OBSERVATIONS ON BEHAVIOUR AND ENCLOSURE USE BY ZOO-CAPTIVE RETICULATED PYTHONS (*Malayopython reticulatus*)

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Introduction

The discussion of enclosure size for snakes is one that has been ongoing for almost as long as snakes have been kept in captivity, with modern keepers leaning towards a principle of "there is no maximum enclosure size," however in recent years, the discussion has turned towards the question: "Is there a minimum size?"[abcdefhj] Several studies have demonstrated that there are welfare benefits to larger enclosures, as well as to enclosures outfitted with enrichment, designed with a species' natural history in mind.[bdhj] However, many of these studies have focused on medium-to-large sized colubrid species (*H. gigas*, *L. madagascariensis*, *P. guttatus*), or examined a variety of species under the same parameters with little accounting for differences in natural history.[bdhj]

The reticulated python (*M. reticulatus*) is a species that is immensely popular in both zoo and private collections.[cgi] The longest snake species, *M. reticulatus* is known for its alertness and active disposition – especially relative to other giant boids, which are said to use very little of their enclosures.[cg] However, to date there has not been a study done on the captive behaviour and enclosure use of this species, nor of any other giant constrictor.

Aims and Objectives

This study is designed to investigate the behavioural repertoires of zoo-captive *M. reticulatus* and the extent to which they utilise enclosure space with the aim of providing evidence of the ways in which this species interacts with the captive environment. This evidence can then be used to better evaluate the needs of *M. reticulatus* in captivity, and the ways in which they can be met by keepers.

Hypotheses

- H_1 *M. reticulatus* will use a significant proportion of zones within their enclosure space.
- H_2 *M. reticulatus* will engage in significantly more active behaviours than inactive behaviours.
- H_3 *M. reticulatus* will demonstrate significantly more instances of mostly uncoiled postures (fully-stretched, outstretched, half-stretched) than in mostly coiled postures (semi-stretched, coiled)
- H_4 Male *M. reticulatus* will display significantly more active behaviours than females of the species.

Methodology

The study was undertaken at four zoological institutions (Crocodiles of the World, West Midlands Safari Park, ZSL London Zoo, and Paradise Wildlife Park), and was conducted by mounting ieGeek 360° cameras in four enclosures to continuously record footage of seven individuals over 21 days [Figure 1].

The study used four female and three male *M. reticulatus*, selected based on logistics and a minimum age of six years [Table 1]. Data was collected every ten minutes, with 144 behaviours and postures being recorded for each snake per day for a total of 1008 recordings per day.

The Spatial Partitioning Index (SPI), paired T-Tests, and Chi-Square Test of Independence were then used to perform statistical analysis in order to analyse zonation use and investigate the expression of differing postures as well as compare active and inactive behaviours by both individuals and groups.

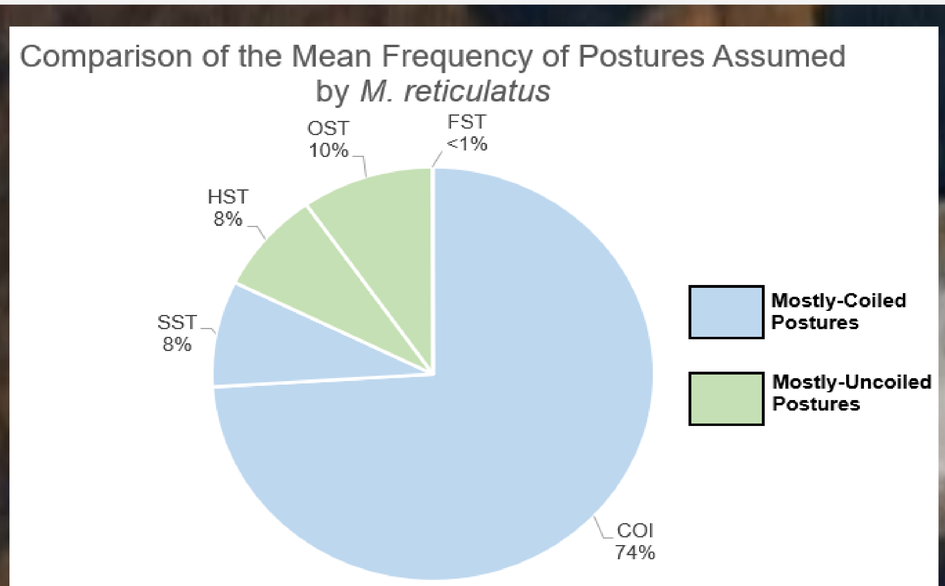

Figure 2. A pie chart comparing the mean frequency of mostly-coiled (coiled (COI) and semi-stretched (SST)) and mostly-uncoiled (half-stretched (HST), outstretched (OST), and fully-stretched (FST)) postures by M. reticulatus (created by author).

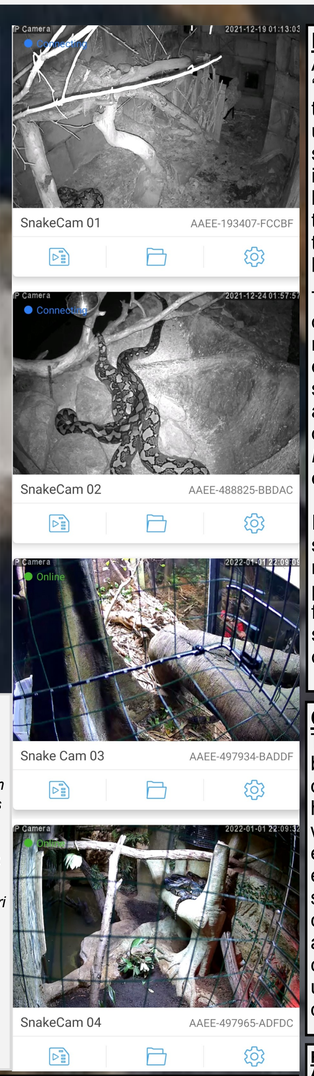

Figure 1. A screen-capture image of all four cameras as visible in the CamHipro app - from top to bottom: Retics 01-02 at Zoo 01 [1.1 at Crocodiles of the World], Retics 03-04 at Zoo 02 [0.2 at West Midlands Safari Park], Retic 05 at Zoo 03 [1.0 at ZSL London Zoo], and Retics 06-07 at Zoo 04 [1.1 at Paradise Wildlife Park] (created by author).

Table 1. A table showing the sex and ages for the seven M. reticulatus utilised in the study (created by author)

Individual	Call Name	Sex	Age
Retic 01	Adrian	Female	16 years
Retic 02	Rocky	Male	14 years
Retic 03	Nagini	Female	21 years
Retic 04	Two-Dot	Female	15 years
Retic 05	Apollo	Male	16 years
Retic 06	Rizla	Female	16 years
Retic 07	Tomshi	Male	16 years

Table 2. A dual-table showing two sets of data. On the left, the SPI numbers for each individual in the study. On the right, is the SPI number for each enclosure in the study, created using totals from all snakes in a given enclosure (created by author)

Individual	SPI	Institution	SPI
Retic 01	0.4	Zoo 01	0.32
Retic 02	0.49	Zoo 02	0.24
Retic 03	0.55	Zoo 03	0.23
Retic 04	0.5	Zoo 04	0.57
Retic 05	0.23		
Retic 06	0.42		
Retic 07	0.79		

Results

Figure 2 compares the mean occurrences of the five main posture categories observed in this study ('obscured' and 'unknown' excluded), and uses colour coding to distinguish between the 'mostly-coiled' and 'mostly-uncoiled' postures. As shown in the graph, there were significantly more 'mostly-coiled' postures observed than 'mostly-uncoiled.' This was confirmed by a paired T-Test (p-value = 0.00846), and failed to reject $H_0(3)$, thus rejecting H_3. Likewise, a Chi-Squared Test of Independence rejected failed to reject $H_0(4)$, as while there was a significant link (p-value < 0.0005) between sex and activity, it was the females of this study which engaged in more active behaviours than their male counterparts.

Table 2 shows two sets of SPI results, both of which are significant in rejecting $H_0(1)$ and supporting H_1. The left side of the table displays the individual SPI numbers of all subjects in the study. The closer the value is to absolute 1, the more an individual favoured only one zone in the enclosure. With the exception of two individuals, all subjects scored 0.5 or below, suggesting a more even use of all available zones, and of the two highest scores, only one scored substantially above 0.5 (Retic 7). The right side of the table displays the SPI numbers for each enclosure used in the study, and more clearly than the individual values shows the extent to which *M. reticulatus* makes use of its enclosure space. Despite this, a paired T-Test failed to reject $H_0(2)$, as while there was a significant difference in active and inactive behaviour instance (p-value = 0.000323) it was the inactive behaviours which had a higher frequency.

Discussion

As discussed in the results, *M. reticulatus* spent substantially more time 'mostly-coiled' than 'mostly-uncoiled,' and furthermore, more time 'coiled' than any other posture. However, what is also worth noting is that of the uncoiled postures, it is the 'outstretched' posture which is most common, suggesting that *M. reticulatus* does regularly engage in activities which involve uncoiling completely. While some would classify this posture as being the same as a fully-stretched rectilinear posture, the findings of this study suggest that treating rectilinear posture as a gradient between two extremes ('coiled' and 'fully-stretched') rather than a dichotomy is beneficial to the ability to evaluate behaviour.[J]

The findings of the SPI Index are also interesting in light of the rejection of H_2, as it suggests that low levels of active behaviours are not necessarily equivalent to low spatial needs or to lack of engagement with enrichment, and complexity may be as important to this species as floor space.[CFG] This possibility is further supported by the findings regarding arboreal zone use, which was found to be significantly higher than even open floor space use in most of the subject, leading one to wonder if, like *P. guttatus*, *M. reticulatus* is opportunistic in terms of interacting with its environment.[BCD]

In addition, there is evidence that while *M. reticulatus* is known as a strong swimmer in the wild, it may actively choose to swim without needing to do so to reach a resource if a large enough body of water is presented. This almost certainly needs much more research, but the frequency of wilful and active swimming behaviour rather than passive soaking may have practical application, especially for overweight or obese pet snakes.

Conclusion

The aim of this study was to develop an understanding of the behavioural repertoire and enclosure use of zoo-captive *M. reticulatus* in order to create a basis for further research into the captive behaviour, husbandry, and welfare of giant constrictors. While the aim of this study was not to evaluate responsiveness to enrichment, there was certainly evidence of this in the behaviour observations, especially where arboreal enrichment and climbing opportunities were concerned. In addition, this study opens up other questions regarding the potential importance of complexity and enrichment to the welfare of *M. reticulatus* in particular, and the possibility of sociality, though a study on the latter may prove challenging. Furthermore, the observations on the way that *M. reticulatus* uses its enclosure may be useful in understanding similar behaviours in other giant constrictor species.

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