Do rinkhals (Hemachatus haemachatus) choose to defecate near water?

Shirleen L. Lazenby \textsuperscript{a} \& Graham J. Alexander \textsuperscript{a}

\textsuperscript{a} Ecophysiological Studies Research Program, Zoology Department, University of the Witwatersrand, Private Bag 3, WITS, 2050, South Africa

E-mail:


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Short communication

Do rinkhals (*Hemachatus haemachatus*) choose to defecate near water?

SHIRLEEN L. LAZENBY AND GRAHAM J. ALEXANDER

Ecophysiological Studies Research Program, Zoology Department, University of the Witwatersrand, Private Bag 3, WITS, 2050, South Africa
e-mail: shirleen@gecko.biol.wits.ac.za

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Pheromones are present in excretory products (such as urine and faeces) as well as vaginal and cutaneous secretions, and this allows animals to make use of faeces to convey signals to conspecifics (Curio 1976). Although signalling mechanisms convey useful information to members of the same species, they may also expose the animal to possible predators or signal its presence to prey and therefore many animals have evolved mechanisms which remove tell-tale cues, including faeces, from their immediate environment (Alcock 1993). For example, the northern pike, *Esox lucius*, avoids alerting prey to their presence by defecating away from their hunting grounds (Brown et al. 1996).

The rinkhals, *Hemachatus haemachatus*, is a common southern African elapid occurring from sea level in the Cape to high altitudes in the Chimanimani mountain range of Zimbabwe (Branch 1988). Rinkhals feed on amphibians and small mammals and are in turn preyed upon by a variety of animals such as leguans (*Varanus* spp.), bullfrogs (*Pyxicephalus adspersus*), birds (e.g., eagles, hawks and ground hornbills) and small mammals (Branch 1988).

Van der Merwe & Alexander (1997) showed significant non-random trends in the spatial defecation patterns in a captive population of *H. haemachatus*. In their study, the snakes showed a strong trend towards defecation in or near the water dish in the cage. It was hypothesised that these trends could be the result of a predator avoidance strategy that operates to remove excreta as visual and chemical cues in the wild. However, their experimental design involved the removal of the entire water dish from the cages during control trials. They therefore controlled for the effect of the container as well as the water. We investigated the possibility that the spatial bias in defecation sites could involve other factors, such as a tactile trigger which stimulated defecation.

Nineteen *H. haemachatus* were captured in their natural habitat in Johannesburg and surrounding areas and maintained in captivity for over a year before experimental procedures commenced. Snakes were housed individually in 750 x 450 x 400 mm wooden cages so that any effects on behaviour caused by social interactions with other snakes were eliminated. Each cage was fitted with a glass sliding door allowing for easy access to, and observation of, the snakes. The snakes were maintained at 25 °C on a LD 12:12 h photocycle, for the duration of the study. Each snake was fed approximately 10% body mass in mice or 20% body mass in *Xenopus leavis* once a month, depending on previously shown dietary preferences. The floor of each cage was covered with newspaper and each snake was provided with a round water dish, a rock and an inverted 2 l plastic container as a shelter. The cages were arranged as shown in
Figure 1. Cage design used for the first experimental trial. The rock was removed in the second trial.

Since data were normally distributed (Lillifores' test for normality), differences in the number of defecations between quarters were tested using a parametric, two factor, two-way ANOVA with the individual snakes used as a blocking factor. This allowed us to test for significant differences in the proportion of defecations in different cage-quarters, as well as for significant differences between individual snakes. We used Bonferroni multiple paired comparisons to determine which cage quarters were significantly different. Sequential adjustments for multiple paired comparisons (Rice 1989) were applied where appropriate, in order to correct for Type I errors.

The effect of water on the site of defecation was tested for using paired sample t-testing of the arcsine transformed proportions of the times that the snakes defecated in the water dish when defecating in the water quarter. Arcsine transformed proportions were also used for t-testing of the effect of the rocks on the likelihood of defecation in the rock quarter. Significance was at the 95% level in all tests.

The individual identity of the snake had no significant effect on the location of defecation, whether rocks were present or absent ($F_{0.99,17} = 0.155, P < 0.695$). When rocks were present in

Data were collected in this way for two months. Data for each snake were pooled, generating a measure of proportion of times that each snake defecated in each quarter and these measures were arcsine transformed. We also tested for the effect that rocks in the cage had on the patterns of defecation. To do this, we removed the rocks and continued collecting data for a further two months.
the cages there were significant differences between the quarters (Fig. 2; $F_{0.99,3} = 39.556, P < 0.001$), with the proportions of defecations in the quarter containing the rock significantly greater than in the other three quarters ($P < 0.001$). Defecation frequency in the quarter containing the water dish was significantly greater than in the empty quarter ($P < 0.001$). Proportion of defecations was still significantly different between the quarters after rocks had been removed (Fig. 3; $F_{0.99,3} = 20.884, P < 0.001$), with the quarter previously occupied by the rock (now empty) and the quarter containing the water dish both having significantly greater defecation frequencies than the empty quarter ($P = 0.004$ and $P < 0.001$ respectively).

The presence of water had no significant effect on mean number of defecations in the water dish ($t_{0.99,18} = 0.958, P = 0.351$). Therefore, defecation in the water dish was equally likely when the dish contained water as when it was empty. The only region of the cage significantly affected by removal of the rock, was the quarter containing the rock, which showed a significant decrease in defecation frequency after the rock was removed ($t_{0.99,18} = 4.582, P < 0.001$).

We confirmed that defecation was indeed spatially non-random in captive *H. haemachatus* and in this regard, our results are in agreement with Van der Merwe and Alexander (1997). However, we also found a preference for defecating in the cage-quarter containing the rock as well as the one containing the water dish. Furthermore, the presence of water in the water dish had no significant effect on the site of defecation. Thus the hypothesis that water dictates where these animals defecate must be rejected.

Our snakes defecated significantly more often in the cage-quarter containing the water dish or rock. We propose that objects such as the rocks and the water dishes provide a tactile stimulus or may provide a mechanical aid to defecation for the snakes. By removing the water dish, Van der Merwe and Alexander (1997) removed the tactile stimulus and thereby decreased defecation frequency in this quarter. The rock and the water dish provide a surface which may cause the snakes to defecate through tactile stimulation.

The region of the cage containing the shelter was not favoured as a defecation site even though it contained a possible tactile stimulus. However, the shelter had rounded corners and was positioned in the corner of the cage and this may have restricted free movement of the snake over the object. Animals generally defecate away from their retreats as a predator avoidance mechanism (Carpenter & Duvall 1995). This may also prevent the introduction of parasites and disease into the area, and the snakes may avoid defecating in or near their shelters for the same reason.

We found that snakes continued to defecate in the cage-quarter containing the rock even after the rock had been removed. (Although defecation frequency in the same cage-quarter was significantly less following removal of the rock.) This surprising result may be due to habituation. Alternatively, snakes may defecate more frequently at the rear of their cages, where the rock was positioned, in response to the light gradient (the back of the cages was darker). Van der Merwe & Alexander (1997) showed a significant trend for snakes to defe-
cate at the back of the cage, possibly in response to differences in light intensity. Further work is needed to elucidate the relative roles of predators, light, and structural objects as trigger mechanisms on defecation site selection in *H. haemachatus*.

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