Erythrolamprus poecilogyrus (Wied-Neuwied, 1825) the Yellow-bellied Liophis: captive husbandry observation of amphigonia retardata (or sperm storage).

DARIO DOMENEGHETTI

Department of Biology, University of Rome, "Tor Vergata", Via della Ricerca Scientifica, I 00133 Rome, Italy.
Email: dario.eco.domeneghetti@gmail.com

INTRODUCTION

Erythrolamprus poecilogyrus (Wied-Neuwied, 1825), the Yellow - bellied Liophis, is a South America snake species belong to the family Dipsadidae. *Erythrolamprus* genus currently comprises 50 recognised species. *E. poecilogyrus* occurs in South America from South-Eastern Venezuela and Eastern Guyana to the Argentinian Pampas and Chaco. There are about four recognized subspecies due to the species great variability in colour patterns, and in meristic and morphological traits throughout its distribution (Alencar & Nascimento, 2014). Despite its widely distribution, the ecology and life history of this species are poorly known. In the literature there are a few natural history notes about reproduction (Pinto & Fernandes, 2004; Quintela, 2013) with the most comprehensive study by Alencar & Nascimento (2014). This species is active both during the day and night. It is partially terrestrial, but if necessary can be a skilled swimmer that looks for food in freshwater habitats. It is oviparous and feeds mainly on anurans of the family Bufonidae, Leptodactylidae and Hylidae, juveniles feed moostly on tadpoles and insects (Pinto & Fernandes, 2004; Prieto et al., 2012). This species is commonly kept in captivity and breeding events are apparently frequent. In this paper sperm storage in a captive female *E. poecilogyrus* is reported.

CAPTIVE HUSBANDRY

The observations in this study derive from a pair of captive breed *E. poecilogyrus*. Both were born in 2010 and the author acquired them from a German herpetoculturist in December 2013 when it is assumed they were already adults. The male measured 45 cm and weighed 47 g while the female (Fig.1) measured 70 cm and weighed 95 g. The couple was housed in a glass terrarium of 70×40×40cm. Half of the terrarium was heated to 28 °C by a heating plate with the other half mostly a large water tank where animals could swim and dive. The terrarium substrate had coconut fiber, branches, hiding places and a humid nest (hn) maintained at a moisture level higher than that of the rest of the terrarium by nebulising water every day. Individuals were fed with defrosted prey: *Atherina boyeri* every two or three days as freshwater fish and one or two time a month, pinky and fuzzy mice *Mus musculus*. During February 3 2014, about two months from the beginning of the observation period in the terrarium, the couple were observed mating for the first time during daylight hours with copulation lasting for about four hours. About one month later on March 5 2014, a clutch of 15 eggs were found in the hn. The eggs were removed from the terrarium and incubated at 27°C until hatching (the same treatment was followed for all successive clutches). The eggs were incubated in a plastic container within the incubator using Vermiculite mixed with water (ratio 2:1) as a substrate placing each egg in a small depression in the vermiculite (Radovanovic, 2011). A further and last mating was observed during March 7 2014. This event indicated that the female, only a few days after depositing eggs was already receptive to mating. In addition, the female never ceased to feed both before and after egg deposition. During April 4 2014, we found the male dead for unknown reason. However, the female

Figure 1. *E. poecilogyrus* adult female. This is the individual showing amphigonia retardata and reported in this note.

Figure 2. *E. poecilogyrus* newborn with the typical colour pattern of the juveniles of this species.

Date	Event	Eggs Clutch
03.02.14	Breed 1	
05.03.14	Eggs deposition 1	15
07.03.14	Breed 2	
04.04.14	Male death	
12.04.14	Eggs deposition 2	14
02.05.14	Born 1	
16.05.14	Eggs deposition 3	14
03.06.14	Born 2	
11.06.14	Eggs deposition 4	15
04.07.14	Born 3	
26.07.14	Eggs deposition 5	15
04.08.14	Born 4	
07.08.14	Eggs deposition 6	12
26.09.14	Born 5	
12.10.14	Eggs deposition 7	10
29.10.14	Born 6	
29.11.14	Born 7	

Table 1. Date, type of biological event and number of eggs in each deposition from the *E. poecilogyrus* couple.

continued to lays eggs, more or less once a month (Table I), to the last deposition on October 12 2014 without any contact with a male. From the first deposition on the March 5 to the last, in October, the female laid a total of 95 fertile eggs. The progeny were housed in small plastic containers (5-6 snakes to a single container) with coconut fiber as substrate, hiding place, a little water tank and they were fed with small pieces of *A. boyeri*. The new born (Fig.2) were up to 10 cm in length but with different colouration and body patterns from the adults. While the latter are uniformly black on the back and pale yellow on the ventral scales (Fig.1), the juveniles had a dorsal colouration of black and brown, marked with black spots that gradually fade towards the terminal part of the body with the ventral scales white/pale yellow. After a few months newborn have been gradually distributed to the Italian and European herpetoculturist community. It is suggested that this captive breeding observation is a case of amphigonia retardata. Also called sperm storage or delayed fertilization, this phenomenon has been described frequently in reptiles, in turtles and snakes in particular. This adaptation allows a female to produce several clutches from a single mating in one season. The viability of the stored sperm is not indefinite and varies with the species, ranging from several months to six years (Ballard & Cheek, 2013). The females of many types of reptiles have specialized structures for storing sperm suggesting that selection for sperm storage has operated on females (Birkhead & Møller, 1993). In snakes, this kind of mechanism is quite common and it has been observed in many species: pythons and boas (Ross & Marzec, 1990); rattlesnake (Matison, 1998); several rat snakes species (Radovanovic, 2011); European grass snake (Kabisch, 1999) and has been studied in wild populations of vipers (Luiselli, 1993; Höggren & Tegelström, 1996).

CONCLUSIONS

A total of 95 eggs were obtained from a single female of *E. poecilogyrus* from just two breeding events, in a time period of only ten months. As indicated in Table 1, the number of eggs remained reasonably constant for the first five events of eggs deposition (15 and 14 eggs), but then there was a slight decrease (10 and 12 eggs) in the last two clutch deposition events. Interestingly, all eggs were fertile and hatched and the female never ceased to feed during this time period, except during the moult. These observations might suggest that *E. poecilogyrus* is also an "income breeder", fueling reproductive expenditure by simultaneous feeding (Bonnet et al., 1998; Stephens et al., 2009). The ecological conditions that this species experiences throughout its geographic range, for example an abundance of fish and amphibians in its habitat (Pinto & Fernandes, 2004), could support the income breeding adaptation. Amphigonia retardata could be an ecological adaptation for particular habitat conditions where male–female encounters are infrequent. However it is recognised that captive observations do not necessarily reflect those in natural conditions and behaviour may be distorted in captive environments. For example, optimal temperatures in captivity and regular food source could explain the large number of fertilized eggs produced by the female from two breeding events.

ACKNOWLEDGEMENTS

The author would like to thank Giulia Severi for the help in the observations and for the husbandry of the animals. Laura Alencar and Daniel Fernandes have provided information and support. Luca Luiselli, Marco A. L. Zuffi and an anonymous reviewer helped improve an earlier version of the manuscript.

REFERENCES

Alencar, L.R.V. & Nascimento, L.B. (2014). Natural history data of a common snake suggest interpopulational variation and conservatism in life history traits: the case of *Erythrolamprus poecilogyrus*. *Herpetological Journal* 24: 79-85.

Ballard, B. & Cheek, R. (2013). *Exotic Animal Medicine for the Veterinary Technician*. John Wiley & Sons, 520 pp.

Birkhead, T.R. & Møller, A.P. (1993). Sexual selection and the temporal separation of reproductive events: sperm storage data from reptiles, birds and mammals. *Biological Journal of the Linnean Society* 50: 295-311.

Bonnet, X. Bradshaw, D. & Shine, R. (1998). Capital versus income breeding: an ectothermic perspective. *Oikos* 83: 333-342.

Höggren, M. & Tegelström, H. (1996). Does long-term storage of spermatozoa occur in the adder (*Vipera berus*)? *Journal of Zoology* 240: 501-510.

Kabisch, K. (1999). *Natrix natrix* (Linnaeus, 1758) – Ringelnatter In: *Handbuch der Reptilien und Amphibien Europas 3/IIA*: Schlangen II, Ed. W. Böhme – Wiebelsheim, Aula–Verlag, pp. 513–580.

Luiselli, L. (1993). Are sperm storage and within-season multiple

mating important components of the adder reproductive biology? *Acta Oecologica* 14: 705-710.

Mattison, C. (1998). *The Encyclopedia of Snakes*. UK: Blandford, 288pp.

Pinto, R.R.& Fernandes, R. (2004). Reproductive biology and diet of *Liophis poecilogyrus poecilogyrus* (Serpentes, Colubridae) from southeastern Brazil. *Phyllomedusa* 3: 9-14.

Prieto, Y.A. Giraudo, A. R. & López, M.S. (2012). Diet and Sexual Dimorphism of *Liophis poecilogyrus* (Serpentes, Dipsadidae) from the Wetland Regions of Northeast Argentina. *Journal of Herpetology* 46: 402-406.

Quintela, F.M. (2013). *Liophis poecilogyrus* (Yellow-bellied Liophis). Copulation. *Herpetological Bulletin* 123: 28.

Radovanovic, A. (2011): Captive breeding, egg incubation and rearing of the red-tailed ratsnake *Gonyosoma oxycephala*. *Herpetological Bulletin* 116: 27-30.

Ross, R.A. & Marzec, G. (1990). *The Reproductive Husbandry of Pythons and Boas*. Stanford: Institute for Herpetological Research. 270 pp.

Stephens, P.A. Boyd, I.L. McNamara, J.M. & Houston, A.I. (2009). Capital breeding and income breeding: their meaning, measurement, and worth. *Ecology* 90: 2057-2067.

Accepted: 16 July 2015