

## Nocturnal Activity of *Varanus salvator* on Tinjil Island, Indonesia

LINDA UYEDA<sup>1,2</sup>, ENTANG ISKANDAR<sup>3</sup>, AARON WIRSING<sup>1</sup> & RANDALL KYES<sup>4</sup>

<sup>1</sup>*School of Environmental and Forest Sciences  
University of Washington  
Box 352100, Seattle, WA, USA 98195-2100*

<sup>2</sup>E-mail: itu@u.washington.edu

<sup>3</sup>*Primate Research Center  
Bogor Agricultural University  
Bogor, West Java, Indonesia*

<sup>4</sup>*Departments. of Psychology & Global Health, Center for Global Field Study,  
and Washington National Primate Research Center,  
University of Washington  
Seattle, WA, USA*

**Abstract - Nocturnal activity has rarely been reported in *Varanus salvator*. This report documents observations of nocturnal activity in *Varanus salvator* on Tinjil Island, Indonesia, where such behavior may provide a competitive advantage over conspecifics in foraging for human food leftovers. Pre-dawn scavenging of a *V. salvator* carcass by a conspecific is also noted.**

### Introduction

The water monitor lizard, *Varanus salvator*, is generally considered to be diurnal (Gaulke & Horn, 2004), though nocturnal activity has been observed on occasion. For example, Biswas & Kar (1981) noted nocturnal nesting behavior in *V. salvator*, and Gaulke (pers comm.; 1989) documented nocturnal feeding behavior by two *V. salvator marmoratus* (now *V. palawanensis*) on the carcass of a wild pig. Here, 16 observations of nocturnal activity by a single *V. salvator* on Tinjil Island, Indonesia are reported. An observation of a second *V. salvator* attempting to scavenge on the carcass of a conspecific in the early morning (prior to daylight) is also noted.

### Methods

*Varanus salvator* were observed from 5 July 2012 to 11 August 2012 on Tinjil Island, Indonesia as part of an ongoing study of the island's population and their behavior, range, and resource use. Tinjil Island,

located approximately 16 km off the south coast of Java, Indonesia, is about 600 ha in size and consists primarily of lowland tropical rainforest and coastal/beach vegetation. Since 1987 the island has been designated as a natural habitat breeding facility for long-tailed macaques (*Macaca fascicularis*) (Kyes *et al.*, 1997). Although there are officially no permanent residents on Tinjil Island, a continuous human presence of staff and researchers (about 5-8 people at any given time) reside in a small base camp area. Food preparation is carried out primarily in a main base camp building, and food scraps (e.g., egg shells, fish skeletons) are regularly discarded in a clearing anywhere from 1 to 5 m from the east side of the main base camp building. Food scraps and other garbage are also routinely disposed of in a large, ca. 1.5 x 2 x 1 m cement garbage box, located approximately 3 m south of the main base camp building. The garbage box has large openings in the side and top, through which *V. salvator* commonly enter to forage (Uyeda, pers. obs.). *Varanus salvator* living in the base camp area are

habituated to people and seem unconcerned about the presence of humans when walking and foraging around base camp (Uyeda, pers. obs.)

In addition to the base camp, there are also three small fishermen camps spaced along the north side of the island. The fishermen utilizing these camps are not permanent residents, but stay on Tinjil Island regularly when fishing in nearby waters. The fishermen camps are small (3-5 fishermen per camp), equipped with basic huts and no modern facilities. Cooking and fish cleaning also occur at the fishermen camps.

Throughout the study period, behavioral observations were carried out using a combination of ad libitum sampling (behaviors of one or more animals were recorded) and focal individual follows (behaviors of a single focal animal were recorded). Focal individuals were followed for two-hour time blocks between 0600 and 1800 h. During these daytime ad libitum and focal sampling periods, recorded behaviors included sleeping, walking, foraging, etc.

Although initial observations were carried out between 0600 and 1800 h, sampling periods were extended to begin at 0500 h on 9 July 2012 after pre-dawn activity was observed on 8 July 2012. Sampling periods were further extended on 30 July 2012 to include the hours between 0300 h and 0500 h following observations of nocturnal activity on 28 and 30 July 2012. These early morning observations were carried out daily from 30 July 2012 to 11 August 2012, with the exceptions of 5 August 2012, 7 August 2012, and 10 August 2012 (Table 1).

The study population consisted of seven *V. salvator* that had been fitted with LPR-3800 radio-telemetric harnesses (Wildlife Materials, Murphysboro, IL, USA) and marked with crayon as part of a broader study on Tinjil Island's population. Although these study animals were outfitted with telemetry equipment, it was extremely difficult to track animals through the forest in the dark without creating a noisy disturbance and without the excessive use of artificial light. For this reason, nocturnal observations were carried out in the immediate base camp area (a cleared perimeter surrounding the main camp building approximately 10 m in width), where they could be accomplished quietly and with minimal effect on the monitors' behavior. No *V. salvator* were observed sleeping in the cleared perimeter surrounding the base camp building during the early morning sampling periods and only active behaviors such as walking and foraging were recorded during these times. As *V. salvator* activity (e.g., walking, foraging) could be easily heard from inside the main

base camp building (Uyeda, pers. obs.), it was also possible for researchers to become aware of nocturnal behavior without actively observing the area. Additional instances of nocturnal behavior were opportunistically recorded as they were discovered.

On 5 July 2012 an adult *V. salvator* was captured, fitted with an LPR-3800 radio-telemetric harness (Wildlife Materials, Murphysboro, IL, USA), and marked with crayon. The animal was assigned the identifier "04" and was released at the point of capture. Monitor 04 was a suspected male based on size (17 kg, 217 cm in total length—minus tail tip) and numerous observed agonistic interactions with other individuals.

### **Repeated nocturnal activity and foraging behavior in a solitary individual**

On 8 July 2012, monitor 04 was observed walking in the dark at 0525 h in the immediate base camp area. At 0530 h on 12 July 2012, monitor 04 was again observed walking in the dark in the base camp area. No other *V. salvator* were observed engaging in nocturnal behavior until 28 July 2012, when monitor 04 was again seen active in the base camp area.

21 July 2012 marked the first day of the month-long religious fasting associated with the observance of Ramadan. All researchers and staff present on Tinjil Island at that time began observing the fast, and meal times were adjusted to include the traditional pre-dawn meal (that occurs during the fasting period) at approximately 0300 h each morning. Cooking for the pre-dawn meal generally began around 0200 h, and perimeter lights for the main base camp building were turned on for approximately an hour between 0230 h and 0330 h. An additional early morning dumping of food scraps (around 0330 h) also occurred on most days during this fasting period.

At 0341 h on 28 July 2012 monitor 04 was seen walking around the main base camp building. Although it was dark outside, perimeter lights to the building had been turned on, illuminating the immediate base camp area. Monitor 04 was seen again at 0343 h on 30 July 2012 walking around the main base camp area. Following the 30 July 2012 sighting of monitor 04, sampling periods were extended to include additional hours corresponding to the pre-dawn meal associated with the Ramadan fast. In total, monitor 04 was observed engaging in nocturnal activity in the base camp area on 14 occasions from 28 July 2012 – 11 August 2012 (Table 1). Among these 14 nocturnal observations, activity was recorded as early as 0128 h (1 August 2012) with the

Table 1. Nocturnal observations of *V. salvator*, monitor 04, at Tinjil Island base camp

Date (2012)	Time observed	Lights	< 1 h after food discarded	Observed consuming food?
8-Jul	0525 h	Off	?	Yes
12-Jul	0530 h	Off	?	No
28-Jul	0341 h	On	?	No
29-Jul	No data	--	--	--
30-Jul	0343 h	On	?	No
31-Jul	0259 h	On	?	No
31-Jul	0317 h	On	Yes	No
1-Aug	0128 h	Off	No	No
1-Aug	0413 h	Off	Yes	Yes
2-Aug	0505 h	Off	?	Yes
3-Aug	0252 h	On	?	No
4-Aug	0330 h	On	?	Yes
5-Aug	No data	--	--	--
6-Aug	0527 h	Off	No	Yes
7-Aug	*	*	--	--
7-Aug	0514 h	Off	No	No
8-Aug	0455 h	Off	No	Yes
9-Aug	0450 h	Off	No	Yes
10-Aug	*	*	--	--
11-Aug	0334 h	On	No	Yes

\* Staff members reported seeing monitor 04 at approximately 0300 h (lights on), but animal was not formally observed

majority of activity observed between the hours of 0300 and 0530 h (Table 1). On seven occasions, monitor 04 was seen active while the perimeter lights were on, but on seven occasions monitor 04 was active in the absence of artificial light (Table 1). Of the seven dates monitor 04 was observed without supplemental perimeter lights, three (1 August 2012 and 2 August 2012) occurred when the moon was near full/full, and the other four (6 August 2012 – 9 August 2012) occurred as the moon approached its third quarter.

Each of the 14 occurrences of nocturnal activity involved monitor 04 alone as it was engaged in foraging/eating and/or walking to one or both base camp garbage dumping areas (approximately 15 m apart). On three occasions monitor 04 was observed actively foraging/eating for longer than 1 hr; foraging was carried out across both base camp garbage scrap dumping areas, and monitor 04 was observed consuming food scraps (fish and crab remains, bits of chicken, etc.) Although monitor

04 often slept along the forest edge, very close to base camp (as confirmed visually and by radio-telemetry), the nocturnal activity did not seem to closely correspond to any obvious cues such as the commencement of cooking, turning on of the perimeter lights, or the dumping of food scraps. On only two occasions did monitor 04 arrive at the base camp clearing within one hour of food scraps having been discarded (Table 1). Monitor 04 was also observed on occasion walking to each of the garbage areas in the dark and leaving the area presumably after finding that no new food had been dumped. On 31 July 2012 and 1 August 2012 monitor 04 was observed returning to camp a second time after food scraps were dumped (Table 1). However, an observer might wait more than two hours after food scraps were dumped before witnessing the emergence of monitor 04 from the forest edge. When active in the base camp clearing, monitor 04 was observed rummaging through newly discarded food scraps whenever available.





Fig. 1. Monitor 04 foraging in the dark on Tinjil Island, Indonesia at 0420 h, 1 August 2012. Photograph by **Linda Uyeda**.



Fig 2. Monitor 04 foraging in the dark at Tinjil Island base camp at 0425 h, 1 August 2012. Photograph by **Linda Uyeda**.



Fig. 3. Monitor 04 foraging in a bucket outside the Tinjil Island base camp kitchen in the dark, 0515 h, 2 August 2012. Photograph by **Linda Uyeda**.

Discarded food did not always include meat, consisting of rice, vegetables, fruit rinds, etc., and was not always consumed.

Based on information obtained via radio-telemetry, monitor 04 was likely not active in the forest prior to the observed nocturnal activity around base camp; at the beginning of each observation period monitor 04 was often tracked to just inside the forest edge, with the position confirmed multiple times and the animal inactive up until emergence from the forest to forage at base camp.

#### **Early morning nocturnal activity: Attempting to eat a carcass**

On 30 July 2012 an unknown adult *V. salvator* was encountered at 0520 h while engaged in foraging in the dark at the forest edge ca. 3 m from the base camp clearing. The individual's behavior was characterized by lateral head movements and frequent tongue flicks focused on a particular area on the ground. After approximately 3 min of this behavior, the monitor scraped at the leaf litter with its forefeet, unearthing an old, desiccated *V. salvator* carcass. The monitor then dragged the carcass approximately 2 m and propped it against a fallen branch. The monitor used its forefeet to hold the carcass down while maneuvering around to tear at the carcass with its mouth. The carcass appeared quite tough and devoid of flesh.

The monitor attempted to rip at the carcass with its mouth from numerous angles but seemed to be unsuccessful. After about 5 min of this behavior, the monitor left the carcass and walked directly towards the observer while tongue flicking, approaching within 0.5 m. The monitor then retreated farther into the forest, at which time the observation was concluded. This observation was carried out in the dark; however, a headlamp and flash photography were utilized sparingly by a single observer, ca. 3 m away from the monitor. The monitor did not appear to have been disturbed noticeably by the presence of the observer or the accompanying light sources.

#### **Discussion**

Throughout the course of the study period, only two individuals were seen engaging in nocturnal behavior. Other than the unknown monitor attempting to feed on a *V. salvator* carcass in the early morning, all occurrences of nocturnal behavior were observed in a single individual, monitor 04. On numerous nighttime occasions, monitor





Fig. 4. *Varanus salvator* addressing the carcass of a conspecific near Tinjil Island base camp, pre-dawn (ca. 0523 h), 30 July 2012. Photograph by **Linda Uyeda**.



Fig. 5. *Varanus salvator* attempting to feed on the carcass of a conspecific near Tinjil Island base camp, pre-dawn (ca. 0525 h), 30 July 2012. Photograph by **Linda Uyeda**.



Fig. 6. *Varanus salvator* pulling on the arm of a *V. salvator* carcass near Tinjil Island base camp, pre-dawn (ca. 0525 h), 30 July 2012. Photograph by **Linda Uyeda**.

04 was seen foraging on recently discarded food scraps alone and free from any competition. During daylight hours, monitor 04 was frequently observed “patrolling” the base camp area, walking back and forth between garbage dumping areas and chasing smaller and even similarly sized monitor lizards away. In all agonistic interactions observed in the base camp area between monitor 04 and other individuals, monitor 04 was the clear “winner”, with the exception of those encounters between monitor 04 and the largest individual recorded in the area, monitor 07 (22 kg, 221.5 cm in total length—minus tail tip). As monitor 07 was an infrequent presence in the base camp area, monitor 04 was generally able to access all dumped garbage at will despite the presence of other monitors, though with some effort. Thus, it can be concluded that monitor 04 did not engage in nocturnal foraging out of necessity, but perhaps as a strategy to increase food consumption without having to expend additional energy on the defense of food resources. Previous research has documented associations between nocturnal activity in varanids and feeding: in addition to Gaulke’s (1989) observation of nocturnal feeding activity in two *V. salvator marmoratus* (now *V. palawanensis*), Yong *et al.* (2008) documented nocturnal foraging in *V. dumerilii*, Trembath (2000) noted nocturnal foraging in *V. gouldii*, and Cota *et al.* (2008) documented nocturnal activity in *V. dumerilii* in an area where crabs, a favorite prey item, were abundant.

High nighttime temperatures have also been suggested as a partial explanation for unusual occurrences of nocturnal behavior in *V. panoptes* (Shannon, 2008) and *V. dumerilii* (Cota *et al.*, 2008). *Varanus salvator*, however, is generally active at body temperatures of 30–32° C (Traeholt, 1995) and has demonstrated an apparent tolerance for ambient temperature fluctuations. For example, Traeholt (1995) noted that *V. salvator* in a Malaysian study population were easily able to raise their body temperatures above the ambient temperature even during the cooler rainy season. Nocturnal behavior in Tinjil Island’s population occurred at ambient temperatures as low as 24.6° C, suggesting that nocturnal activity in *V. salvator* is not restricted to high nighttime temperatures.

Though monitor 04 was observed engaging in early morning nocturnal activity before the start of Ramadan, fourteen of the sixteen recorded occurrences fell within the month of religious fasting. Monitor 04’s behavior may represent a shift in foraging activity in response to a change in human activity associated with the fast. A logical test of this hypothesis would be to compare the incidence of monitor 04’s nocturnal activity between

periods including the month of Ramadan, to those typifying times when Tinjil Island's inhabitants are not participating in a nightly 0300 h meal. Interestingly, throughout the study period monitor 04 was not observed engaging in regular nocturnal activity between 1800 h and 0100 h despite the fact that food scraps were often dumped after an evening meal around 1800 h. As research on Tinjil Island's *V. salvator* population is ongoing, future observations of monitor 04 in subsequent field seasons will serve as opportunities to shed further light on this individual's nocturnal behavior. Additional observations in the Tinjil Island study area may also reveal new instances of individuals engaged in nocturnal activity. Further systematic study of nocturnal activity in varanids is needed to explore the prevalence and potential fitness benefits of such behavior.

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