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# Reproduction in the Yellow-spotted night lizard, *Lepidophyma flavimaculatum* (Squamata, Xantusiidae), from Costa Rica

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*Lepidophyma flavimaculatum* Duméril, 1851 is a secretive inhabitant of undisturbed moist and wet forests, typically found under fallen logs in the humid lowlands from Oaxaca and southern Veracruz, Mexico to central Panama (Savage 2002). Like other xantusiids *L. flavimaculatum* is viviparous (Goin *et al.* 1978). Telford and Campbell (1970) reported that *L. flavimaculatum* populations from central Panama were all-female, however, Bezy (1989) concluded that *L. flavimaculatum* populations from Honduras and northward included 41% (30/73) males and were probably bisexual. The purpose of this note is to add information on reproduction of *L. flavimaculatum* from a histological examination of gonadal material from museum specimens from five Provinces of Costa Rica. The first information on the testicular cycle is presented. Minimum sizes for reproduction of males and females are given.

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A total of 60 *L. flavimaculatum* from Costa Rica including 26 adult females (mean snout vent length, SVL = 85.0 mm ± 6.6 *SD,* range = 73-96; six adult males, mean SVL = 87.5 mm ± 7.4 *SD*, range = 77-98 mm; 13 juveniles, mean SVL = 63.5 ± 4.0 *SD*. range = 58-71 mm and 15 neonates, mean SVL = 36.3 mm ± 3.0 *SD*, range = 30-39 mm) were examined from the herpetology collection of the Natural History Museum of Los Angeles County (LACM), Los Angeles, California (Appendix I). Lizards were collected 1961 to 1992.

The left testis was removed from males and the left ovary was removed from females for histological examination. Enlarged follicles (> 4 mm length) were counted. Tissues were embedded in paraffin and cut into sections of 5 µm. Slides were stained with Harris hematoxylin followed by eosin counterstain (Presnell and Schreibman 1997). Slides of testes were examined to determine the stage of the spermatogenic cycle. Slides of ovaries were examined for the presence of yolk deposition or corpora lutea. Histology slides were deposited in LACM. An unpaired *t*-test was used to

compare *L. flavimaculatum* male and female mean body sizes and chi-square test was used to compare ratios of males versus females (Instat, vers. 3.0b, Graphpad Software, San Diego, CA).

No significant size difference was detected between *L. flavimaculatum* males and females (unpaired *t*-test, $t = 0.82$, $df = 30$, $P = 0.42$). Two stages were present in the testicular cycle of *L. flavimaculatum* (Table 1). (1) Recrudescence: occurs prior to the onset of spermiogenesis (sperm formation). Secondary spermatocytes and spermatocytes are the predominant cells; (2) Spermiogenesis in which the seminiferous tubules are lined by clusters of spermatozoa and/or metamorphosing spermatids. The smallest reproductively active male (in recrudescence) measured 77 mm SVL (LACM 131097) and was from August. My samples are too small to completely elucidate the seasonal testicular cycle of *L. flavimaculatum* as one each spermiogenic male came from Limón and Heredia Provinces, nevertheless these preliminary data indicated a late-summer to autumn period of sperm formation. This appears similar to the timing of the testicular cycles of other species of *Lepidophyma*: *L. gaigae* (Goldberg and Camarillo-Rangel 2003), *L. sylvaticum* (Ramírez-Hernández 2003, Ramírez-Bautista *et al.* 2008) and *L. pajapanensis* (Méndez-de La Cruz *et al.* 1999) in which males are reproductively active in summer to autumn. It thus appears from my results and other studies on congeneric species that *Lepidophyma* males undergo a late-summer to autumn period of sperm formation This timing differs from males of the xantusiid lizards, *Xantusia vigilis* (Zweifel and Lowe 1966) a desert species, and *Xantusia riversiana* (Goldberg and Bezy 1974), an island species in which mating occurs in spring.

Yolk deposition in *L. flavimaculatum* commences in spring and continues into late summer (Table 2) when males are producing sperm. Twelve of the August females in Table 2 were from the same locality, Hacienda Tapezco, 29 km W Tortugero in Límon Province. Seven of these exhibited quiescent ovaries with no yolk deposition. Five were in early yolk deposition. One female (LACM 159177) from Heredia Province collected in January contained 4 enlarged follicles > 5 mm diameter suggesting young would have been produced late that spring. This is the only clutch I can report. *Lepidophyma flavimaculatum* from Panama produce 4-8 young that measure 35-38 mm SVL (Telford and Campbell 1970, Alvarez del Toro 1982). This is in agreement with Telford and Campbell (1970) who reported *L. flavimaculatum* in Panama are born in late April-early June around the start of the wet season and June or July in Chiapas, Mexico (Alvarez del Toro 1982). This occurs in other species of *Lepidophyma* which also produce young in spring (*L. tuxtlae* Castillo-Cerón and López-González, 1990; *L. lowei* Camarillo R., 1999; *L. sylvaticum* Ramírez-Hernández, 2003; *L. gaigae* Goldberg and Camarillo-Rangel, 2003). The smallest reproductively active females of *L. flavimaculatum* (both in early yolk deposition) measured 79 mm SVL (LACM 128547, 131092) and were from September and August, respectively. In Costa Rica, lizards of neonate size were collected in May to September.

**Table 1** - Monthly stages in the testicular cycle of six *Lepidophyma flavimaculatum* from Costa Rica.

| Month | *n* | Recrudescent | Spermiogenesis |
|---|---|---|---|
| June | 1 | 1 | 0 |
| July | 1 | 1 | 0 |
| August | 3 | 2 | 1 |
| October | 1 | 0 | 1 |

The sex ratio of six adult males and 26 adult females was significantly different from the expected 50:50 ratio (chi squared = 12.5, $df = 1$, $P = 0.0004$). This may suggest that at least some of the *L. flavimaculatum* females from Costa Rica are parthenogenetic. My findings of

**Table 2 -** Monthly stages in the ovarian cycle of 26 *Lepidophyma flavimaculatum* from Costa Rica.

| Month | *n* | No yolk deposition | Early yolk deposition | Follicles > 4 mm |
|---|---|---|---|---|
| January | 2 | 1 | 0 | 1 |
| March | 1 | 1 | 0 | 0 |
| April | 1 | 1 | 0 | 0 |
| May | 4 | 3 | 1 | 0 |
| July-August | 1 | 0 | 1 | 0 |
| August | 12 | 7 | 5 | 0 |
| September | 5 | 4 | 1 | 0 |

a reduced frequency of males in Costa Rica suggests either a patchwork of parthenogenetic and sexual populations or replacement of sexual populations by parthenogentic populations. Similar sex ratio bias toward females has been reported for *L. flavimaculatum* in Panama (Telford and Campbell 1970), *L. reticulatum* (Bezy 1989) and *L. tuxtlae* from Veracruz, Mexico (Castillo-Cerón and López González 1990).

The presence of 15/23 (65%) non-reproductive females (no yolk deposition) of adult size (May-September) during which time other *L. flavimaculatum* females are depositing yolk indicates only a portion of the female population reproduces each year. This was also reported in *X. riversiana* (Goldberg and Bezy 1974) and also occurs in *Xenosaurus grandis* in Mexico (Ballinger *et al.* 2000), but is more typical of lizards living in very harsh environments (Cree and Guillette Jr. 1995, Boretto and Ibargüengoytía 2006, Ibargüengoytia and Casalins 2007).

Utilization of museum specimens to gather reproductive data is becoming increasingly important as it is very difficult to obtain permission to collect monthly samples of native populations from the same locality. This is particularly true for secretive species like *L. flavimaculatum,* collection of which, results in habitat destruction. Also, localized variations in the reproductive cycle will likely not be detected from examination of museum specimens since the investigator must work with available materials.

In summary, *L. flavimaculatum* in Costa Rica may consist of a mixture of sexually reproducing and parthenogenetic populations (based on female-biased sex ratios), mating occurs in late summer, females produce live young in late spring at the beginning of the wet season, and only a portion of females produce offspring in a given year. This reproductive cycle is similar to that in other tropical xantusiids.

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**Appendix I –** *Lepidophyma flavimaculatum* from Costa Rica (by province) examined from the herpetology collection of LACM.

Alajuela: 114858, Guanacaste: 137449, 159156, Heredia: 128538, 128539, 128541, 128547, 128549, 128555, 128556, 128558, 159146, 159150, 159152, 159155, 159158, 159159, 159168, 159177, 159179-159181, Limón: 131086-131088, 131092-131102, 131104, 131108-131111, 132392, 159153, 159161, 159163, 159164, Puntarenas: 72323, 76161-76169, 106794, 159140-159142.