REPRODUCTION IN THREE SYMPATRIC LIZARD SPECIES FROM WEST-CENTRAL UTAH

John B. Andre[1] and James A. MacMahon[1]

ABSTRACT.— Data on reproduction by the lizards *Uta stansburiana*, *Crotaphytus collaris*, and *Cnemidophorus tigris* are presented from a community where they are sympatric in west-central Utah. Data are compared to a previous study of these species at the same site and to data from other sites in the United States.

Lizard reproductive data from geographically separated populations are important to ecologists attempting to explain a highly variable species characteristic. Reproduction by *Uta stansburiana* has been well documented in the literature (Fautin 1946, Medica and Turner 1976, Nussbaum and Diller 1977, Tanner 1965, Tinkle 1961, 1967, Turner et al. 1970, 1973, 1976, Worthington and Arvizo 1973, Parker 1974, Parker and Pianka 1975, Tinkle and Hadley 1975, and Goldberg 1977). Reproductive studies of *Crotaphytus collaris* and *Cnemidophorous tigris* are scarce (Fautin 1946, Turner et al. 1969, Pianka 1970, Burkholder and Walker 1973, Parker 1973, and Vitt and Ohmart 1977). This paper presents data on the reproduction by three lizard species (*Uta stansburiana stansburiana*, *Crotaphytus collaris bicinctoris*, and *Cnemidophorus tigris tigris*), coexisting in west-central Utah.

We are cognizant of the limitations imposed by the short period covered by our collections. Despite this, there is clearly a need for carefully collected data on reproduction by lizards, or other taxa, so that one might gather such data into a body of information used to address general evolutionary theory (Tinkle 1969a, b, Tinkle et al. 1970).

METHODS

Lizards were collected in Tule Valley, Millard County, Utah (lat. 39°13′N, long. 113°27′W). Tule Valley, bordered on the east and west by mountain ranges, is typical of the basin and range topography of the Great Basin Desert (MacMahon 1979). Bajadas (coalesced alluvial fans) slope from the bases of both mountain ranges to the playa that covers most of the valley floor.

The study site was located in the *Tetradymia glabrata* and *Atriplex confertifolia* communities described by Fautin (1946). The common plant species were *T. glabrata*, *A. confertifolia*, *Chrysothamnus viscidiflorus*, *Artemisia spinescens*, *Ephedra nevadensis*, *Ceratoides* (*Eurotia*) *lanata*, and *Hilaria jamesii*. The substrate was mostly small rocks embedded in packed soil, with localized areas containing large boulders, which were used as basking/perching sites by *C. collaris*.

Lizards were collected (shot) throughout the day, at three-week intervals between 1 April and 29 August 1976. Specimens were preserved in 10 percent formalin within two hours of collection. Analysis of reproductive state (for females) and measurement of snout-vent length (SVL) were made in the laboratory.

The sex of each specimen was determined by dissection. The reproductive tracts of the females were removed and the number of corpora lutea, yolked follicles and/or oviducal eggs were recorded. Estimates of clutch size were based on the number of yolked follicles $\geq$ 2.5 mm diameter and/or oviducal eggs and corpora lutea for *U. stansburiana*

[1]This paper is a contribution from the Department of Biology and the Ecology Center, Utah State University, Logan, Utah 84322. Reprint requests should be sent to James A. MacMahon. Present address for John B. Andre is Cape Romain National Wildlife Refuge, R.R. 1, Box 191, Awendaw, South Carolina 29429.

and yolked follicles $\geq$ 5.0 mm diameter and/or oviducal eggs and corpora lutea for *C. collaris* and *C. tigris*.

RESULTS

Mean clutch size and mean SVL of sexually mature females of each species are listed in Table 1. The relationship between clutch size and SVL is illustrated for *U. stansburiana* in Figure 1. Analyses of similar data for *C. collaris* and *C. tigris* showed no significant correlation (F-tests). The line in this figure was determined by linear regression, the correlation coefficient is given for the data set.

Uta stansburiana females reach sexual maturity in their second growing season (10 mo. old) at about 40 mm SVL (the smallest female having yolked follicles was 37.0 mm SVL, see Table 2). Most *U. stansburiana* emerged from hibernation by the first week of April and bred shortly after this time. Yolked follicles and oviducal eggs were present from 1 April to 16 May; only oviducal eggs were found from 6 June to 29 June. From 17 July through 29 August no yolked follicles or oviducal eggs were found in the females collected. Though yolked follicles and oviducal eggs were present in the females from April to the end of June, females contained the most oviducal eggs between 24 April and 15 May. While we believe that females laid one or two clutches of eggs in 1976, our data are not extensive enough on this point. Turner et al. (1970) have warned of the problem of determining clutch frequency with too few observations.

Crotaphytus collaris females are sexually mature at about 85 mm SVL. Yolked follicles were present in the single specimen collected 15 May. All females collected in the first week of June contained oviducal eggs. At the end of June no females contained yolked follicles or oviducal eggs.

Cnemidophorus tigris females attain sexual maturity about 73 mm SVL. Specimens collected during the first and last weeks of June

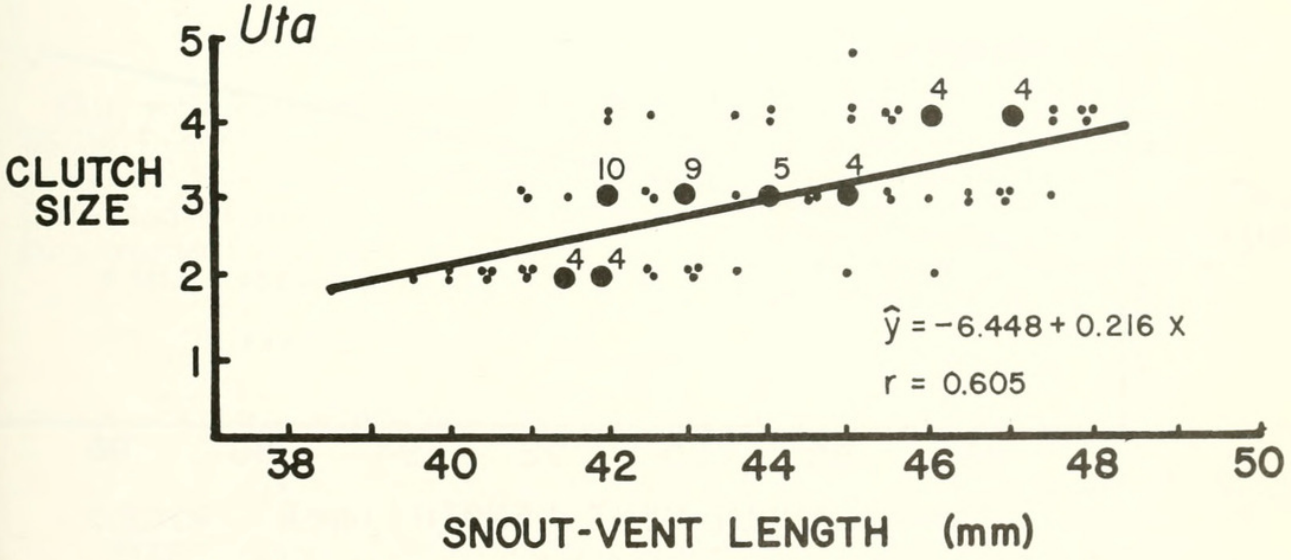

Fig. 1. Relationship between clutch size (number) and SVL (mm) for *U. stansburiana*.

TABLE 1. Clutch size and SVL of adult female *Uta stansburiana*, *Crotaphytus collaris* and *Cnemidophorus tigris*.

		SVL (mm)		Clutch size	
Species	N	$\bar{x}$	Range	$\bar{x}$	Range
Uta stansburiana	96	44.61	39.5–49.0	2.99	2–5
Crotaphytus collaris	13	90.69	85.5–99.0	5.38	3–7
Cnemidophorus tigris	15	83.13	73.0–96.0	3.07	2–5

contained yolked follicles and/or oviducal eggs. After mid-July, no females contained yolked follicles or oviducal eggs.

The first hatchlings observed were: *U. stansburiana*, 17 July; *C. collaris*, 9 August; *C. tigris*, 7 August.

DISCUSSION

Mean clutch size for *U. stansburiana* was 2.99 (range 2–5). Fautin (1946) reported a mean clutch size of 4.1 (range 3–5) from the vicinity of our study site. For northern populations (Tooele County, Utah) Parker and Pianka (1975) found a mean clutch size for *Uta* of 4.6; Nussbaum and Diller (1977) in Oregon found 3.3. Both Parker and Pianka (1975) and Nussbaum and Diller (1977) reported that *Uta* produces one or two clutches per season. At our site, one, and for some females perhaps two, clutches of eggs were laid by *Uta* in 1976.

Parker and Pianka (1975) also reported that oviducal eggs were present during a three- to four-month period; our data agree.

The relationship between SVL and clutch size indicates that larger females produce larger clutches. An F test shows a significant relationship between SVL and clutch size (0.05 level). Other workers report the same relationship between SVL and clutch size for *Uta stansburiana* from other parts of its range (Tinkle 1961, Turner et al. 1973, Parker and Pianka 1975, and Goldberg 1977).

By mid-July *Uta* is in postreproductive condition: the reproductive tracts of both males and females have decreased in size. This size decrease is accompanied by an increase in the size of the fat bodies. Fat bodies continue to enlarge as the growing season progresses.

Little information exists on the reproduction of *C. collaris*. In southern New Mexico, Parker (1973) reported a mean clutch size of 5.3 (range 3–7). Robison and Tanner (1962) reported a mean clutch size of 6.7, but the lizard was collected from many different parts of its range. Our data show a mean clutch size of 5.38 (range 3–7).

The relationship between SVL and clutch size is illustrated in Figure 2. A loose correla-

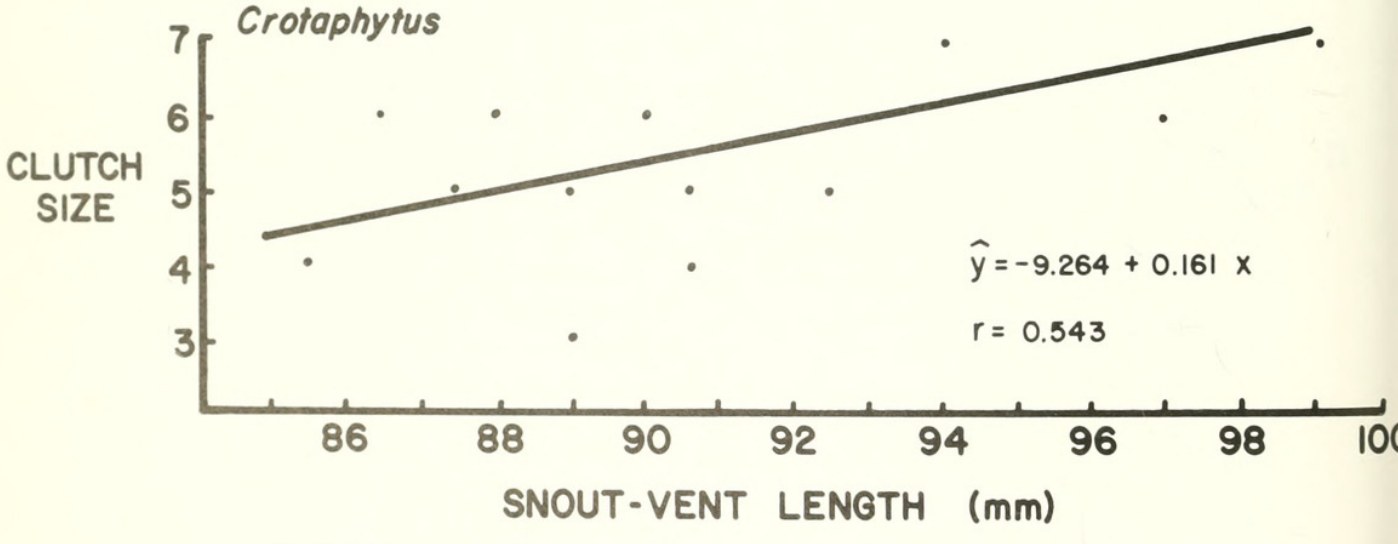

Fig. 2. Relationship between clutch size (number) and SVL (mm) for *C. collaris*.

TABLE 2. Monthly clutch size and SVL of adult female *Uta stansburiana*.

Month	N	SVL (mm)		Clutch size	
		$\bar{x}$	Range	$\bar{x}$	Range
April	21	43.17	37.0–47.5	2.39	2–4
May	13	44.38	41.5–48.0	3.46	2–5
June	20	42.73	38.0–47.5	2.45	2–4
July	20	42.80	38.0–49.0	2.47	2–4
August	22	43.50	40.0–48.0	2.76	2–4

tion exists, with larger females producing larger clutches; an F test (0.05 level) is not significant.

Yolked follicles and/or oviducal eggs were present from mid-May to mid-June in *C. collaris* females. By the end of June this species is postreproductive; the reproductive tracts are decreasing in size and the fat bodies are enlarging.

Cnemidophorus tigris becomes active near the end of April. Mating occurs shortly after. Yolked follicles and/or oviducal eggs were present from June to the first week of July. By mid-July this species is postreproductive; they exhibit small reproductive tracts and enlarging fat bodies.

Mean clutch size was 3.07 (range 2–5), whereas Fautin (1946) reported a mean clutch size of 6.7 (range 5–9). The relationship between SVL and clutch size is similar to that of *C. collaris*, with larger females tending to produce more eggs (Fig. 3), although an F test (0.05 level) is not significant. Pianka (1970) and Vitt and Ohmart (1977) report a relationship between SVL and clutch size that is "loosely correlated" for *C. tigris*.

Acknowledgments

This work was made possible by the US/IBP Desert Biome funded by the National Science Foundation (Grant GB32139). Linda Finchum typed the manuscript. Robert Bayn executed the figures.

Literature Cited

BURKHOLDER, G. L., AND J. M. WALKER. 1973. Habitat and reproduction of the desert whiptail lizard, *Cnemidophorus tigris* Baird and Girard in southwestern Idaho at the northern part of its range. Herpetologica 29:76–83.

FAUTIN, R. W. 1946. Biotic communities of the northern desert shrub biome in western Utah. Ecol. Monogr. 16:251–310.

GOLDBERG, S. R. 1977. Reproduction in a mountain population of the side-blotched lizard, *Uta stansburiana* (Reptilia, Lacertilia, Iguanidae). J. Herpetol. 11:31–35.

MACMAHON, J. A. 1979. North American deserts: Their floral and faunal components. Pages 21–82 *in* R. Perry and D. Goodall, eds. Arid land ecosystems: Their structure, functioning and management, Vol. 1. Cambridge University Press, Cambridge.

MEDICA, P. A., AND F. B. TURNER. 1976. Reproduction by *Uta stansburiana* (Reptilia, Lacertilia, Iguanidae) in southern Nevada. J. Herpetol. 10:123–128.

NUSSBAUM, R. A., AND L. V. DILLER. 1977. The life history of the side-blotched lizard, *Uta stansburiana* Baird and Girard, in north-central Oregon. Northwest Sci. 50:243–260.

PARKER, W. S. 1973. Notes on the reproduction of some lizards from Arizona, New Mexico, Texas and Utah. Herpetologica 29:258–264.

———. 1974. Home range, growth and population density of *Uta stansburiana* in Arizona. J. Herpetol. 8:135–139.

PARKER, W. S., AND E. R. PIANKA. 1975. Comparative ecology of populations of the lizard *Uta stansburiana*. Copeia 1975:615–632.

PIANKA, E. R. 1970. Comparative autecology of the lizard *Cnemidophorus tigris* in different parts of its geographic range. Ecology 51:703–719.

ROBISON, W. G., JR., AND W. W. TANNER. 1962. A comparative study of the species of the genus *Crotaphytus* Holbrook (Iguanidae). Brigham Young Univ. Sci. Bull., Biol. Ser. 2(1):1–21.

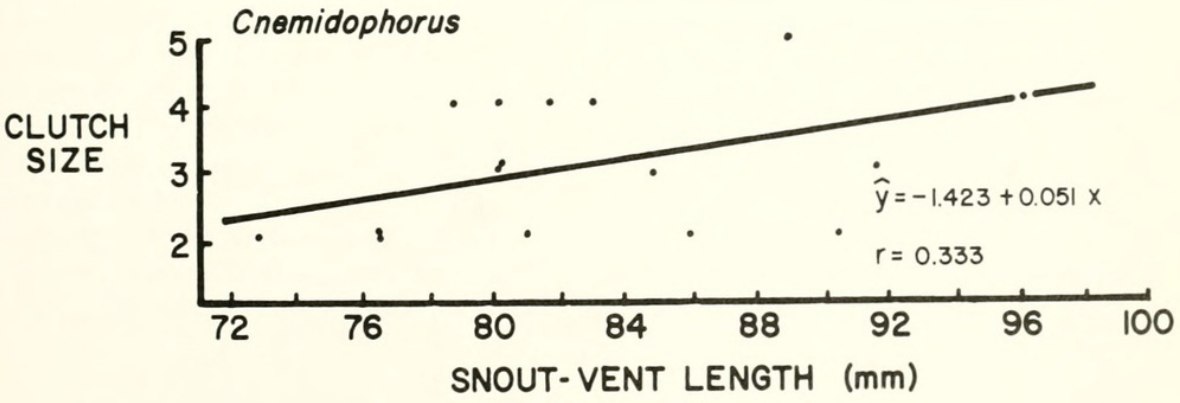

Fig. 3. Relationship between clutch size (number) and SVL (mm) for *C. tigris*.

TANNER, W. W. 1965. A comparative population study of small vertebrates in the uranium areas of the Upper Colorado River Basin of Utah. Brigham Young Univ. Sci. Bull., Biol. Ser. 7(1):1–31.

TINKLE, D. W. 1961. Population structure and reproduction in the lizard *Uta stansburiana stejnegeri*. Amer. Midl. Natur. 66:206–234.

_____. 1967. The life and demography of the side-blotched lizard *Uta stansburiana*. Misc. Publ. Mus. Zool. Univ. Michigan 132:1–182.

_____. 1969a. The concept of reproductive effort and its relation to the evolution of life histories of lizards. Amer. Natur. 103:501–516.

_____. 1969b. Evolutionary implications of comparative population studies in the lizard *Uta stansburiana*. Pages 133–154 *in* Systematic biology, Proc. of International Conf., National Acad. Sci. Publ. No. 1692, Washington, D.C.

TINKLE, D. W., AND N. F. HADLEY. 1975. Lizard reproduction effort: caloric estimates and comments on its evolution. Ecology 56:427–434.

TINKLE, D. W., H. M. WILBUR, AND S. G. TILLEY. 1970. Evolutionary strategies in lizard reproduction. Evolution 24:55–74.

TURNER, F. B., G. A. HODDENBACH, P. A. MEDICA, AND J. R. LANNOM. 1970. The demography of the lizard, *Uta stansburiana* Baird and Girard, in southern Nevada. J. Anim. Ecol. 39:505–519.

TURNER, F. B., P. A. MEDICA, AND B. W. KOWALEWSKY. 1976. Energy utilization by a desert lizard (*Uta stansburiana*). US/IBP Desert Biome Monogr. No. 1. Utah State Univ. Press, Logan.

TURNER, F. B., P. A. MEDICA, J. R. LANNOM, AND G. A. HODDENBACH. 1969. A demographic analysis of fenced populations of the whiptail lizard, *Cnemidophorus tigris*, in southern Nevada. Southwest. Nat. 14:189–202.

TURNER, F. B., P. A. MEDICA, AND D. D. SMITH. 1973. Reproduction and survivorshp of the lizard, *Uta stansburiana*, and the effects of winter rainfall, density and predation on these processes. US/IBP Desert Biome Res. Memo. RM 74-26, Utah State Univ., Logan.

VITT, L. J., AND R. D. OHMART. 1977. Ecology and reproduction of lower Colorado River lizards: II. *Cnemidophorus tigris* (Teiidae), with comparisons. Herpetologica 33:223–234.

WORTHINGTON, R. D., AND E. R. ARVIZO. 1973. Density, growth and home range of the lizard *Uta stansburiana stejnegeri* in southern Dona Ana County, New Mexico. Great Basin Nat. 33:124–128.