SALAMANDRA	43	1	52-56	Rheinbach, 20 February 2007	ISSN 0036-3375

On the husbandry and reproduction of *Blanus cinereus* (Vandelli, 1797) (Squamata: Amphisbaenia) in captivity

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Abstract. Seven *Blanus cinereus* of unknown sex ratio were kept together in captivity for three years. Accounts of captive husbandry and anecdotal observations on general and feeding behaviour are given. During the third year in early October, three juveniles (78-92 mm; 0.91-1.11 g) and seven eggshells were found. It is suggested, by interpretation of grouping of the eggs found, that one clutch of three eggs and two clutches of two eggs each were laid and that conspecific predation on juveniles or rather eggs occurred.

Key words. Captive reproduction; clutch size; feeding behaviour.

Amphisbaenia are elongate, limbless and permanently fossorial squamates with still controversial placement within squamate phylogeny (for review see Gans 1978, Kearney 2003) and are perhaps the least known group of reptiles. The genus *Blanus*, consisting of four species (Busack 1988), is the only European taxon among the family Amphisbaenidae with the species *Blanus cinereus* (Vandelli, 1797) distributed throughout the Iberian peninsula (Busack 1988, Salvador 1981). Little is known about the reproductive biology of *B. cinereus* (Salvador 1981, Gil et al. 1994), as with all amphisbaenians (Carr 1949, Papenfuss 1982, Colli & Zamboni 1999, Vega 2001).

Amphisbaenians are rarely kept in captivity. The few reports on captive amphisbaenians refer to their husbandry (Obst 1959, Wicker 1987, Malkmus 1991) or reproduction of a viviparous species (Goetz 2005) and to my knowledge there are no publications on captive reproduction of an egg laying amphisbaenian. Here, I report on the captive husbandry of *B. cinereus* over a period of three years, and the reproduction in captivity during one season.

Seven wild-caught individuals were collected in 1999 and 2000 in Andalusia, Spain. All animals were between 14.5 cm and 23.5 cm in length, and so were considered adult (Gil et al. 1994). The sexes of the individuals could not be determined.

All animals were housed together in a glass tank measuring 170x70x65 cm. The substrate of sandy soil, about 30 cm deep, was constantly kept humid in one half. The auditory system of amphisbaenians is highly adapted to perceive the faintest groundborne vibrations (e.g. Gans 1974, Gans & Wever 1975). In order to enhance the possibility of reproduction, I tried to minimise disturbances and stress to the animals, and the enclosure was therefore located in a secluded, climate-controlled room and people entered the room only briefly to service the animals. Room temperatures were constant at 24 °C throughout the year (day and night). Artificial lighting was 12/12 hours (day/night) using fluorescent tubes. Spot-lights provided temperatures up to 32 °C under stones located directly under the spots. Temperatures in the substrate away from the spotlights were similar to room temperature, around 24 °C. "Mealworms" (*Tenebrio molitor*), their pupae and freshly killed crickets (*Achaeta domestica* and *Gryllus assimilis*) of all stages were offered for food twice a week under stones.

The crickets were killed so they would stay under the stones where they could easily be taken by the emerging *Blanus* and controlling of the feeding would be much easier. The animals were checked simply by lifting the stones under which they were frequently found, but were not disturbed otherwise. The only times that they were dug out and therefore more intensively handled was when they were transferred into hibernation. This took place from mid-November until the end of March at 7-11 °C in small plastic buckets filled with humid peat moss, a stone and about half a centimeter of water on the bottom to increase humidity.

During the day, individuals were frequently found under the stones with encounters reaching a peak around mid-day when the stones had just heated up and declining during the afternoon. Whenever the animals were dug out and not caught under the stones, they were almost always found in the most humid areas of the substrate. Shed skins were found frequently under stones as well as in all parts of the substrate. All skins were torn, found in large pieces and often split open longitudinally. Due to the secrecy of the animals, feeding behaviour was only observed directly on two occasions and therefore was largely inferred. Whereas "mealworm"-pupae, their larvae and cricket-larvae left under the stones disappeared and could not be retrieved from near tunnels (so were probably eaten whole), adult crickets were often found left under the stones with a hole bitten in the abdomen and the cutis hollowed out (Fig. 1A). This observation was supported on both occasions when feeding was observed; the amphisbaenian emerged from a tunnel under a stone, chewing on the abdomen of a large adult cricket (Fig. 1B), apparently sucking out the content of the prey's body. This feeding method supports both, the suggestion of Gans (1969, 1974) that their occluding tooth rows enable amphisbaenians to bite pieces off larger prey, as well as the extended chewing of food observed by Malkmus (1991).

A confirmed copulation was never recorded although two individuals were observed in what was suspected to be courtship. These animals were found on 5 May 2000 around mid-day under a heated stone, their bodies loosely coiled around each other and one individual biting the other in the side of the first third of the body. On October 3, 2001, three juvenile *B. cinereus* were found in the enclosure. A thorough search through the substrate revealed several eggshells. These were in three groups and found near each other at the base of the enclosure where the substrate remained constantly humid. The temperature at that spot was 24 °C (± 1 °C), day and night. Although the eggs were not glued together, they were grouped in three clusters of three, two and two eggs. Whereas the eggs within a cluster nearly touched each other, each cluster was separated from another cluster by at least 2.5 cm, suggesting they were different clutches (see below). The eggshells in the three-egg clusters were all complete, but with horizontal incisions part-way around the egg, the top and bottom remaining joined. Two were completely empty, one contained a small yolk remnant.The eggs in one two-egg cluster were both lacking their apical tips and were empty, suggesting preda-

Tab. 1. Measurements of juveniles and eggs of *Blanus cinereus*. See text for validity of numbers and difficulty in assigning eggs to juveniles.

	infertile egg	infertile egg	empty shell	empty shell	hatched egg	hatched egg	hatched egg
egg size [mm × mm]	26 × 8	25 × 8	25 × 12	20 × 14	22 × 15	23 × 12	26 × 14
hatchling total length	–	–	–	–	87 mm	90 mm	92 mm
hatchling weight	–	–	–	–	0.92 g	0.91 g	1.11 g

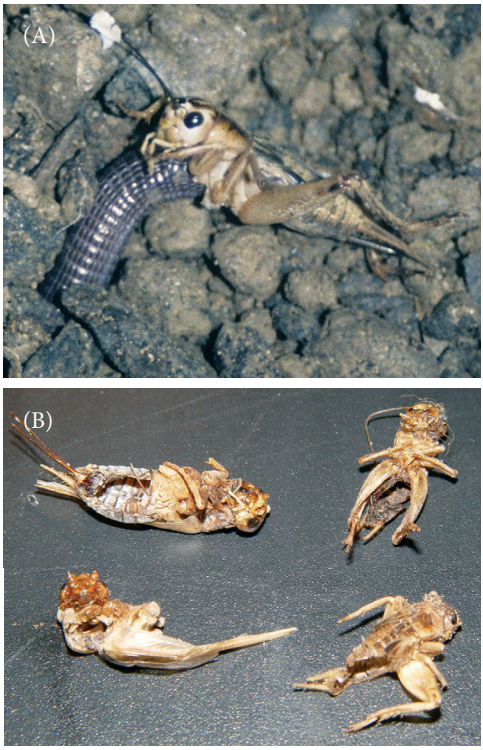

Fig. 1. A sample of hollowed out food crickets found under the stones. (A) *Blanus cinereus* feeding on a cricket with its head inside the cricket's abdomen; (B) leading to the hollowed out crickets shown.

tion by an adult prior to hatching as no traces of more juveniles or carcasses were found. The two eggs in the second two-egg cluster were presumably infertile as they were dried out and contained a hard cheesy mass (Fig. 2). The eggshell was very thin, smooth and of leathery consistence. For size and shape see Fig. 2, measurements are given in Table 1 (but see comments on validity of measurements below). In order to give more accurate data regarding measurements, the dried-out eggshells were soaked in tap water for two days prior to measuring. However, the yolk of the two infertile eggs was too dried up and the eggs could not be stretched out. Measurements for these two eggs are therefore very imprecise. The three juveniles found resem-

Fig. 2. Eggs and egg shells of *Blanus cinereus* as explained in the text. Top row: dried out, presumably infertile. Middle row: empty shells, possibly predated on. Note missing apical tips best seen on right hand egg shell. Bottom row: empty shells, note incision best seen in right hand egg shell.

bled the adults in colour, although the vestigial eyes were much more visible under the skin, as were the intestines, which shone through the ventral skin. The initial measurements are given in Table 1. Measurements were taken with a standard ruler to the nearest mm after the animals crawled into a thin, transparent tube and relaxed enough to lay fully streched out. Weight was determined with a Pezola digital scale. Housing of the juveniles was similar to that of the adults, although in smaller enclosures (30 x 20 x 20 cm) and rearing these animals with husbandry parameters and feeding as described for the adults posed no problems.

When the juveniles were found, it was unclear whether they had hatched a few days or even weeks before. There was no yolk sac remaining, the umbilical area was fully closed and the juveniles had shed at least once. Aditionally, the juveniles, when found, were longer than the 78-86 mm given as the length for hatchlings by Gonzalez de la Vega, cited in Salvador (1998). The same source gives measurements for eggs at 4.8-5.3 mm x 26.6-29.2 mm which is significantly bigger than the measurements obtained from the open, dried-out eggs found in the enclo-

sure. Therefore, it is likely that even soaking the eggshells prior to measuring could not extend the shells to their original size, so the numbers given in Table 1 should not be taken as valid egg sizes.

Unfortunately, having kept seven individuals together, and without knowing the sex ratio, it is not possible to conclusively determine clutch sizes. However, the three patches of eggs as described above (two clutches of two eggs and one clutch of three eggs) suggests clutch sizes for *B. cinereus* between one and at least three eggs. Most previous publications state clutches of single eggs (Stemmler, 1971, Salvador, 1998) with the exception of Gil et al. (1994) who suggest a more variable clutch size after finding two oviductal eggs in one female. Taking into consideration the relatively low energy requirements of *B. cinereus* (Lopez et al. 1991), it is possible that the relatively low competition for a high abundance of food in captivity made it possible for the females to produce larger clutches.

As suggested above, one clutch of two eggs was either predated on during incubation, or the emerging hatchlings were attacked by adults, as no traces of carcasses could be found. The conspicuous opening on the apical tip of both eggs with the end piece missing suggests the predation of the eggs, possibly consumed in the same manner as the large crickets. Whether this possible predation on eggs is a common behaviour which would fit in with the opportunistic feeding pattern of *B. cinereus*, or whether it is due to captive circumstances remains to be investigated.

Acknowledgements

I would like to thank W. Maier for facilitating one field trip to Spain and for the opportunity to use the premises of the Department of Systematic Zoology, University of Tübingen, Germany, as well as P. Bernstein, Y. Pavlista and T. Moritz who cared for the animals during my absences. I am grateful to the Conserejeria de Agricultura y Medio Ambiente, Merida, Spain for granting permission to collect animals and S. Lötters, J. Louch and Heiko Werning for their appreciated comments on the manuscript.

References

Busack, S. D. (1988): Biochemical and morphological differentiation in Spanish and Moroccan *Blanus* and the description of a new species from southern Morocco (Reptilia, Anphisbaenia, Amphisbaenidae). – Copeia, **1988**: 101-109.

Carr, A. (1949): Notes on eggs and young of the lizard *Rhineura floridana*. – Copeia, **1949**: 77.

Colli, R. C. & D. S. Zamboni (1999). Ecology of the worm-lizard *Amphisbaena alba* in the Cerrado of central Brazil. – Copeia, **1999**: 733-742.

Gans, C. (1969): Ringelechsen (Amphisbaenen) – grabende Reptilien. – Endeavour, **28**: 146-151.

Gans, C. (1974): Biomechanics: an approach to vertebrate biology. – Lippincot (Philadelphia).

Gans, C. (1978): The characteristics and affinities of the Amphisbaenia. – Transactions of the Zoological Society of London, **34**: 347-416.

Gans, C. & E. G. Wever (1975): The amphisbaenian ear: *Blanus cinereus* and *Diplometopon zarudnyi*. – Proceedings of the National Academy of Science, **72**: 1487-1490.

Gil, M. J., F. Guerrero & V. Perez-Mellado (1994): Clutch size and reproductive frequency of *Blanus cinereus* in central Spain. – Acta Biologica Cracoviensia Series Zoologia, **36**: 37-40.

Goetz, M. (2005): Zur Haltung und Nachzucht der Schachbrett-Doppelschleiche *Trogonophis wiegmanni* Kaup, 1830 (Squamata: Amphisbaenia: Trogonophidae). – Sauria, **27**:27-31.

Kearney, M. (2003): Systematics of the Amphisbaenia (Lepidosauria: Squamata) based on morphological evidence from recent and fossil forms. – Herpetological Monographs, **17**: 1-74.

Lopez, P., J. Martin & A. Salvador (1991): Diet selection by the amphisbaenian *Blanus cinereus*. – Herpetologica, **47**: 210-217.

Malkmus, R. (1991): Zur Aktivitätsrhytmik der Netzwühle *Blanus cinereus*. – Nachr. Naturwiss. Museum Aschaffenburg, **98**: 79-91.

Obst, F. J. (1959): Ringelechsen. – Aquarien-Terrarien, **6**: 48.

Papenfuss, T. J. (1982). The ecology and systematics of the amphisbaenian genus *Bipes*. –

Occasional Papers of the Californian Academy of Scicience, **136**: 1-42.

Salvador, A. (1981): *Blanus cinereus* (Vandelli 1797) Netzwühle. – pp. 277-289 in: Böhme, W. (ed.): Handbuch der Reptilien und Amphibien Europas. Band 1, Echsen (Sauria). – Aula Verlag, Wiesbaden.

Salvador, A. (1998): Familia Amphisbaenidae Gray, 1825. – pp. 333-339 in: Andreu, A., A. Bea, F. Brana, P. Galan, L. F. Lopez-Jurado, V. Perez-Mellado, J.M. Pleguezuelos & A. Salvador (eds.): Fauna Iberica, Vol. 10, Reptiles. – Museo National de Ciencias Naturales, Madrid.

Stemmler, O. (1970): Beobachtungen an marokkanischen Schachbrettschleichen, *Trogonophis wiegmanni* Kaup 1830 (Amphisbaenia, Trogonophidae). – Aquarien-Terrarien **17**(10): 343-347.

Vega, L. E. (2001): Reproductive and feeding ecology of the amphisbaenian *Anops kingii* in east-central Argentinia. – Amphibia-Reptilia, **22**: 447-454.

Wicker, R. (1987): Handwühlen in Frankfurt. – Naturwissenschaftliche Rundschau, **40**: 197-198.

Manuscript received: 8 August 2005

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