Dispelling Python regius Myths

By Francis Cosquieri

Before we get deep into the “nitty gritty” of the subject I want to take a moment to say that the AHH Royal Python sub-group "Not Just a Pet Rock" is the best place to start for getting rid of the preconceptions surrounding the poor old Royal Python. Zack Tippie and the other admins have done an incredible job of dispelling the myths surrounding Royal Python behaviour and husbandry, and Zack’s care guide for this oft-maligned snake (to be found in the third *Advancing Herpetological Husbandry Quarterly* Newsletter) is one of the best I have read.

In the meantime, here is a post I made some time ago on AHH itself bringing together some information on the wild habits of this python. All the papers mentioned here can be found in the AHH Files section.

We all know there are certain "givens" that are taken for granted by some keepers of this species; "these snakes spend all their time underground," "these snakes live in termite mounds," "these snakes don't climb," "these snakes live solitary lives," “these snakes are stressed by light.”

However it is always worth plumbing the deepest depths of literature as these assumptions are half truths and do not take into consideration the entirety of Royal Python behaviour which, if we are to truly provide ideal and all-encompassing husbandry, must be accounted for...

I have previously made posts in the past detailing the various studies and observations of arboreality in the species, which are summarised here:

"Gorzula, Stefan, William Owusu Nsiah, and William Oduro. *Survey of the status and management of the Royal Python (Python regius) in Ghana*. Secrétariat CITES, 1997."

This paper lists several pythons being found in trees, although points out that the species is very adaptable to the point of being semi-invasive and responds well to anthropogenic disturbance.

"Luiselli, Luca, and Francesco Maria Angelici. "*Sexual size dimorphism and natural history traits are correlated with intersexual dietary divergence in royal pythons (Python regius) from the rainforests of southeastern Nigeria*." Italian Journal of Zoology 65.2 (1998): 183-185." -

Half of the male pythons encountered over a two year period were found on trees, there is a large discrepancy between habitat use by male and female pythons, and by larger and smaller specimens - with smaller specimens and males being more likely to ascend trees to hunt. 87 specimens were found between the hours of 08:00 and 18:00 (so - in the daytime!), of which 49 were on trees.

In addition, detailed analyses of stomach contents and faecal pellets that males in particular heavily predate on consummately arboreal birds such as doves (*Turtus sp.*), parrots (*Psittacus erithacus*), bee-eaters (Meropidae), Sylviid warblers (*Nectarinia sp.*), weaver birds (*Ploceus sp.*) and starlings (Sturnidae).

Not only does this directly contradict the narrative of these snakes “living down holes” (a somewhat untenable habitat to find parrots, warblers, bee-eaters and weaver birds) but it directly affects husbandry and may explain why male Royal Pythons traditionally have been seen as being harder to get feeding on lab mice.

The same study also described the mammal remains found; males were found to only have eaten shrews and striped grass mice as above, and also a dwarf galago (*Galagoides demidoff*) another consummately arboreal species. Females however had consumed fruit bats (*Epophomorus sp.* and *Megaloglossus woermanni*), Gambian pouched rats (*Cricetomys gambianus*), Soft-furred mice (*Praomys tullbergi*) and a giant squirrel (*Protoxerus stangeri*) as well as more diverse Muridae.

L. LUISELLI, F. M. ANGELICI

TABLE I - *Food composition of male and female* Python regius *from southeastern Nigeria.*

Prey Type	Males		Females	
	Ns	Nf	Ns	Nf
BIRDS				
Turtus sp.	1	-	-	-
Columbidae (ND)	-	6	-	-
Psittacus erithacus juv.	2	-	-	-
Meropidae (ND)	-	1	-	-
Sylviidae (ND)	-	2	-	-
Nectarinia sp.	2	-	-	-
Sturnidae (ND)	-	1	-	-
Ploceus sp.	2	-	-	-
Birds (ND)	-	16	1	17
MAMMALS				
Crocidura sp.	1	-	-	-
Epomophorus sp.	-	-	2	-
Megaloglossus woermanni	-	-	1	-
Cricetomys gambianus	-	-	1	-
Praomys tullbergi	-	-	3	-
Muridae (ND)	-	-	-	5
Lemniscomys striatus	2	-	3	-
Protoxerus stangeri	-	-	1	-
Galagoides demidoff	1	-	-	-
Mammals (ND)	-	10	-	20

From this is will be seen that males seem more likely to take arboreal prey, and that females consume a more diverse assortment of species including terrestrial prey but - perhaps crucially for the sake of this point - will also take arboreal prey like bats and squirrels on occasion, indicating that they too at least occasionally will forage in trees.

"Luiselli, Luca, Godfrey C. Akani, and Dario Capizzi. "*Food resource partitioning of a community of snakes in a swamp rainforest of south-eastern Nigeria*." Journal of Zoology 246.2 (1998): 125-133."

This study lists woodpeckers and warblers (both consummately arboreal species that do not spend much if any time on the ground) as among the most numerous prey retrieved from Royal Python stomachs (*Cisticola* warblers were the single prey genus that had the highest number found in Royal Pythons during the survey).

Alongside the expected rodents (*Lemniscomys*, the Striped Grass Mouse, and *Crocidura*, a type of shrew, as well as unassigned members of Muridae) we also see two species of bat; a Fruit bat (Macrochiropteridae) and *Plecotus sp*. among the species found to have been consumed by Royal pythons. Of the three constrictors found in the habitat (Rock pythons, Royal pythons and Calabar pythons) only the Calabar python is referred to as specifically fossorial.

Again these results directly contradict the narrative that this species is a fossorial tunnel-dweller eating only rodents.

It will often be the argument of those that argue against semi-arboreality, dietary preferences and habitat usage other than termite mounds and rodent burrows, that the “sample size is too small.”

And while it is true, it is always better to have larger sample sizes, what we have here is not one but TWO different studies performed in different areas that strongly imply that birds and arboreal mammals make up a significant percentage of Royal Python diet, which itself

implies they are spending at last some of their time foraging in trees.

It would be great to have MORE dietary studies for the species… but these are the two we have, and unless further studies reveal that both of these were flukes (unlikely) this is the best we have to go on. Two studies are better than no studies after all!

"Luiselli, Luca. "*Why do males and females of Python regius differ in ectoparasite load?*." Amphibia-Reptilia 27.3 (2006): 469-471."

This paper points out that male Royal pythons (which are more arboreal) carry different and much higher parasite loads than females, possibly as a result of differences in habitat use. This was observed in populations in both Togo and Nigeria, not only hinting that the different sexes occupy various niches but this is not a phenomenon limited to an isolated area.

"Sweeney, R. Charles H. "*Jebels by moonlight*." (1969)."

Within is a first hand observation by the author of a Royal Python actively foraging up a tree in Sudan that corroborates the reports of several other herpers in the field that this snake is not just a ground dwelling ambush hunter, but indeed an active forager.

I wandered on seeing no animal larger than a skinny hare, that took off from almost under my feet and zig-zagged away, absurdly long ears erect and seeming out of all proportion to the scraggy body that was scarcely the size of a three-quarter-grown English rabbit. I collected a few insects, being especially pleased to find a small 'tree-cricket', a tettigonid, that was unrepresented in our collection. Although only about a quarter of an inch long it produced as much sound as the bellowing *Rana*, making a persistent and continuous sound like a small, electrically driven bell.

It was not until I was returning to my camp that I saw the royal python about ten feet high in the tree, an old *mahagiya (Celtis integrifolia)*. Its four-foot length was half hidden in a hole in the trunk. I waited and watched nearby.

In a few moments the reptile emerged from the hole, pulling the forepart of the body out by wrapping its tail round a branch. I expected it to have caught some prey but apparently it had found nothing in the hole. Next the python moved slowly to the end of a branch before turning back to the main trunk where it paused for a moment, then moved to a higher branch. Here there was another hole into which it inserted its head, but again it found nothing. By this tedious process the snake investigated most of the tree, spending almost half an hour from the time that I came upon it, but without finding any supper. If this was its usual method of finding its prey then there must have been many nights when the python went hungry and it was just as well for the animal that it could live without eating for months.

The snake came close to the ground, lowering its length until, suspended by only the prehensile tail, it dropped the last few inches. I would have liked to see what it would do next as it moved ponderously over the ground, but I was tired, it was now early morning, and I was afraid that I might lose the python amongst the rocks or in a hole, so I picked it up. It made no protest and remained quite passive when I draped it round my neck, this being the easiest way to carry it although it required to be adjusted occasionally when it moved.

In a hurry now I made no effort at concealment and I had no thought of meeting any other animal. Thus I was surprised when I heard a loud snorting grunt near by as I reached the track again. The sound was not repeated but as I searched around, half expecting

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On that note, it is commonly stated that Royal pythons are “ambush predators” - even if this were true that does not mean they sit down a hole waiting for parrots and warblers and bats to fly down and get eaten. No. *Python regius* are active foragers. They track rodents to their burrows by their spoor, they climb trees in search of roosting birds and arboreal mammals. Sure, having found suitable spots they may *position* themselves in a place ideal for an ambush, but being an ambush hunter does NOT mean they remain in one hole their entire lives!

Further common sense evidence for this is to be found in the Gorzula paper, wherein the author describes local trackers following the python’s tracks to their burrows.

It would seem rather odd for there to be tracks to follow if the pythons were remaining below ground, no?

Whilst it would be easy to again cite Luiselli's two-year study where he captured 87 of the damn things in daylight between the hours of 08:00 and 18:00 - half of which were up trees - and his ecological studies of them in Ghana and Nigeria showing dietary trends, it seems his studies are often ignored as somehow "aberrant" or "erroneous" because they happened to take place in primary forest as opposed to farmland (where the snakes are invasive; they reach their greatest population densities in forest and just happen to be adaptive enough to withstand anthropogenic change and recolonise farmland - it isn't their original habitat).

So instead here's ANOTHER report of arboreal hunting in this species from Sudan, half a continent away!

"*Species trade and conservation: Snake trade and conservation management (Serpentes.spp.) An assessment of the impact of the pet trade on five CITES-Appendix II case studies*"

Citing other studies including those by Luiselli, this paper lists the species as being both terrestrial and tree-dwelling animals.

This paper states that Royal pythons are extraordinarily adaptive snakes that can tolerate a wide variety of habitats and are not negatively affected by anthropogenic change to the same extent as many other reptiles are. They can be terrestrial AND semi-arboreal depending on the habitats they inhabit, although according to studies by authors such as Luca Luiselli they reach their highest population densities in forested areas as opposed to grassland and farmland (which is by definition recolonised land after alteration by human activity).

So. What we have here is a broad scope of research and anecdotal material supporting the fact that not only are Royal pythons semi-arboreal, this is far from an isolated trait in one population as it has been observed in Ghana, Nigeria, Togo and Sudan - in other words across the length and breadth of the species range.

It is worth noting that males especially seem to have adapted to fit a different niche to the larger females to the point that diet composition has been observed to be almost totally different in several of these studies, and includes a significant percentage of birds and arboreal mammals that are most likely being stalked and captured in trees at night. This directly affects the way these animals might be kept in captivity. They are also picking up a completely different parasite load because of this!

So. First point. Royal Pythons are not strictly fossorial "hole dwellers." They are active foragers that can climb to find arboreal prey, and routinely predate upon species that categorically cannot be found down holes or “in termite mounds.”

Which brings us to the next point: termite mounds. Oh how everybody loves to hear about termite mounds and the fixation Royal pythons have with living inside them.

The topic of Royal pythons spending the majority of their lives in termite mounds is deeply ingrained in the reptile-keeping culture. This is an assertion I have previously been somewhat wary of, as I had only ever found one reference to animals inhabiting termite mounds, which was the 2006/2007 paper by Gorzula "*Survey of the Status and Management of the Royal Python (Python regius) in Ghana*" - a paper which, from the outset, states that it limited itself to only four localities of farmland where trapping is most common (and therefore not necessarily indicative of *Python* habits in the wider sense; it states from the get-go Royal pythons take advantage of and colonise anthropogenically disturbed habitat far more easily than most snakes).

"A preliminary itinerary included the whole of Ghana. However, once it became evident that the commercial trapping of royal pythons was limited to four regions in the south of Ghana, it was decided that the field work should be concentrated in these areas."

As a side note, this paper also mentioned that trappers can identify active python burrows by shed skin and faeces at the entrance. This to me suggests the pythons are spending at least some time at the entrances of their burrows, which tallies with my own observations in the wild; that the snakes bask at least some of the time at the mouths of their burrows. (again, anecdotal reports aside, the fact that 87 Royal Pythons were discovered between the hours of 08:00 and 18:00 in Luka Luiselli's study mentioned above supports this).

Every other paper I have read that has mentioned termite mounds has done so in the context that termite mounds are used by nesting females. Certainly they can be found within termite mounds (trappers would know when to find gravid females) but this is by no means their exclusive habitat.

For example:

Morrill, Benson H. "*Quantitative Genetic Analysis of Reproduction Traits in Ball Pythons*." (2011).

This paper has the following to say on the matter: during the day ball pythons can frequently be found in burrows or termite mounds (Aubret et al., 2003, 2005b, 2005c; Gorzula, 1998; Gorzula et al., 1997; Luiselli, 2006). Checking up each of these citations reveals that all but one of these papers mention termite mounds in the context of being used by nesting females, not as a standard refuge.

By the way, termite mounds are also often refugia for all sorts of other snakes and lizards. I've personally observed monitor lizards, mambas, skinks, rock pythons, agamas and other species of reptile using them. Others have mentioned cobras also make use of this habitat. Monitors and Rock pythons have been well documented (including on film) using them as nesting sites.They make great places for any reptile that can get inside because they offer constant temperatures, none of these other species get labelled as "living in holes so they need smaller enclosures." Why is that?

Snake biologist Henry Astley had this to say on the subject: "Coming from my background (snake biomechanics), NOTHING about the ball python morphology is consistent with an animal which "spends all their time in a termite mound". Their skulls have no reinforcement or digging adaptations, their eyes aren't reduced, they have distinct "necks" (as opposed to the robust "train locomotive" morphology of most burrowers), and have no specialized digging rostral scales. Anyone who claims they spend their whole lives in termite mounds needs to go take a look at *Loxocemus* and *Calabaria* to see *real* burrowing morphology, then defend how balls can have the lifestyle claimed with zero morphological adaptations."

One other somewhat obvious point for those that have not seen a real termite mound. Have a look at the picture below:

Which part of that four metre high termite mound specifically does the snake inhabit, I

wonder? They can be surprisingly big structures after all!

In short, I am sure lots of Royal pythons do use termite mounds at least some of the time, as they are great refugia for a variety of other reptiles… however this can only happen on open grassland habitats where termite mounds actually occur. Pythons living in forested areas where there are few or no termite mounds to make use of, find other places to hide.

In any case… even if it were true that termite mounds are a major part of the Royal Python ecology, why does this somehow equate to shoving them into a tiny plastic tupperware? There are a hundred and one ways to replicate the conditions inside of a termite mound, here is a particularly spiffing example shared on the Facebook page Jurassik-Var of a fantastic and innovative way of replicating such an environment that offers both security AND enrichment.

Of course nobody is suggesting one needs to go to this extreme to keep Royals, but it is nice to see somebody go that extra mile - and it would be perfectly easy to get similar results using various drawers and hide boxes within a larger enclosure.

The next “hobby absolute”, and one that has caused some controversy recently, is that of Royal pythons being completely solitary and cohabitation being a bad idea... which is challenged by the following excerpt:

"*From November through January pairs and small groups of ball pythons can be found together in burrows, and females are found brooding clutches from February through March*”

(Barker, David G., and Tracy M. Barker. *Ball pythons: the history, natural history, care and breeding*. VPI Library, 2006.."

This is referenced and supported by De Vosjoli, Philippe. *The art of keeping snakes.* i5 Publishing, 2012.

"*Ball pythons will readily breed in captivity if kept with a group of males and females in large cages and exposed to a period of slight cooling in winter*."

So, it would appear that - just as is common with many other snakes, this species can in fact inhabit communal burrows at least part of the year and are not necessarily as solitary as some would assume.

Again, this is fairly common among many snakes and it would not surprise me if the snakes came together to aestivate during the dry season as well as to mate.

Does this mean it is essential to cohabit the snakes in captivity? No of course not, that is down to the keeper and there are many good reasons not to do it. However this does NOT mean it can not or that it should not be done by any means… or that those so eager to jump on any cohabitation posts are correct.

Final topic. Royal Pythons and LIGHT. Now we have all seen the posts insisting these snakes will spontaneously combust (or get stressed and go off their food) if exposed to

light. Further, that UV, which is known to be so beneficial to other reptiles (and indeed most terrestrial vertebrates) is not utilised or beneficial to this snake.

It is always worth mentioning several things when the "UV is not needed" discussion appears.

Firstly, the function of UV is not just calcium metabolism. Reptile keepers just happen to focus on this as cases of MBD have been highly publicised. There *was* a paper published showing no appreciable change in serum D3 levels in female Royal Pythons after exposure to UV:

"Hedley, J., and K. Eatwell. "The effects of UV light on calcium metabolism in ball pythons (Python regius)." The Veterinary record 173.14 (2013): 345-345."

It is probably best to re-post veterinarian Fran Baines commentary of this study though:

"The second study cited - Hedley & Eatwell (2013) - was unable to demonstrate elevation of serum 25(OH)D3 in an all-female group of 6 ball pythons given quite intense UVB exposure daily for 70 days. A control group, (mixed males and females) not supplied with UVB, also showed little change in 25(OH)D3 levels over the same period. However, there were some very curious features about this study. All the females in the experimental group (a batch from one owner) had extremely high 25(OH)D3 levels initially, compared to the control group (a batch from another owner) so the groups were not comparable from the start. Also, the females in both groups had far higher 25(OH)D3 levels than the males, both at the start and the end... the authors discuss the possibility of egg production stimulating raised serum 25(OH)D3 levels in these females. This surely raises the question as to whether, if vitamin D3 synthesis was indeed occurring in the females given UVB, any extra produced could have been transferred to developing eggs - which require high levels of vitamin D for embryonic development."

Further, she explained:

"There is still no clear evidence that royal pythons cannot synthesise vitamin D under UVB; in fact I think it very unlikely indeed that they do not. Every other reptile so far investigated has been shown to have this ability. (Almost all vertebrates have the ability - it is evolutionarily conserved from very primitive life forms since it is a very simple biological process with enormous importance in calcium metabolism). Corn snakes definitely do, (the only other snakes in which it has been investigated) and the study in that case was properly controlled in a research laboratory, not done on privately owned animals in two different collections.

Royal pythons may not have a particularly high requirement for UVB because they are primarily active at night, however, they have been observed basking in sunlight at the entrance to burrows in the wild, and owners supplying full spectrum lighting also frequently report daytime basking behaviour. Thus, UVB is freely available to them, and most animals utilise free resources whenever they are on offer."

Of course it is also possible that ball pythons do not synthesise vitamin D3 from UVB, but obtain all they need from their diet. Very high serum 25(OH)D3 in the experimental group, initially, before they had ever experienced UVB, clearly indicates that dietary supplementation with D3 works in this species!

It is also possible that these high serum levels inhibited formation and/or absorption of more D3 under the influence of UVB. Cutaneous synthesis is a self-limiting process in which, when the vitamin D binding protein is saturated, excess formed in the skin is "recycled" into apparently inert byproducts, owing to an equilibrium reaction dependent

upon the wavelengths of UVB (and some UVA) present in the light....

As the authors themselves suggest, this study poses more questions than it answers, and hopefully further research will be done."

In addition to synthesis of 25-hydroxyvitamin D3, UV has other benefits to snakes. For example, UV is a completely separate visible colour to them; we know that Royal Pythons have visual pigments in their eyes that enable them to perceive UV (360 nm, 494 nm λmax and 561 nm). That this UV-absorbing pigment was truly a visual pigment was confirmed by its dichroism, behaviour following exposure to UV radiation and “nomogram” fit as pointed out by the below study:

Sillman, A. J., J. K. Carver, and E. R. Loew. "*The photoreceptors and visual pigments in the retina of a boid snake, the ball python (Python regius)*." *Journal of Experimental Biology* 202.14 (1999): 1931-1938.

Another argument against the use of lighting for these snakes is the ill-informed idea that “slit pupiled snakes are nocturnal and therefore do not need light.”

In actuality nothing could be further from the truth, lots of diurnal and crepuscular snakes (such as many vipers) also have slit pupils. In fact it is specified in the below study that slit pupils actually function to help block UV, which is supported by the fact that the spectacle of these types of snake exhibit lower cutoff wavelengths than those of elapids and colubrids - it does not necessarily mean the snakes are nocturnal, just that they have a different method of blocking UV out from the eye.

van Doorn, Kevin, and Jacob G. Sivak. "*Spectral transmittance of the spectacle scale of snakes and geckos*." *Contrib Zool* 84 (2015): 1-12.

So, we have a species of snake that can see well into the UV spectrum and has well developed, large eyes with adaptations to block out excessive UV. These are NOT the traits of a nocturnal, fossorial animal that never experiences light!

We know UV stimulates everything from basking behaviour to reproductive activity in reptiles (Clausen et al. 1937; melatonin production and synthesis of methoxyindoles and therefore activity level (Firth & Kennaway, 1987) and therefore Circadian rhythm (Janik et al. 1990). At night, it affects serotonin production and thus the presence or absence of light affects production of different hormones (Enrbretson & Lent 1976).

In other words - UV has significant effects on snake behaviour and is an important stimulus for them, even if we ignore its role in D3 production which is its most often-touted positive effect on reptiles by reptile keepers.

You can supplement D3 to a reptile, but you cannot account for all the other effects UV has on their physiology which is why the idea of keeping heliothermic animals without UV and compensating by supplementing a vitamin is so trenchant.

It is our outlook that, knowing UV to be a beneficial stimulus to most terrestrial vertebrates, so long as correct amounts of exposure are accounted for, it is better to provide UV than not.

Those wishing to learn more on how to do this, and find out recommended UV Indices (UVI) for this species from zoos and veterinarians, are referred to the following study:

Baines, Frances, et al. "How much UV-B does my reptile need? The UV-Tool, a guide to the selection of UV lighting for reptiles and amphibians in captivity." *Journal of Zoo and Aquarium Research* 4.1 (2016): 42.

OK. So we have busted a few myths and hopefully opened some readers' eyes to the complexity of Royal Python ecology, and that it does not follow the narrative that many tub breeders would have us believe that these are snakes of cramped, narrow spaces, holes and termite mounds that rarely move and only eat rodents. No doubt there will be those that disagree with these interpretations or that say there is "not enough evidence" - to which I say, that's cool, by all means show me any evidence refuting anything published here with peer-reviewed studies. You will find that there is not much out there and what there is supports the conclusions drawn here.

Anyway, how do we utilise that information for improving husbandry?

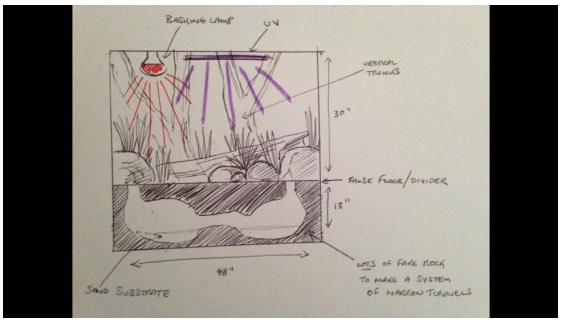
Well, I thought it would be best to show rather than tell by posting a few of the Royal Python enclosures shared over the years on the *Advancing Herpetological Husbandry* Facebook page.

Here are some photos of Ricky Johnson's wonderful Royal enclosure showing the snake climbing 24" off the floor, basking happily under bright lights and UV. He reports breeding successes so often with his pythons that he uses the excess eggs as an alternate food source for some of his other reptiles.

Here are some images from James Pettit showing the same thing; a happy, stress free Royal basking and exhibiting natural behaviours, not overcome with stress, that feeds just fine:

Finally here is Ed Howard's gargantuan Royal enclosure, a vivarium the size of what most would associate a Reticulated Python or Monitor with, not a humble Royal. It is always fantastic to see people go so above and beyond in the care of their pets.

Over the years I have also applied some thought to what would be the "ideal" Royal Python enclosure, and the conclusion I came to is one that encompasses both sides of their habits - the side that spends days at a time in burrows, and the side that emerges from those burrows, climbs, basks and forages in the wider world. This is a diagram of my design:



This system would utilise a double-layered viv, with access holes between the top and bottom portions allowing the snake to move between them (the old Vivexoic AX series with their false floors and two sets of doors would have been perfect).

This would allow the keeper to incorporate different humidities and thermal and light conditions between the top and the bottom sections, with no light at the bottom and some humid hides and tight tunnel sections, which the snake could exit by climbing out into the taller section in order to bask, climb and explore. It would be interesting to see just which section the snake would spend more time in - going by past experiences I would hazard a guess and it would not be the one that many would pick!