Ecological data on road killed *Amphisbaena alba* Linnaeus, 1758 (Squamata, Amphisbaenidae) in southeast Brazil

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ABSTRACT - Vehicles running over vertebrates has been an increasing challenge to the local conservation of some herpetofauna. The Amphisbaenidae are fossorial reptiles which are poorly known ecologically. Biological and natural history data were obtained from three specimens of *Amphisbaenia alba* that were found dead along 8320 km survey of highways. The rarity of road kill and the importance of the species conservation are discussed.

THE mortality of wild fauna caused by road traffic has been a problem in the developed and developing country motorway systems around the world (Saeki & Macdonald, 2004). It has long been considered a challenge for local conservation of many species due to negative trends in species populations that are aggravated by humancentric expansion and global economic growth (Seiler 2003; Forman et al., 2003).

According to Hels & Buchwald (2001) the impact of highways on fauna can be seen in two ways; directly, when animals are run over and killed, and indirectly, through the fragmentation and isolation of populations. The killing of anurans *Pelobates fuscus* Wagler, 1830, *Rana temporaria* Linnaeus, 1758 and *Rana arvalis* Nilsson, 1842 by vehicles in Denmark resulted in mortalities of up to 21-25% (Hels & Buchwald, 2001). Ehmann & Cogger, (1985) also report approximately 5.5 million reptiles and amphibians are killed every year on Australian highways.

Amphisbaena alba Linnaeus, 1758 is a Squamate lizard of the Amphisbaenidae and is distributed from Panama through Venezuela and the Guianas, Colombia, Peru and Bolivia, east of the Andes, to Brazil, north of Paraguay, Trinidad and the Guianas (Gans, 1962). The species is among the largest of the amphisbaenians. It has the widest distribution among them and it has been suggested that it may comprise a complex of species (Gans, 1962).

A. alba diet was recorded by Colli & Zamboni (1999) and data about their biology and reproduction was studied in captivity by Andrade et al. (2006). The species has been noted from few studies of road kill events in Brazil (Prada, 2004; Rodrigues et al., 2002). Despite numerous studies on the systematics and anatomy of amphisbaenians (Vanzolini, 1955, 2002; Gans 1962, 2005; Barros-Filho & Valverde, 1996; Jared et al., 1999; Kearney, 2002) data on the ecology and natural history of many species are still scarce. The current study obtained information on the habits, occurrence and morphometrics of three *A. alba* using road kill specimens from an area of Brazilian savanna (Cerrado).

MATERIAL & METHODS

The three samples were collected during a study on vertebrate road kill by highways. Highway MG-428 which hems the National Park of Serra da Canastra in Sacramento, state of Minas Gerais (19º49' S 47º16 W) and SP-334 beside Furnas do Bom Jesus State Park, in Pedregulho, state of São Paulo (20º10' S 47º28 W), southeast Brazil were studied. The highways were travelled weekly by car at an average speed of 60 km/h (January-December 2007; n = 52 days, 8320 Km) aiming to record vertebrates that were run over within a

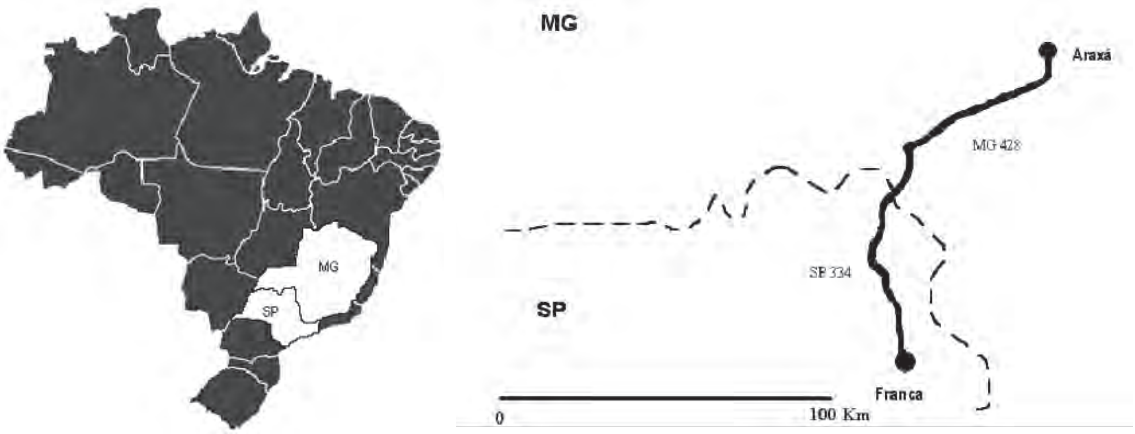

Figure 1. Location of the highways in the study, MG-428 and SP-334, MG-Minas Gerais State and SP-São Paulo State.

section of 160 km between the cities of Franca-SP and Araxá-MG (97 km on the MG-428 and 63 km on the SP-334) in the southeast of Brazil (Fig. 1).

The specimens of *A. alba* were collected, placed in plastic bags and brought to the Laboratory of General Biology of the Institute of Sciences and Health in the University Center of Araxá (UNIARAXÁ - MG, Brazil). In the laboratory, the weight of the carcass (WC) was obtained by using a digital weighing scale (+/- 10 g) and measurements of snout-vent length (SVL), and tail length (TL), were taken with the aid of a measuring tape (mm). The pre-cloacal pores of each specimen were counted and their standard deviation determined. Animals were then dissected and sexed by inspection of the gonads. The digestive tube was opened longitudinally and the content was taken out and washed through with tap water over a sieve (mesh 0.5 mm).

A triage was made with the aid of a stereomicroscope (4 x amplification, Zeiss™)to separate the different items ingested into groups of invertebrates to Class and Order. Each item was recorded according to the number of the present parts and identified as morpho-species, whenever possible. This method allowed the simultaneous consideration of the fragmentation of the mandibles of invertebrates, their size, and what occurred most frequently in the gut. The calculation of the proportions of the parts of the different items of invertebrates that were found was calculated from the formula:

$$P_i = F_i/N \times 100$$

P_i = proportion of the item, F_i = frequency of the item and N = total of items.

RESULTS

We found three specimens of *A. alba* that were run over. Two individuals (A and B) were collected on the same day, at the end of the rainy season in March (14/03/2007) at km 67 of the MG-428 (19º49'10" S and 47º16'11" W) and 450 of the SP-334 (20º09'56" S and 47º28'19" W) at altitudes of 938 and 983 m respectively. A and B were both found next to fragments of savanna vegetation and gallery forest. The third (C) on 30/11/2007 was found on km 63 of the MG-428 (19º49'11" S and 47º14'52" W) at an altitude of 910 m (Fig. 2).

The three specimens had complete tails, proving the non-occurrence of caudal autotomy, even after the likely impact of a vehicle running over them. The specimen from São Paulo did not present any external signs of injuries.

The measures obtained were: 85 g (WC), 505 mm (SVL), 40 mm (TL), 170 g (WC), 580 mm (SVL) and 40 mm (TL) for the specimens from MG and 390 g (WC), 655 mm (SVL) and 55 mm (TL) for that of São Paulo. Precloacal pores numbered

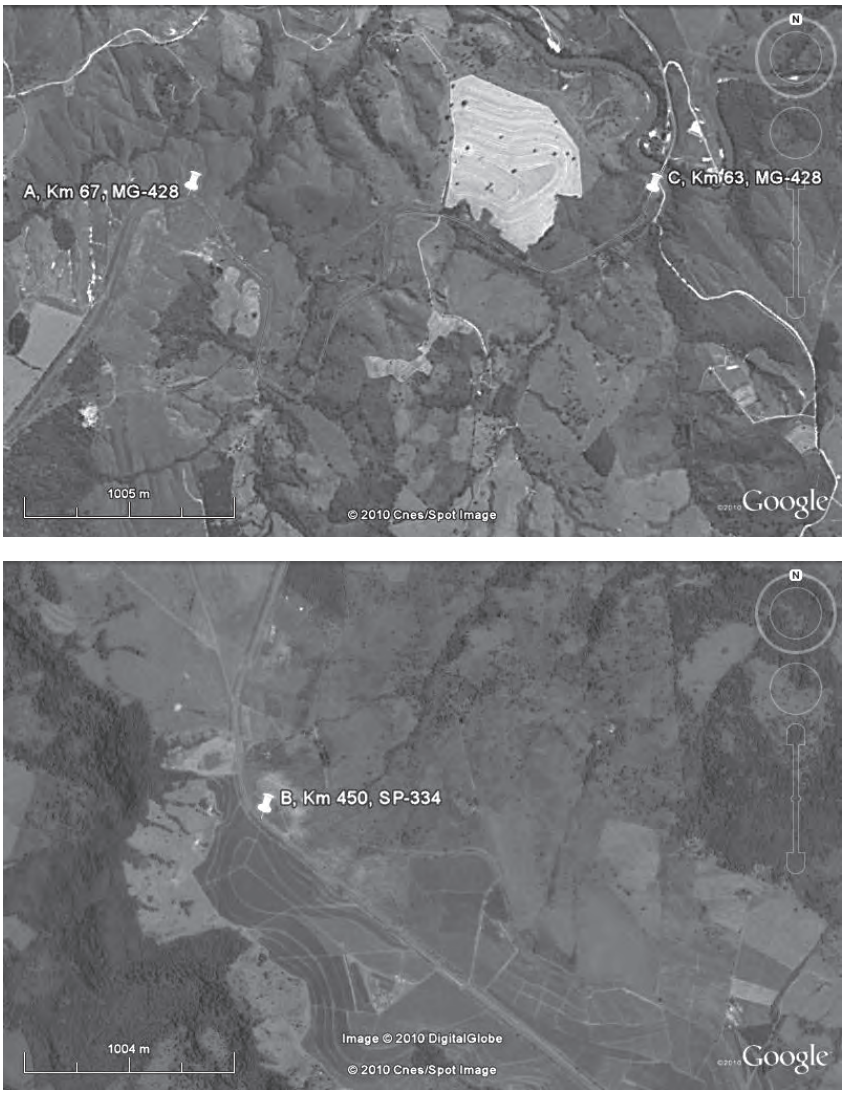

Figure 2. Images showing the geographic location of the three specimens collection; Above, MG-428 Highway, A and C specimens; Below SP-334 Highway, B specimen (Source: Google Earth™, 2010).

6-8 pores and cloacal 'plugs' were extracted from the specimen found on the highway in São Paulo. In the dissection it was possible to sex two individuals, one male, from Minas Gerais (C) and one female specimen from São Paulo (B).

The sample analysis of the digestive tube content from the São Paulo specimen exhibited: insects (59.5%), ants (Hymenoptera-32%), bugs (Coleoptera-19.5%) and crickets (Orthoptera-8%), unidentified invertebrates (28%), plant material (11.5%), Clitellata (1%) and worms (Haplotaxida; 1%). The remaining two specimens had empty digestive tubes.

DISCUSSION

It is intriguing that the specimens presented tails, even after the likely death shock caused by a vehicles. However, according to Gans (1962) refusal of caudal autonomy is a characteristic which differentiates *A. alba* from the other amphisbaenians.

The date that the two first specimens were

collected coincided with the reproductive period of the species in the Brazilian Cerrado and can also be related to periods of intense rain in their habitat, a seasonal period that promotes the soaking of soil and may encourage *A. alba* to exit from fossorial tunnels (Abe & Johansen, 1987) with consequent overland movement that could lead them to encounter a road. The female was sexually mature, with well developed eggs, possibly due to being found during the seasonal period of mating. Colli & Zamboni (1999) found two female specimens reproductively active in April. Their reproductive period is likely therefore to be at the end of the rainy season and the beginning of the dry season. The same authors also documented that 45.8% of the stomachs of 214 specimens that were analysed were empty.

The items in the diet that were recorded for specimens herein are much like those registered by Colli & Zamboni (1999) and the proportions found are also similar to the specimens' dietary composition in this study (ants 32%, bugs 19.5%, crickets and grasshoppers 8%, unidentified invertebrates 28%, plant material 11.5% [Colli & Zamboni, 1999]). The major differences between the finds are between crickets/grasshoppers, vegetal material and bugs. Such a dietary composition can result from the environment of roadside habitat and the generalist dietary habits of the species (Colli & Zamboni, 1999). In another encounter of a single specimen in Bahia, northwest Brazil, only nematode worms were recorded in the stomach (Barros-Filho & Valverde, 1996). However, as our sample data and the northwest study were obtained from one specimen, interpretation of the analysis should be viewed carefully and not considered a definitive dietary analysis for the species.

The amphisbaenians are fossorial reptiles that occur in various tropical regions of the globe. *Amphisbaena alba* is the largest species of the family with a wide distribution throughout south America (Pough et al., 1998). In studies from Brazil the species constituted only 0.5-1% of the total number of specimens encountered during reptile surveys (Prada, 2004). This highlights the low encounter rate expected for the species and how difficult it is to sample these fossorial reptiles, despite their wide geographical distribution. Two of the individuals found (B and C) are larger than the known average for the species (572 mm [Colli & Zamboni 1999]) and this factor may suggest that larger specimens have more probability of being killed in the wet season, although this is only a conjecture. Due to the difficulty in locating this species, it is expected that the occurrence of roadkill is likely a rare event. What also makes these encounters rare is that there are many scavenging animals that prey on corpses near roadsides and thus the likelihood of finding specimens could be considered very low.

We consider that the presence of *A. alba* close to highway shoulders could be associated with the occurrence of nests of cutter ants (*Atta* sp.) as this species is known to shelter inside ant nests (Riley et al., 1986). This theory is fortified by Vasconcelos et al. (2006) work that showed the presence of cutter ants using man made roads as corridors to colonise new areas in the central area of Brazil. Specimens of *Atta* sp. ants were also found in the digestive tube of one of the specimens.

Amphisbaena alba is poorly known by zoological science and information herein assists in documenting knowledge for the species. We therefore encourage other herpetologists to consider using more roadkill herpetofauna specimens to investigate the ecology and biology of species that are accidently killed in this manner.

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