

VIVIPARITY AND REPRODUCTIVE PATTERN IN *PHRYNOSOMA DITMARSII* IN SONORA, MEXICO

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ABSTRACT. Live-bearing reproduction is reported in *Phrynosoma ditmarsii*, a horned lizard species recently rediscovered in mountains in northern Sonora, Mexico. Parturition is timed to coincide with the summer monsoon. *Phrynosoma ditmarsii* is a distinctive species that is strikingly similar to the short-horned *P. douglassi* in features of reproduction, structure, and general ecology.

Recent papers report that *Phrynosoma ditmarsii* lives in madrean upland communities in northwestern Mexico and that it is closely related to *P. douglassi* (Lowe, Robinson, and Roth 1971; Roth 1971). They report that *P. ditmarsii* inhabits rocky sites in oak woodland habitats where the species was rediscovered in Sierra Manzanal in north-eastern Sonora, Mexico. Several basic similarities of the two adjacent (parapatric) and distinctive upland species.—*P. douglassi* (short-horned lizard) and *P. ditmarsii* (rock horned lizard)—extend to viviparity as reported here (Fig. 1).

Live series of the rock horned lizard were recently obtained in rocky habitats in oak woodland on Cerro de la Palma (vicinity Rancho la Palma) at 1425 meters (4700 ft.) elevation in Sierra Baviacora, east of Río Sonora (Fig. 2). The mountain was climbed by two field parties with the first series of lizards collected in October, 1972, and a second series in July, 1974. Rancho la Palma in Sierra Baviacora is approximately 130 airline kilometers southeast of the first established locality for *P. ditmarsii* at Rancho Alecrán in Sierra Manzanal near Cananea, Sonora.

Parturition

Examination of post-parturition females verified our early suspicion that *P. ditmarsii* was viviparous. To obtain the direct evidence, a trip was planned into Sierra Baviacora in early July, 1974, to collect one or more gravid females. A large and fully gravid female (SV 90 mm) was collected at approximately 0800 on 13 July (Fig. 2), immediately

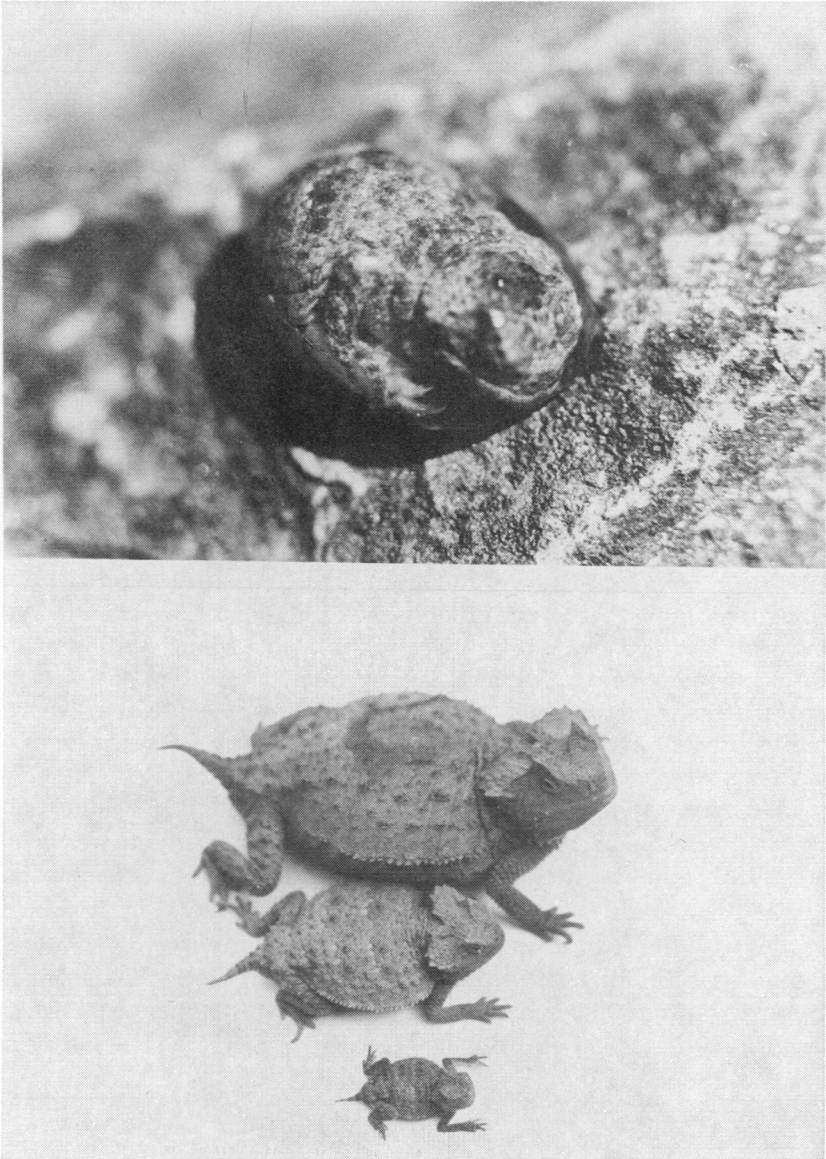


Fig. 1. Above: Young of *Phrynosoma ditmarsii* in fluid capsule a few moments after extrusion and deposition on a rock surface by adult female, July 23, 1974, in laboratory. **Below:** Juvenile female a few minutes after birth and drying, on the morning of July 23; the female parent is at top in photo, and a one-year subadult female is in center of photo (from same population in July).



Fig. 2. Above: Oak woodland habitat of the rock horned lizard on Cerro de la Palma in Sierra Baviacora, Sonora, Mexico, July 13, 1974; a southwest-facing slope exposure, elevation 1425 m (4700 ft). Two oaks comprise the open woodland canopy, the evergreen *Quercus viminea* and the deciduous *Quercus endlichiana*. Below: The gravid female *P. ditmarsii* reported in text, a few moments before capture on the rocky substratum that is located in lower center of woodland photograph above; vertical grass blades and forb stems are conspicuous. Note lateral bulge in female's abdomen while carrying nine young at 10 days before parturition.

brought down the mountain and to the university laboratory in Tucson the same evening.

Laboratory maintenance was under a 12–12 hour photoperiod and a 20–30 C cycled thermal regime, with an overhead infrared heat lamp for diurnal basking on rocks and voluntary control of body temperature. Water, ants (*Pogonomymex*), and insects from sweep netting were consumed *ad libitum*.

On 23 July the female was observed contracting her abdomen at about 0930. In the following 40 minutes, 9 hatchlings (3♂, 6♀) were deposited singly in their embryo sacs (Fig. 1) at approximately 2–7 minute intervals. All were deposited on rock and soil surfaces in the cage; the female did no digging. Each newborn took 7–8 minutes to dry before bursting from the fluid capsule (Fig. 1), sitting for a few moments, then walking. Movement of the body and cord could be clearly observed in all but the last individual deposited, which was stillborn at deficient weight (wt 0.83 g; SVL 26.4 mm).

Body weight recorded immediately for each of the young after drying (excluding the stillborn) was $1.14 \pm .03$ g (1.10–1.19). Snout-vent length of this series (N=8) was 26.0 ± 0.4 mm (25.5–26.8). The adult female weighed 31.14 g directly after parturition. Five of the young were preserved immediately after birth. The remaining four were maintained alive with the parent for one month. The specimens are UAZ Nos. 39530–39539.

Reproductive Effort and the Water-Cost of Viviparity

The female's field body weight was 54.05 g on the day of collection and did not fluctuate significantly in the 10 day period of captivity prior to parturition. Her weight immediately after deposition (34.14 g) indicates a weight loss of 19.91 g, of which 9.96 is accountable by hatchling weight. The remaining 9.95 g lost is accounted by the fluid within the covering envelopes of the nine young.

An estimate of reproductive effort from clutch weight/body weight is 36.8%, while hatchling weight/body weight is 18.4%. The latter ratio compares closely with the reproductive effort determined from enlarged late ovarian eggs in the closely related viviparous *P. douglassi*. We assume that the considerable moisture lost ($9.95/19.91 = 50\%$ water-cost) in the viviparous process in *P. ditmarsii* is also comparable to that in *P. douglassi*, as yet to be determined. It appears that the water-cost to maintain viviparity is indeed high compared to oviparity, a fact that may be related to the presence of viviparity in these

phrynosome species that live essentially in relatively mesic upland environments.

A productivity index (PI, Howard 1974) of 9, based on the single brood of *ditmars*i reported here for a relatively dry year, is in the lower part of the overall known brood range for *P. douglassi* (5–48). Assuming that yolked ovarian follicles (see below) may be used to roughly approximate a subsequent brood size, the PI for *P. ditmars*i may lie between 10 and 15. Howard (1974) gives PI 23.1 for *P. douglassi* with brood size 9–48, based on a sample of 32 females from Arizona, New Mexico, Sonora, and Chihuahua. Fitch (1970) and Goldberg (1971) give lower values based on smaller samples. Lowest reported brood size in *P. douglassi* is 5 according to Stebbins (1954).

The Testicular and Ovarian Cycles

The testis in *P. ditmars*i approaches or reaches maximum recrudescence in autumn and is at minimum activity during mid-summer. The testicular cycle appears to closely correspond to that in nearby madrean mountain lizard populations of *Phrynosoma douglassi*; see Goldberg (1971) for a population in Arizona.

Ovarian follicles in *P. ditmars*i are 12.2 (11–14) in a sample of four adult specimens collected in autumn months during recent years. These ovaries contain only small yolked follicles that are less than 4 mm diameter.

The male and female reproductive cycles in *P. ditmars*i are timed through natural selection to provide the ultimate coincidence of parturition with the onset of the summer monsoon, and the sharply increased moisture and insect food supplies that result during the warm-wet summer months (July–October). This fundamental aspect of the reproductive pattern in *P. ditmars*i is precisely that in other madrean mountain live-bearers, as seen, for example, in the closely related short-horned lizard *Phrynosoma douglassi* and the mountain (Yarrow's) spiny lizard *Sceloporus jarrovi*.

We are indebted to Mr. Paul Geiger for bringing to the senior author a specimen of *P. ditmars*i from Sierra Baviacora in Sonora, to Mr. Alexander "Ike" Russell for piloting the first field party to the Baviacora airstrip and ascending the mountain with us, to Señor Hector Lopez for local arrangements and ground transportation to the end of the road, to Mr. Robert "Barry" Spicer for assisting us in hunting rock horned lizards, and to all of our enthusiastic chamacos who yelled "Aquí esta uno."

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