

**OBLIGATORY SPERM STORAGE IN THE LIZARD**  
***Sceloporus grammicus***

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**RESUMEN**

La anatomía del oviducto de *Sceloporus grammicus* es similar a la descrita para otras especies de lacertilios: consiste de un infundíbulo anterior con la región del tubo, un útero medio y una vagina posterior. La pared del oviducto consiste de una serosa externa, una capa media de músculo liso y una mucosa interna con un epitelio ciliado simple. La mucosa de la vagina presenta pliegues longitudinales, los cuales se proyectan hacia el lumen. Se observan grandes masas de espermatozoides durante los meses de septiembre y octubre en

pequeñas invaginaciones del epitelio. El apareamiento ocurre en los meses de verano y las hembras ovulan hasta el otoño, por lo que el retraso en la fertilización es un fenómeno obligado en *S. grammicus*.

**PALABRAS CLAVE:** *Sceloporus*, oviducto, vagina, esperma.

## ABSTRACT

The oviduct anatomy of *Sceloporus grammicus* is similar to that described for other species of lizards, consisting of an anterior infundibulum with tube, a middle uterus and a posterior vagina. The oviductal wall consists of an outer serosa, a middle layer of smooth muscle, and an inner mucosa lined with simple ciliated epithelium. The mucosa in the vagina is folded longitudinally, the folds projecting inward into the lumen. Large masses of sperm were present during September and October at the base of the folds and in small blind invaginations of the epithelium. Since mating occurs during summer and females ovulate in the fall, delayed fertilization is obligatory in *S. grammicus*.

**KEY WORDS:** *Sceloporus*, oviduct, vagina, sperm.

## INTRODUCTION

Duration of sperm retention in lizards varies from a few months (Cuellar, 1966b; Shaefer and Roeding, 1973) to several years (Atsatt, 1953, Jun-Yi, 1982). In turtles viable sperm can be stored as long as four years (Hildebrand, 1929), and in some snakes as long as six (Haines, 1940). Overwintering of sperm in the female reproductive tract is common in rattlesnakes (Ludwig and Rahn, 1943) and garter snakes (Fox, 1956; Halpert et al., 1982). Most workers agree that the function of store sperm is to insure fertilization in situations in which males are scarce or in which the chances of the sexes coming together are reduced: (Rahn, 1940; Fox, 1956, Cuellar, 1966b; Smyth and Smith, 1968; Saint Girons, 1975; Conner and Crews, 1980; Jun-Yi, 1982; Adams and Cooper, 1988). According to Rahn (1940), the function of stored sperm "may be a safety factor which insures fertile eggs regardless of the time of ovulation".

Long-term retention of viable sperm in the reproductive tract of females is known to occur widely among reptiles (Cuellar, 1966a,b; Saint Girons, 1975; Fox, 1977; Halpert *et al.*, 1982; Adams and Cooper, 1988). The specific location within the oviduct where storage occurs and the particular storage structures vary in different species. In most reptiles the sperm are stored in special tubules located in the vagina (Fox, 1956; Cuellar, 1966a), but the tubules may occur in the infundibulum (Fox, 1956; Cuellar, 1966a; Hoffman and Wimsatt, 1972; Halpert *et al.*, 1982).

*Sceloporus grammicus* is a high altitude viviparous lizard native to Mexico. The reproductive cycle of this montane lizard is distinctive in that males and females become sexually active in different seasons (Guillette and Casas-Andreu, 1980; Crews, 1984). Males achieve maximal sperm production during early summer, when they inseminate the females, whereas females begin vitellogenesis in late summer, with ovulation occurring in September. Since fertilization cannot occur until after ovulation, the sperm are retained alive in the oviducts for approximately three months (Méndez-de la Cruz, 1989).

This study was conducted to document the existence of stored sperm in *S. grammicus*, and to describe the histology of the oviduct.

## MATERIAL AND METHODS

Specimens of *Sceloporus grammicus* were obtained in the vicinity of El Capulín, Ajusco in the State of Mexico at an elevation of 3400 m. Five females were collected monthly from September to October. The oviducts were fixed in 10% buffered formaldehyde, dehydrated in ethanol, cleared in xylene and embedded in paraffin. They were sectioned at 7  $\mu\text{m}$  and stained with hematoxylin-eosin according to Humason (1979).

## RESULTS

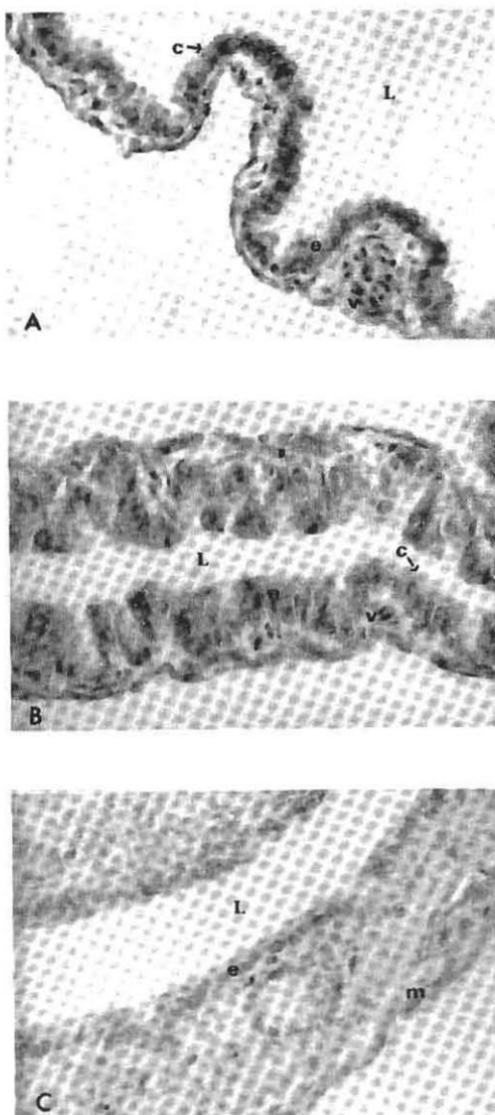
The oviduct is divided into three distinct regions, an anterior infundibulum with tube, a middle uterus and a posterior vagina (Fig. 1). Histologically, it consists of three layers of tissue, an outer serosa, a middle layer of smooth muscle, and an inner mucosa lining the lumen. The smooth muscle is arranged into inner circular and outer longitudinal layers, which become progressively thicker posteriorly. The mucosa is lined with a simple layer of intermingled ciliated and non ciliated epithelial cells attached to the lamina propria. In the infundibulum and uterus the mucosa is flat and lined with simple cuboidal epithelium (Fig. 1A, 1C).

In the tube and vagina the mucosa is convoluted and lined with simple columnar epithelium (Fig. 1B, 2B). The folds of the mucosa run transversely in the tube and longitudinally in the vagina (Fig. 1B, 2D) increasing in height and number posteriorly in the latter (Fig. 2A). Sperm were observed only in the vagina, forming dense bundles with heads oriented towards the epithelium (2B). The bundles were situated between the folds and in seminal receptacles at the base of the folds (Figs. 2A-2C).

The posterior vagina lacked seminal receptacles, but scattered sperm were observed in the lumen between the folds.

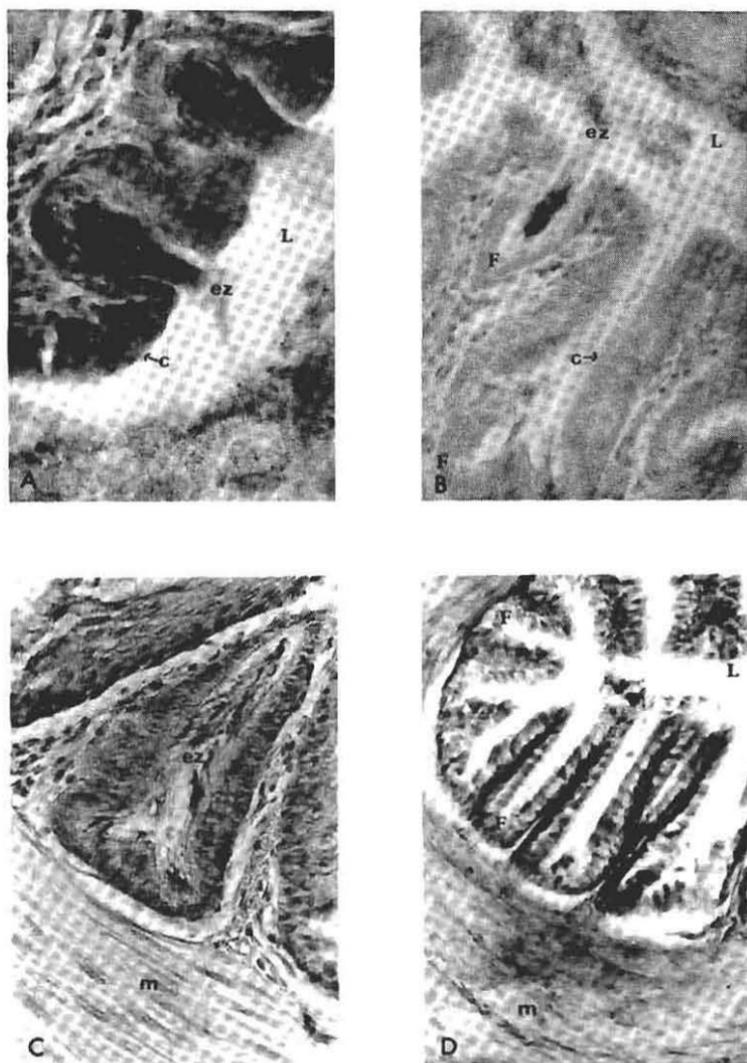
## DISCUSSION

The anatomy of the oviduct of *S. grammicus* is very similar to that described for other lizards (Cuellar, 1966a; Fox, 1977; Guillette and Jones, 1985). Structural differences in the vagina may reflect anatomical specializations in the different regions. The high posterior folds occluding the lumen may seal the vagina from the cloaca while the thick circular muscle may serve as a sphincter regulating the diameter of this junction (Cuellar, 1966a).



**Figure 1**

Longitudinal sections of the oviduct of *Sceloporus grammicus* showing: infundibulum (A), tube (B), and uterus (C). Note epithelium (e), cilia (c), blood vessels (v), and lumen (L). 500X.



**Figure 2**

Transverse section through the vaginal region. Anterior vagina showing epithelial folds with sperm (A). Middle vagina showing seminal receptacles with sperm (B) and (C). Posterior vagina (D) showing circular muscle (m), folds (F), cilia (c), lumen (L), and sperm (ez). 500 X.

As in other iguanids, the vagina also serves as the main chamber for the storage of sperm, possibly providing nutritional and protective functions (Fox, 1963, Cuellar, 1966a; Halpert et al., 1982). Saint Girons (1975) has even suggested that vaginal storage may be needed for sperm maturation, and that the orderly arrangement of sperm in the middle and anterior regions may be chemically regulated. The lack of sperm in the infundibulum suggests that storage may occur exclusively in the vagina.

The sperm storage mechanisms are evolved in different circumstances: a) Habits, as low motility and solitary behavior (Jun Yi, 1982), or low density and high vagility (Saint Girons, 1975). In these cases, there is a low meeting probability during the fertile season, and sperm storage guarantees fertilization. B) Life history characters, as low proportion of males in the sexual ratio (Jun Yi, 1982; Saint Girons, 1975); enlargement of the reproductive season, in multiple layer species (Conner and Crews, 1980; Adams and Cooper, 1988); and asynchronous cycles of males and females (Smyth and Smith, 1968).

In montane populations of *S. grammicus* testicular activity (*i.e.* courtship and mating) occurs during late spring and early summer (May-July), whereas females has vitellogenesis and ovulation during summer and early fall (July-October, Guillette and Casas-Andreu, 1980; Méndez-de la Cruz, 1989). Therefore, sperm retention is an obligatory event as in *Hemiergis peronii* (Smyth and Smith, 1968).

Viviparity in *S. grammicus* is related to the short growing season and low temperatures of its montane habitat (Guillette and Casas-Andreu, 1980). Similar viviparity and reproductive cycle has been demonstrated in various other species of *Sceloporus* inhabiting high mountains, such as *S. malachiticus* (Marion and Sexton, 1971), *S. bicanthalis* (Guillette, 1982), *S. formosus* (Guillette and Sullivan, 1985), *S. mucronatus* (Méndez-de la Cruz *et al.*, 1989). As well as other populations of a *S. grammicus* (Guillette and Casas-Andreu, 1980; Méndez-de la Cruz, 1989). More

studies should be done to know more about the physiology and evolution of sperm storage in all the mentioned species.

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