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NOTE

STOMACH CONTENTS OF THE INDIAN PANGOLIN *MANIS CRASSICAUDATA* (MAMMALIA: PHOLIDOTA: MANIDAE) IN TROPICAL FORESTS OF SOUTHERN INDIA

Mohanarangan Ashokkumar, Dipika Valsarajan, M. Arjun Suresh,
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Pangolins are scaly anteaters and are unique in being the world's only true scaly mammals, distributed in Asia and Africa. Of the eight species of pangolin, four species are found in Asia, the Chinese Pangolin *Manis pentadactyla*, Indian Pangolin *M. crassicaudata*, Sunda Pangolin *M. javanica* and the Philippine Pangolin *M. culionensis*. The Indian Pangolin (hereafter referred to as Pangolin) is distributed in South Asia from the northeast and southeast of Pakistan, throughout the Indian sub-continent including Sri Lanka and east to southern Nepal. It was found throughout Bangladesh historically, but there are no records currently and their presence is uncertain in Western China (Schlitter 2005; Baillie et al. 2014). They occupy diverse habitats ranging from tropical and sub-tropical forests to dry woodlands and savannah regions, as well as human modified habitats such as coconut and rubber plantations. Though they are distributed in diverse habitats, their population status is unknown.

Pangolins are predominantly nocturnal although they have also been known to be active during the daytime. Occurring at low densities, their solitary, nocturnal and elusive behaviour make them difficult to study (Prater 1971). Pangolin plays a vital role in the ecosystem and agricultural areas by consuming insects (feeding on ants, termites and fossorial creatures) that cause considerable damage to agricultural crops (d'aularie & d'aularie 1983).

Pangolin's limbs are powerful and are tipped with sharp, clawed digits used for digging into ant hills and termite mounds (Atkins 2004). Pangolin's diet consists

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of ants and termites. Although there are many species of ants, they prefer only a few species of ants that constitute the major proportion of their diet (Stewart et al. 1999; Mahmood et al. 2013; Pieterse et al. 2015). For example, fecal examination of pangolins in Pakistan revealed that it composed of only ant species *Camponotus confucii*, *Camponotus compressus* whereas termites were not recorded (Mahmood et al. 2013). Stewart et al. (1999) reported that six species of ants contributed to the diet of Pangolins, but only one species, *Anoplolepis custodiens*, constituted 77% of the overall diet. The stomach content analysis from the Nilgiris revealed presence of black ants, beetle wing sheath, remains of cockroaches and skins of worms

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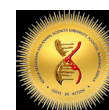
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(Hutton 1949) and it was also reported that eggs were preferred over adult ants.

The primary threats to pangolins are illegal hunting and poaching for illicit international trade and local use (Baillie et al. 2014). Pangolins are hunted for their flesh, skin and scales (Nowak 1991). The scales are thought to have medicinal value. Over a million pangolins are believed to have been traded illegally in the last decade (Challender et al. 2014; Anonymous 2016a) and it is considered the most heavily trafficked wild mammal in the world. Thus, hunting pressure, habitat degradation and the transference of trade and trafficking attention to this species contributed to the change in the status of pangolin on The IUCN Red List of Threatened Species™ from Near Threatened to Endangered category (Baillie et al. 2014).

The stomach content of one female Indian Pangolin was collected from a road kill specimen from Kalpetta (76°05'2.97"E & 11°37'16.08"N) of South Wayanad Forest Division and the post-mortem examination was carried out at Kerala Veterinary and Animal Sciences University, Pookode, Wayanad on September 2013. The stomach content was preserved in 10% formalin and subsequently analysed to identify the diet composition (Fig. 1). A chi-square goodness of fit test was done to find differences in both frequency and biomass of ant and/or termite remnants using statistical programs R (Anonymous 2009).

The stomach content of Pangolin composed of body parts of ant species, ant egg shells, ant heads and grit. The morphometry of the head and position of the eye in the head among the ant species were used to identify them to species level based on Bolton (1994), fauna of British India (Bingham 1903) and AntWeb website (Anonymous 2016b). The ant species found in diet of Pangolin was exclusively *Leptogenys* sp. with head size of one to two millimeter (Image 1). Since the abundance of the ant species was not available, the preference could not be determined. Our preliminary survey in the area revealed that *Leptogenys* sp. is likely to be the most abundant species in the tropical moist deciduous forests of Wayanad District of Kerala, though this should be treated with caution as our survey was not systematic. Earlier studies have also reported *Leptogenys* sp. as the dominant species in this region (Anu & Sabu 2006). Grit content was higher in both frequency and biomass with 49% and 57% respectively (Image 2). Since pangolin lacks teeth, they mainly rely on grit for grinding the food material (Krause & Lesson 1974). A greater proportion of grit content was reported here than in other studies (45%; Mahmood et al. 2013) though our sample size

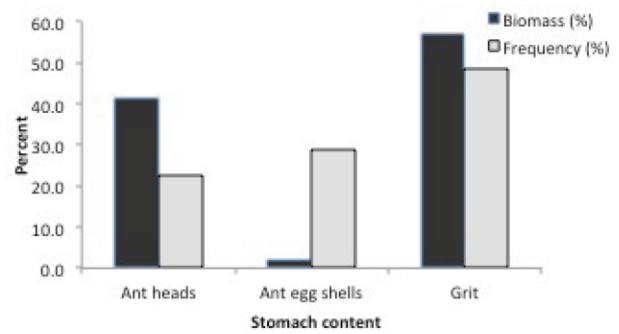


Figure 1. Percent composition (biomass and frequency) of ant species remnants of *Leptogenys* sp. in the stomach content of Pangolin



Image 1. Stomach content of Indian Pangolin *Manis crassicaudata* showing ant body parts, ant egg shells and grit.

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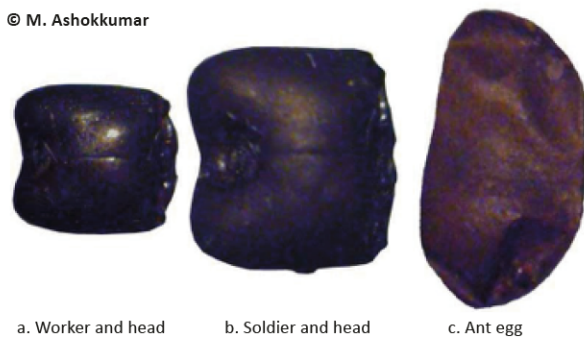


Image 2. Microscopic images of gut content of pangolin showing ant heads (ventral view) and an egg shell.

only included one animal.

Both frequency ($X^2=36.76$; $df=2$; $p<0.00$) and biomass ($X^2=1740$; $df=2$; $p<0.00$) content varied significantly among different diet components. In terms of biomass, ant head contributed higher percentage

(41.3%) than ant egg shells (1.8%) suggesting higher percent consumption of adult ant than ant eggs. On the contrary, frequency of ant egg shells was higher (29%) than ant heads (22.5%). Ant head biomass was higher because of external chitinous covering of ant head that was undigested and remained intact and excreted. Whereas, egg content was digested and only egg shells that is weightless had lower biomass. But the actual biomass contribution would be higher since the frequency of egg shell is higher. Analysis of fecal sample also revealed similar higher contribution (percent volume) of ant head (0.71%) than egg shell (0.21%) (Mahmood et al. 2013). Similar preference of ant egg was reported by (Heath 1995). Though the biomass of ant head was higher, its contribution to the pangolin as nutrient is unknown.

Stomach content of pangolin suggests that Pangolin is highly specialized in its foraging habits and ant eggs are more likely to be relished than the adult ants. Further research on the ecology and diet composition is needed to better understand the diet of the Indian Pangolin.

References

- Anonymous (2009).** R Development Core Team, R: A Language and Environment for Statistical Computing. R Foundation for Statistical Computing, Vienna, Austria.
- Anonymous (2016a).** The status, trade and conservation of Pangolins (*Manis* sp.) information document for 17th Meeting of the Conference of the parties of CITES.
- Anonymous (2016b).** AntWeb. Available from <http://www.antweb.org>. Downloaded on 16 January 2016.
- Anu, A. & T.K. Sabu (2007).** Biodiversity analysis of forest litter ant assemblages in the Wayanad region of Western Ghats using taxonomic and conventional diversity measures. *Journal of Insect Science* 7: 6; <http://doi.org/10.1673/031.007.0601>
- Atkins, W.A. (2004).** Pholidota Pangolins (Manidae). In: Grzimek, B., D.G. Kleiman, V. Geist & M.C. McDade (eds.), *Grzimek's Animal Life Encyclopedia, Volume 16*. Thomson-Gale, Detroit, 704pp.
- Baillie, J., D. Challender, P. Kaspal, A. Khatiwada, R. Mohapatra & H. Nash (2014).** *Manis crassicaudata*. The IUCN Red List of Threatened Species 2014: e.T12761A45221874. Downloaded on 15 April 2017. <http://doi.org/10.2305/IUCN.UK.2014-2.RLTS.T12761A45221874.en>
- Bingham, C.T. (1903).** *The Fauna of British India - Hymenoptera, Vol - 2*. Taylor and Francis, London
- Bolton, B. (1994).** *Identification Guide to The Ant Genera of the World*. Harvard University Press, London, 222pp.
- Challender, D.W.S., C. Waterman & J.E.M. Baillie (2014).** Scaling up Pangolin conservation. IUCN SSC, Pangolin Specialist Group Conservation Action Plan. Zoological Society of London, London, UK, 21pp.
- d'Aulaire, E. & P.O. d'Aulaire (1983).** Pangolins are all the rage. *International Wildlife* 13: 14–16.
- Heath, M.E. (1995).** *Manis crassicaudata*. *Mammalian species* 513: 1–4.
- Hutton, A.F. (1949).** Notes on the Indian Pangolin (*Manis crassicaudata*). *Journal of the Bombay Natural History Society* 48: 805–806.
- Krause, W.J. & C.R. Lesson (1974).** The stomach of the Pangolin (*Manis pentadactyla*) with emphasis on the pyloric teeth, *Acta anatomica*. 88: 1–10.
- Mahmood, T., K. Jabeen, I. Hussain & A.R. Kayani (2013).** Plant species association, burrow characteristics and the diet of the Indian Pangolin, *Manis crassicaudata*, in the Potohar Plateau, Pakistan. *Journal of Zoology* 45: 1533–1539.
- Nowak, R.M. (1991).** *Walker's Mammals of the World*. John Hopkins University Press, Baltimore, USA. 2015pp.
- Pietersen, D.W., C.T. Symes, S. Woodborne, A.E. Mckechnie & R. Jansen (2015).** Diet and prey selectivity of the specialist myrmecophage, Temminck's ground pangolin. *Journal of Zoology* 298: 198–208.
- Prater, S.H. (1971).** *The Book of Indian Animals*. Bombay Natural History Society, Oxford University Press, Chennai, 348pp.
- Schmitter, D.A. (2005).** Order Pholidota, pp. 530–531. In: Wilson, D.E. & D.M. Reeder (eds.). *Mammal Species of the World: A Taxonomic and Geographic Reference*, Johns Hopkins University Press, Baltimore.
- Stewart, J.M., P.R.K. Richardson & J.W.H. Ferguson (1999).** Ecological factors affecting the feeding behaviour of Pangolins (*Manis temminckii*). *Journal of Zoology* 247: 281–292.





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