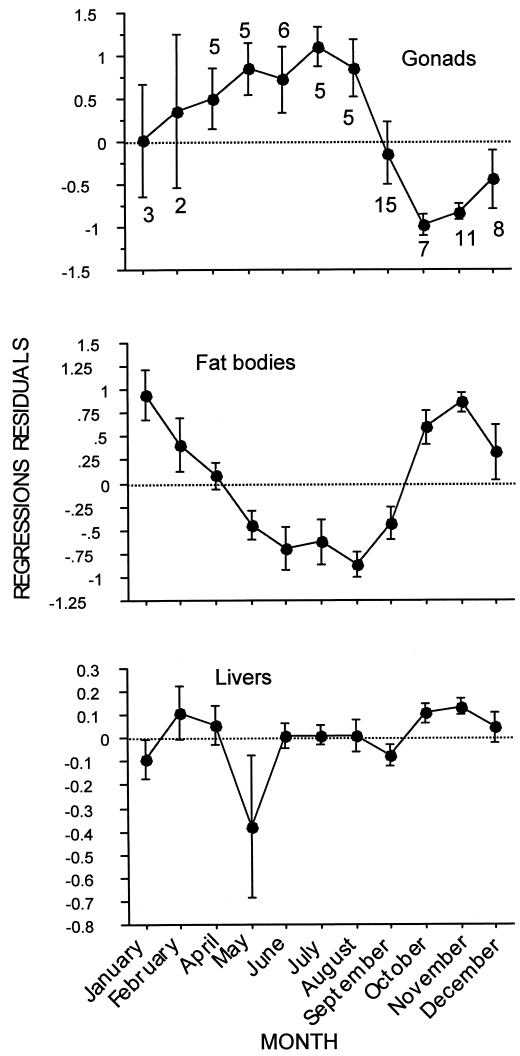


Fig. 2. Female gonad, fat body, and liver mass cycles of *Sceloporus gadoviae* from Tehuacán Valley, Puebla, México. Data are mean ( $\pm 1 s_{\bar{x}}$ ) residuals from a regression of  $\log_{10}$  gonadal volume ( $\text{mm}^3$ ), fat body mass (g), liver mass (g) against  $\log_{10}$  SVL.

both species were larger in other morphological structures (HL, FL, TL). Sexual dimorphism in *S. gadoviae* and *S. jalapae*, as in other species of the genus, may be a response of sexual selection, with larger males having an advantage over smaller ones in obtaining mates (Fitch 1981, Stamps 1983, Shine 1989). Sexual selection can help maintain large body size in male lizards if larger males mate more frequently than smaller ones. During the reproductive sea-

son (July–August), larger males of both species were observed on cactus (*S. jalapae*) and on rocks (*S. gadoviae*), exhibiting their bright ventral region to smaller males and driving the smaller individuals from their areas as occurs in other lizard species (Trivers 1976, Ruby 1981).

The reproductive cycles of *S. gadoviae* and *S. jalapae* differ in timing and duration. The male reproductive period of *S. gadoviae* was during the dry (November to May) and wet (June to September) seasons. In contrast, males

of *S. jalapae* showed a seasonal reproductive period during the wet season (July to September). These data suggest that both species have different reproductive requirements, even though they inhabit the same area. *Sceloporus jalapae* seems to be responding to the environmental factors of the wet season as shown by other species inhabiting tropical dry forest (Ramírez-Bautista and Vitt 1997, 1998). Male and female reproductive cycles in *S. jalapae* appear to be synchronized because females showed vitellogenic follicles and oviductal eggs from May to September; this pattern is similar to other oviparous lizard species inhabiting arid environments (Jones and Ballinger 1987, Smith et al. 1995).

Reproductive cycles for both sexes of *S. gadoviae* are synchronized from January to December. In *S. gadoviae* the longer reproductive season, larger clutch size, larger oviductal egg volume, and smaller mean SVL of sexually mature adult females than other populations of the same species could be influenced by contrasting conditions of precipitation (450 vs. 730 mm), altitude (1420 vs. 600 m), and temperature (21°C vs. 27.8°C) in the Tehuacán Valley and Cañón del Zopilote (Lemos-Espinal et al. 1999). Another difference associated with the longer reproductive season is that individual females may lay 2 or more clutches rather than a single clutch as occurs in other small-bodied species (Ramírez-Bautista et al. 1995).

Differences in the reproductive characteristics between *S. gadoviae* and *S. jalapae*, such as reproductive period, snout-vent length of adults, mean number of vitellogenic follicles, clutch size, and oviductal egg volume, suggest that each species is responding in a different way to environmental cues. Differences in reproductive characteristics between both species could reflect their phylogenetic distance (different groups) and the microhabitat used by each species (Miles and Dunham 1992). Resources such as food abundance are strongly correlated with precipitation in several environments, and variation in resource abundance in turn is related to variations in reproductive characteristics in many lizard species (Ballinger 1977, Benabib 1994, Ramírez-Bautista and Vitt 1997, 1998). This could be the case for the populations of *S. gadoviae* because both females and males are larger at sexual maturity (mean SVL) than *S. jalapae* of either sex. The variation in body size of females of both species

could result from a demographic response that may influence clutch size and egg size or volume as in other species (Dunham 1982, Benabib 1994, Ramírez-Bautista and Vitt 1997, 1998) and congeners (Ramírez-Bautista et al. 2002, Valdéz-González and Ramírez-Bautista 2002).

The smaller clutch size and the larger egg volume for *S. gadoviae* compared with *S. jalapae* might be considered a reproductive strategy because production of several clutches of small size might subject offspring to excessive predation. The larger egg volume in *S. gadoviae* results in hatchlings with a larger SVL (25.0 mm) than the smaller egg volume clutches of *S. jalapae* (SVL = 23.0 mm). These data show that *S. gadoviae* females have smaller clutch sizes, laying 2 or more clutches during the reproductive season, but the hatchlings are larger in SVL than hatchlings of *S. jalapae* females from a single egg clutch. This pattern is similar to other small-bodied species with multiple egg clutches (Benabib 1994, Ramírez-Bautista and Vitt 1998).

Although both species belong to the Phrynosomatidae family, if the difference in clutch size between the 2 species does not reflect their phylogeny, it might be a response to different environmental pressure. Most small-bodied species of this family have multiple egg clutches of small size. However, exceptions exist such as in *S. siniferus* (5.0 eggs; Fitch 1978), *S. pyrocephalus* (5.8 eggs; Ramírez-Bautista and Oliver-Becerril 2004), and *S. jalapae* (5.6 eggs; this study) with a single egg clutch. Although clutch sizes differ between both species, *S. jalapae* is closer to species of smaller clutch size than to other large-bodied species (Valdéz-González and Ramírez-Bautista 2002). The variation among populations of the same or different species of this family (Phrynosomatidae) could reflect either adaptive differences that evolved as a result of different environments or proximate effects of different environments (Dunham and Miles 1985, Vitt 1990, 1992).

Females of *S. gadoviae* are able to lay 2 or more clutches during the reproductive season. Like most small-bodied species, some *S. gadoviae* females (14.3%) are capable of laying 2 or more clutches during reproduction, since vitellogenic follicles and oviductal eggs were present at the same time. This pattern is similar to other oviparous species of small body size found in tropical dry forest, tropical wet

forest, and temperate zones (Dunham 1982, Benabib 1994, Ramírez-Bautista et al. 1995, Ramírez-Bautista and Vitt 1998).

Much remains to be learned about the reproductive cycles of the lizards *Sceloporus gadoviae* and *S. jalapae*, especially those inhabiting tropical arid environments. It is clear that *S. gadoviae* has multiple clutches during the reproductive season, but data do not exist about clutch frequency for the small-bodied lizard *S. jalapae*. Our data in this present study suggest that further research in other regions of the geographic range of both species is necessary to provide additional information about variations in their reproductive characteristics.

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