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Microhabitat of Indian Rock Pythons (*Python molurus*) in Moyar River Valley, Tropical India

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***Abstract*:** The knowledge of microhabitats used by a species is essential for its effective conservation and management. This study aimed to quantify the microhabitat use of Indian rock pythons (*Python molurus*) in the Sathyamangalam and Mudumalai Tiger Reserves (STR & MTR), Tamil Nadu. Fourteen pythons were captured through intensive search and opportunistic methods from STR, MTR, and nearby villages and then radio-track between 2018 and 2020. The various microhabitats were categorized and quantified based on sightings of the radio-tagged pythons. A total of 401 microhabitat locations were collected and classified into eight categories: burrows, dead fallen trees, dry bushes, green bushes, trees, open areas, rock crevices, and water. The study results showed that the microhabitat use of male and female pythons was significantly related . The number of sightings was converted into proportions, revealing that dry and green bushes were the most preferred microhabitats by pythons. This study provides valuable insights into the microhabitat preferences of *P. molurus* in tropical climatic conditions and can help in the formulation of effective policies and measures to protect this species and its micro- habitats.

***Keywords*:** Indian Rock Pythons, *Python molurus*, Bushes, Microhabitat, Radio-transmitter, Moyar river valley

Snakes are known to inhabit diverse habitats and microhabitats, which include terrestrial, aquatic, and arboreal. Microhabitats differ from place to place, including stone, burrows, paddy fields, streams, rock, leaf litter, open forests, forest edges, and water bodies (Lalremsanga et al 2011, Rahman et al 2014). Among pythons, different species have an affinity over various landscapes, habitats, and microhabitats. Indian rock pythons (*Python molurus*) are known to inhabit a wide range of habitats across their distribution range. *P. molurus* occupy scrub jungles, moist forests, evergreen forests, grasslands, and mangrove ecosystems and are water dwellers; thus, they prefer zones with water bodies like swamps and riparian habitats (Sharma 2003, Whitaker and Captain 2004). Pythons also thrive in rocky hills (Hunter et al 2018, Babar et al 2019).

The microhabitat selection in *P. molurus* is also diverse. They are known to use burrows, tree hollows, marshes, wet rocky ledges along the pools and streams, thickets found in the mangrove, bushes, dense vegetation clumps, large rotten logs, treetops, water reeds, and leaf litters, caves, crevices, and ruins (Sharma 2003, Whitaker and Captain 2004, Mukherjee et al 2017, Babar et al 2019). However, the microhabitat usage of *P. molurus* in the tropical climate regions have not been studied yet. Burmese pythons (*Python bivittatus*) are the sister species of *P. molurus*; in general, they are known from South East Asia, inhabiting forests, lowlands of the tropics, grasslands, agricultural lands, and aquatic habitats (Barker and Barker 2008, Cota 2010, Stuart et al 2012, Rahman et al 2014). Walters et al (2016) found the *P. bivittatus* to show a negative selection over freshwater bodies but preferred canopy-associated coniferous forests. However, most of the studies show *P. bivittatus* to have a positive selection towards water or aquatic habitats irrespective of the native population or invasiveness in a different geographical area (Cota 2010, Stuart et al 2010, Rahman et al 2014, Hunter et al 2015, Mustascio et al 2017, Conyers and Roy 2021, Smith et al 2021). Therefore, habitat selection is an essential cue in the pythons, and various ecological and climatic factors influence it.

P. molurus is a Schedule I animal of the Indian Wildlife Protection Act 1972. The International Union for Conservation of Nature assessment lists them in the Near Threatened category (Aengals et al 2021). The species was facing population decline due to severe habitat loss and poaching (Babar et al 2019). In this context, understanding the microhabitat use of this species in the tropical climate will support their conservation management from habitat degradation. In this study, quantified the proportion of microhabitat use in the *P. molurus* in the tropical climatic region, Southern India. The study results would help in identifying and conserving natural microhabitats of the study site which can also be supported in identifying suitable translocation sites for rescued individuals from conflict zones.

MATERIAL AND METHODS

Study area: The study was conducted between 2018 and

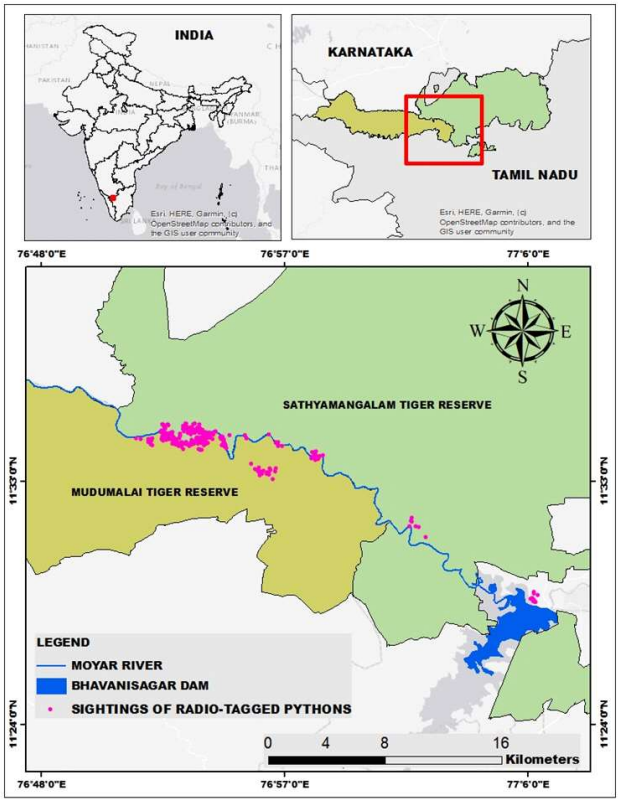

Fig. 1. Study area map

2020 in the Moyar River Valley (MRV), a tropical climate region of India, which lies in both the STR and MTR (Fig. 1). The major forest types of the region are Southern tropical dry thorn forest, Southern tropical dry deciduous forest, Southern tropical moist deciduous forest, Southern tropical semi-evergreen forest, moist bamboo brakes, and Riparian forests. Through the intensive search, opportunistically captured 14 pythons from the MTR, STR, and adjacent villages. The pythons were radio-tagged, released in the study sites, and observed their microhabitat use.

Microhabitat classification: The study area was classified into eight broad microhabitat types (Fig. 2): 1. burrows; 2. dried fallen trees; 3. dry bushes (dried bushes dominated by invasive plant *prosopis sps*, debris and sticks, and leaf litter); 4. green bushes (including *prosopis* saplings); 5. trees (including tree hollows and tree roots); 6. open area; 7. rocky area (including rocky crevices and beneath the rocks); 8. water.

Surgical method for radio-tagging: The three types of VHF implantable Radio-transmitters, AI-2 Holohil with 17 g and 28 g sizes, and the ATS ARChive ARC400 tag of 14g was used. The transmitters were implanted into the coelomic cavity of individuals after the isoflurane gaseous anaesthesia (Renurt and Cundall 1984, Vishnu et al 2023). Simultaneously, we

A. Burrow; B. Dry Fallen Tree; C. Dry Bush; D. Green Bush; E. Tree; F. Open Area; G. Rocky Area/ Rocky Crevices; H. Water

Fig. 2. Types of Microhabitats

have collected morphometry details of individuals. In addition, we confirmed that the mass of each transmitter did not exceed 0.26 % body mass of the individuals. The individuals were given post-surgery care at the veterinary unit of the Sathaymangalam Tiger Reserve prior to release.

Data analysis: The radio-tagged pythons were tracked on different days in 2018-2020, and noted the microhabitat of each python and calculated the proportion of sightings in each microhabitat. The male and female microhabitat association was tested by using the chi-square test.

RESULTS AND DISCUSSION

Morphometry: Information on microhabitat use and movement patterns were obtained from 14 adult pythons, which were radio-tracked between 2018 and 2020 for a mean tracking day period of 444 days, and 29 data points were obtained per individual. These included six females (SVL 197.5-376 cm, mass 6.65kg to 36.25 kg) and eight males (SVL 172-252 cm, mass 3.3 kg-36.25kg).

Relationship of pythons with microhabitats: The null hypothesis of the study was that there would be no significant relationship between the microhabitat use of male and female pythons. However, the alternative hypothesis was supported by the results, which showed that the microhabitat use of male and female pythons was significantly related (x^2= 29.40, v=7, P <0.001) (Table 1 and Table 2). Pythons exhibit a pattern of microhabitat selection, with a preference for dry and green bushes and a tendency to avoid burrows.

Proportionality in microhabitat use: Female pythons utilized 49% of their microhabitats as green bushes, while male pythons only used 30% of their microhabitats for this purpose (Fig. 3, 4). In contrast, male pythons used green and dry bushes in equal proportions (30%), and female pythons were observed to use dry bushes at a rate of 22%. Most pythons were observed in dry bushes and green bushes during the study. Male pythons were seen the least inside water bodies (1%), while females were observed in water 7% of the time. Burrows was the least used microhabitat for female pythons (1%), while males were sighted in burrows at a proportion of 2%. The male pythons used rocky areas or rock crevices more often than females (12% compared to 6%) and were sighted in open areas more frequently than females, with a proportion of 10% compared to 5%. On the other hand, male pythons were found in treetops and tree hollows at a proportion of 8%, while female pythons were 6%. Dead fallen trees were used as microhabitats by males at a ratio of 7%, compared to only 4% for females. However, both males and females were observed in burrows at a minor proportion, with males at 2% and females at 1%.

Similar study on *P. bivittatus* conducted in Bangladesh reported that the pythons exhibited a strong preference for microhabitats such as bushes and thickets. In contrast, the major habitat type observed was bushy habitat or degraded forest, while the least observed habitats were paddy fields and trees (Rahman et al 2014). Dry bushes are the hiding sites for pythons, where they can be highly camouflaged and await prey and can be helpful to avoid predation. The moist substrate along the dry bushes is an essential microhabitat

Table 1. Frequency of microhabitat use by radio-tracked Indian Rock Pythons

	Burrows	Dead fallen trees	Dry bushes	Green bushes	Open areas	Trees	Rock crevices	Water	Total
Male	5	15	64	66	18	21	26	2	217
Female	1	8	40	90	11	10	12	12	184
Total	6	23	104	156	29	31	38	14	401
Total %	1.45	5.73	25.93	38.90	7.23	7.73	9.48	3.49	100

Table 2. Observed and expected frequencies

	Burrows	dead fallen trees	Dry bushes	Green bushes	Open areas	Trees	Rock crevices	Water	Grand total
Observed frequencies									
Male	5	15	64	66	18	21	26	2	217
Female	1	8	40	90	11	10	12	12	184
Total	6	23	104	156	29	31	38	14	401
Expected frequencies									
Male	3.24688	12.4464	56.2793	84.419	15.6933	16.7755611	20.5636	7.57606	217
Female	2.75312	10.5536	47.7207	71.581	13.3067	14.2244389	17.4364	6.42394	184
Total	6	23	104	156	29	31	38	14	401

for *Phrynonax poecilonotus* from another tropical country Brazil (dos Santos-Costa et al 2015). Studies conducted in the Keoladeo National Park have shown that *P. molurus* typically prefer burrows as microhabitats, particularly those located under *Salvadora* bushes (Ramesh 2012). Burrows are engineered shelters that provide crucial refuge and protection against temperature extremes, fire, and predation (Mukherjee et al 2017, Ramesh and Kamalakannan 2018).

Pythons have a strong affinity for water and prefer to reside in it. *P. molurus*, is a good swimmer and can remain submerged in water for at least 30 minutes if necessary (Sharma 2003). Similarly, most studies of *P. bivittatus* show that this species has a positive selection towards water or aquatic habitats (Barker and Barker 2008, Cota 2010, Stuart et al 2010, Rahman et al 2014, Hunter et al 2015, Mustascio et al 2017, Conyers and Roy 2021, Smith et al 2021). These observations suggest that water plays a critical role in the behaviour and biology of pythons. Rocky areas, trees, and dried fallen trees are the other microhabitats used by the *P. molurus* in the MRV. The *P. molurus* prefer the microhabitats like rock crevices, tree hollows, and rock bottoms during hibernation in northern India between late December and to the middle of February (Sharma 2003). They are also skilled climbers and can suspend themselves from tree branches, remaining motionless as they wait for prey to come within reach (Sharma 2003). Similarly, open areas can be beneficial for maintaining thermoregulation in pythons. A study on *Hyperolius viridiflavus* found that thermal specialization for hot temperatures was associated with the microhabitat selection of open areas (Lelièvre et al 2011). All of the microhabitat types described are crucial for fulfilling the ecological requirements of this species in the study area.

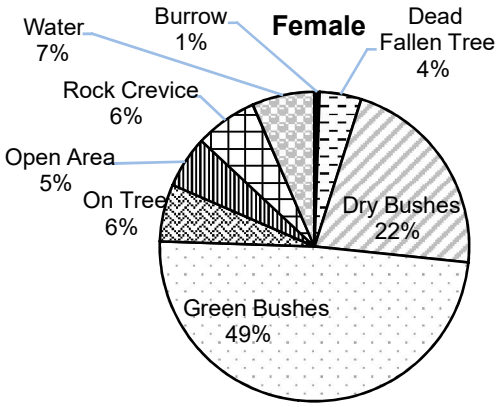

Fig. 3. Proportion of female microhabitats

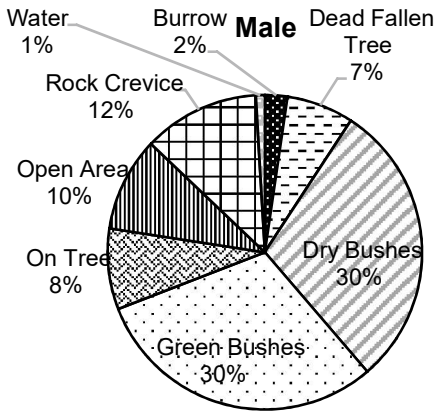

Fig. 4. Proportion of male microhabitats

CONCLUSIONS

There is a significant relationship between sex and microhabitat selection in pythons. The proportion of microhabitat use was found to be varied according to microhabitat types. *P. molurus* in tropical regions, where they tend to prefer bushes, as they have been known to prefer burrow microhabitats in sub-tropical regions. Knowledge of the exact microhabitats used by *P. molurus* is essential for effective conservation and management in the context of habitat fragmentation and changing climatic conditions. All of the microhabitat types described are crucial for fulfilling the ecological needs of this species in the study area. However, these microhabitats are often overlooked in many conservation plans. It is essential to include them in conservation and management practices to ensure the well-being of this species. The long-term studies on microhabitat selection in pythons will provide more precise results and information on seasonal shifts in their microhabitat use.

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