A coconut-eating monitor lizard? On an unusual case of frugivory in the melanistic Sulawesi water monitor (*Varanus togianus*)

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Among the top predators in many environments they inhabit, monitor lizards (Varanidae: *Varanus*) are known to be almost exclusively carnivorous (Losos & Greene, 1988). Only three out of nearly eighty currently recognised species are known to feed mainly on vegetarian items, for example on fruits, seeds, and leaves (Koch et al., 2013). These are *Varanus olivaceus*, *V. mabitang*, and the recently described *V. bitatawa* (Auffenberg, 1988; Struck et al., 2002). All three nominal species are endemics of the Philippine Islands and seem to represent an adaptive radiation (Welton et al., 2010). Asian water monitor lizards of the *V. salvator* complex are the most wide-spread monitor lizard group, inhabiting most of mainland and insular southeast Asia reaching their eastern-most distribution in the northern Moluccas (Koch & Böhme, 2010). Accordingly, these euryoecious lizards are carnivorous feeding on a wide variety of prey including carrion, garbage, and even human corpses (Traeholt, 1994; Uyeda, 2010; Gunawardena, 2016).

During field work on Selayar Island off the coast of southwest Sulawesi, an adult male specimen of the melanistic Sulawesi water monitor (*V. togianus*) was found dead on a road south of the village of Benteng (6°7'10.73'' S, 120°27'59.88'' E) on 6 June 2006 (Fig. 1). The specimen had a snout-vent-length of 56.5 cm with the tail measuring 79.3 cm. Its head exhibited clear evidence from a lethal accident with a vehicle, while the remaining body showed no injuries. The specimen was collected to be examined in detail. In order to preserve and deposit it at the Museum Zoologicum Bogoriense (MZB Lac. 5951, field number AK208), the venter was opened to remove all stomach contents and prey items. Surprisingly, no prey remains were recovered from the digestive tract, but instead an unidentifiable mass comprised of countless small pieces of a whitish hard substance. After flushing and cleaning, closer examination revealed that these were small pieces of coconut flesh and had filled out the body cavity of the lizard (Fig. 2). Although the stomach contents of other voucher specimens of water monitor lizards collected from different localities on Sulawesi have not been investigated, some specimens disgorged the remains of scorpions, chicken, and sea turtle eggs when handled for examination. The coconut pieces of the Selayar specimen, however, represent the only case of frugivorous remains recorded.

Aside from reports of vegetarian nutrition in the three Philippine species mentioned above, only a few cases of frugivory in monitor lizards have been published so far. Mertens (1971), for instance, reported on banana-eating in the emerald tree monitor lizard (*V. prasinus*) in captivity. Among other unidentified items, Sprackland (1982) found

Figure 1. A road-kill specimen of the melanistic Sulawesi water monitor lizard (*V. togianus*) found dead on a road on Selayar Island, Southwest Sulawesi. To prevent physical decay the stomach contents were removed.

Figure 2. Emptying and cleaning the stomach contents revealed countless pieces of coconut flesh from the intestines of the monitor specimen depicted in Fig. 1

55% frogs, 17% geckos and 12% plant material in the feces of newly acquired (i.e. assumed wild-caught) *V. prasinus* specimens. Subsequently, this author fed bananas and cantaloupe melons in addition to various carnivorous items to his monitor lizards and noticed no digestive problems in the specimens. However, based on the examination of wild-caught museum specimens of *V. prasinus* Greene (1986) and Losos & Greene (1988) could not confirm Sprackland's (1982) observation.

Observations of frugivory from the wild are restricted to few anecdotal notes. Parry (1932), for instance, mentioned that water monitors in the Garo Hills of Assam, North-East India, are said to "(…) come into the fields to eat melons, cucumbers and the ears of paddy (…)". Vogel (1979) reported frugivory in *V. salvator bivittatus* from Java.

It is well known that monitor lizards, like snakes, use their tongues to trace potential prey by guiding odorous particles from the air to the olfactory receptors located in the Jacobson's organ on the palate (Smith, 1986). Consequently, a possible explanation for our unusual finding could be the fact that coconuts are widely used in the tropics to obtain coconut oil. For this purpose, the coconut flesh is cut into large pieces and spread on the ground to dry in the sun. This treatment with heat leads to fermentation processes that cause an offensive smell that is carried by the wind. Thus, it seems possible that the monitor lizard detected the odour of fermenting coconut flesh (called copra) when searching for food and regarded it as a rotting carcass. This assumption is supported from the observations of a keeper of monitor lizards who reported that specimens under his care ate pieces of banana or carrots after they had been in contact with crickets (K. Wesiak, pers. comm.). Our observation probably represents an exception since water monitors can only feed on coconut flesh, where coconut palms are cultivated and harvested by men, and also very few animals are able to open these hard-shelled fruits. Thus, although being probably one of the better-studied monitor lizard groups (i.e., Vogel, 1979; Gaulke, 1989), due to their wide distribution and ability to inhabit anthropogenic environments, further field studies are certainly needed to better understand the ecology of (Sulawesi) water monitor lizards.

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REFERENCES

Auffenberg, W. (1988). *Gray's Monitor Lizard*. Gainsville: University Press of Florida. 419 pp.

Gaulke, M. (1989). Zur Biologie des Bindenwarans, unter Berücksichtigung der paläogeographischen Verbreitung und der phylogenetischen Entwicklung der Varanidae. *Courier Forschungsinstitut Senckenberg* 112: 1-242.

Greene, H.W. (1986). Diet and arboreality in the emerald monitor, *Varanus prasinus*, with comments on the study of adaptation. *Fieldiana Zoology* 31: 1-12.

Gunawardena, S.A. (2016). Forensic significance of monitor lizard scavenging activity on human corpses. *Biawak* 10: 45-47.

Koch, A. & Böhme, W. (2010). Heading east: a new subspecies of *Varanus salvator* from Obi Island, Maluku Province, Indonesia, with a discussion about the easternmost natural occurrence of Southeast Asian water monitor lizards. *Russian Journal of Herpetology* 17: 299-309.

Koch, A., Ziegler, T., Böhme, W., Arida, E. & Auliya, M. (2013). Pressing Problems: Distribution, Threats, and Conservation Status of the Monitor Lizards (Varanidae: *Varanus* spp.) of Southeast Asia and the Indo-Australian Archipelago. *Herpetological Conservation and Biology* 8 (Monograph 3): 1-62.

Losos, J.B. & Greene, H.W. (1988). Ecological and evolutionary implications of diet in monitor lizards. *Biological Journal of the Linnean Society* 35: 379-407.

Mertens, R. (1971). Unerwartete bananenfresser unter Reptilien. *Salamandra* 7: 39-40.

Parry, N.E. (1932). Some notes on water monitors in the Garo Hills, Assam. *Journal of the Bombay Natural History Society* 35: 903-905.

Smith, K.K. (1986). Morphology and function of the tongue and hyoid apparatus in *Varanus* (Varanidae, Lacertilia). *Journal of Morphology* 187: 261-287.

Sprackland, R.G. (1982). Feeding and nutrition of monitor lizards in captivity and in the wild. *Kansas Herpetological Society Newsletter* 47: 15-18.

Struck, U., Altenbach, A.V., Gaulke, M. & Demegillo, A. (2002). Tracing the diet of the monitor lizard *Varanus mabitang* by stable isotope analyses (δ15N, δ13C). *Naturwissenschaften* 89: 470-473.

Traeholt, C. (1994). Notes on the water monitor, *Varanus salvator*, as a scavenger. *Malayan Nature Journal* 47: 345-353.

Uyeda, L. (2009). Garbage Appeal: Relative Abundance of Water Monitor Lizards (*Varanus salvator*) correlates with Presence of Human Food Leftovers on Tinjil Island, Indonesia. *Biawak* 3: 9-17.

Vogel, P. (1979). Zur Biologie des Bindenwarans (*Varanus salvator*) im westjavanischen Naturschutzgebiet Ujung Kulon. PhD. Thesis, University of Basel, Switzerland, 139 pp.

Welton, L.J., Siler, C.D., Bennett, D., Diesmos, A., Duya, M.R., Dugay, R., Rico, E.L.B., van Weerd, M. & Brown, R.M. (2010). A spectacular new Philippine monitor lizard reveals a hidden biogeographic boundary and a novel flagship species for conservation. *Biology Letters* 6: 654-658.

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