BIAWAK

Quarterly Journal of Varanid
Biology and Husbandry

Volume 3 Number 3
September 2009

ISSN: 1936-296X

On the Cover: *Varanus panoptes panoptes*

The *Varanus panoptes panoptes* depicted on the cover and inset of this issue was photographed by **Bruce Thomson** at Lake Broadwater, near Dalby, Queensland on 25 November 2008. While observing aquatic birds along the shore of the lake at around 1400 h, a sub-adult *V. p. panoptes* (ca. 1 m in total length) was seen foraging along the water's edge. At ca. 45 m from the edge of the lake, the monitor began digging, then quickly located a clutch of freshwater turtle eggs, presumably *Chelodina longicollis*. The *V. p. panoptes* consumed about six eggs over the course of 20 minutes, until it was disturbed by the photographer and left the area. No additional *V. p. panoptes* were seen the day of the observation. *Varanus varius* and *V. gouldii* are also present in the area.

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INTERNATIONAL VARANID INTEREST GROUP
www.varanidae.org

The International Varanid Interest Group is a volunteer-based organization established to advance varanid research, conservation, and husbandry, and to promote scientific literacy among varanid enthusiasts. Membership to the IVIG is free, and open to anyone with an interest in monitor lizards and the advancement of varanid research. Membership includes subscription to *Biawak*, a quarterly journal of varanid biology and husbandry, and is available online through the IVIG website.

ISSN 1936-296X

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Varanus bengalensis bengalensis. Corbett Tiger Reserve. Uttar Pradesh, India.
Photograph by **Kahini Ghosh Mehta** and **Shivang Mehta** www.naturewanderers.com

ORGANIZATIONAL NEWS

New Additions to the Editorial Board

The IVIG welcomes Markus Juschka of Aquazoo Düsseldorf, Germany to the editorial board of *Biawak* as zoo liaison, and Matthew Somma as editorial liaison.

Australian Zoo Liaison Needed

The IVIG currently seeks a member of the Australian zoo and aquarium field to serve as a regional zoo liazon for *Biawak*, Primary duties and responsibilities will include networking with zoological institutions in your respective region to report quarterly announcements of recent captive breedings as well as promote *Biawak* to related institutions. This is a volunteer position. For additional details, please contact the IVIG at info@varanidae.org.

Layout Editor Needed

The IVIG currently seeks a motivated individual to join the editorial board of *Biawak* as layout editor. A proficiency and ability to work with Adobe InDesign (must furnish your own copy) is required, as well as the ability to work under deadlines. The layout editor will be responsible for working with the senior and associate editors on the publication's layout as well as assembling each quarterly issue of *Biawak*. This is a volunteer position. Interested parties, please contact info@varanidae.org for more details.

Varanus niloticus. Kruger NP, South Africa
Photograph by **Jody Fairish** www.ournaturalworld.co.uk

NEWS NOTES

Parthenogenesis Reported in *Varanus niloticus*

Reptile Village, a small reptile zoo in Kilkenny, Ireland, has reported a case of parthenogenesis in *Varanus niloticus*. According to curator James Hennessy, one of the zoo's 10 year old, 1.4 m female *V. niloticus*, having never been with a male, produced a clutch of 21 eggs. Though most of the eggs failed to develop, one egg incubated full-term and contained a fully-developed embryo which had died in the egg. According to the zoo's website, this specimen was physically sexed as a male and has been preserved at the zoo.

If authentic, this case represents the third species in which parthenogenesis has been observed in *Varanus*. Previously published accounts exist for *V. panoptes* and *V. komodoensis*.

Source: irishtimes.com – 1 July, 2009 ; Wikinews - 4 July 2009 ; http://reptilevillage.net

Florida Expands Python Hunting to Include *Varanus niloticus*

In response to growing concerns over exotic reptiles which has become established in southern Florida, the Florida Fish and Wildlife Conservation Commission recently announced a policy which will give licensed hunters authority to kill pythons and other invasive reptiles in south Florida. The policy, which takes effect 29 August 2009, will allow hunters with licenses for deer, hogs or alligators to kill Burmese pythons, green anacondas, and Nile monitors, but only in season and with approved weapons, and all reptile kills must be reported to the commission.

Source: UPI.com – 22 August 2009

Varanus bengalensis nebulosus. Central Catchment Nature Reserve, Singapore.
Photograph by **Shirly Ng**.

Malaysian *Varanus salvator* Feeds on Human Remains

Remains of a dead infant were found in a garbage bag along the banks of the Kelantan River in Kampung Peramu village, Pahang, Malaysia, after it had been partially consumed by an Asian water monitor, *Varanus salvator*. Witnesses claimed to have first seen the garbage bag a few days earlier, but thought nothing of it, even though whatever was in the bag was being eaten by a monitor. Upon investigation, a police team found only the newborn's head and part of the right arm. Kampung Peramu village head Baharuddin Sulong said that this was the first time such an incident has occurred in the village.

Source: New Strait Times - 5 Aug 2009

Monitor Lizard Keeps its Name

Thailand's Department of National Parks, Wildlife and Plant Conservation wildlife conservation office has abandoned plans to assign a new Thai name for the water monitor, *Varanus salvator*. Department officials suggested that the name *hia* be changed, due to the many negative connotations associated with it. Proposed name changes to *Voranuch* or *Voranus* were abandoned when several individuals named Voranuch and Voranus had contacted the department's office to complain that they would have to share their name with the lizard.

Source: The Nation- 3 July 2009

Cameron Park Zoo Unveils New Komodo dragon

The Cameron Park Zoo in Waco, Texas has recently unveiled a brand-new Asian Forest exhibit, which among other animals such as Orangutans, houses a sub-adult Komodo dragon, *Varanus komodoensis*.

Source: wacotrib.com – 14 August 2009

Indonesian Government Plans to Relocate Komodo Dragons to Bali

Recent plans by the Indonesian Forest Ministry to relocate ten *Varanus komodoensis* from East Nusa

Varanus scalaris. Halloran's Hill Conservation Park, Queensland. Photograph by **Tim Wiemers**.

Tenggara Province, West Manggarai to the island of Bali have drawn a considerable amount of criticism by conservationists, West Manggarai residents, and Indonesian student groups. The animals are planned to be relocated from Wae Wuul Nature Reserve to Bali Marine and Safari Park. According to Hans Manangsang, head of the Bali park, the population of *V. komodoensis* has declined considerably due to fire and habitat alteration, thus necessitating the transfer of some animals. Opponents of the plan claim that the move is merely designed to increase Bali tourism; a charge park and government officials deny. The government has also cited the need for 'genetic purification' as a reason for the move; a reason quickly denounced by opponents. "If the goal of the move is genetic purification, why should the dragons have to leave their habitat? It's an illogical reason" opined Herman Son.

Source: The Jakarta Globe – 24 July, 1, 4, 6, 7 August 2009

East Nusa Tenggara Asks for Return of Dragons

Esthon Foenay, Deputy Governor of East Nusa Tenggara Province, West Manggarai, has asked Bali Marine and Safari Park to return four *Varanus komodoensis* they currently possess. The request comes in the wake of a controversial plan to relocate ten dragons from East Nusa Tenggara to the Bali park. The origin of these animals is not known. Tamen Sitorus, head of Komodo National Park, believes the animals may have originated as captive-bred offspring from any number of Indonesian zoos and not from East Nusa Tenggara. Genetic tests would determine the specimen's origin, though the timing of this comes as a larger controversy over the planned relocation of ten wild dragons from East Nusa Tenggara to the Bali park looms.

Source: The Jakarta Post – 6 August 2009

Varanus salvator. Sungei Buloh Wetlands Reserve, Singapore.
Photograph by **Madeline Teo**

ARTICLES

Biawak, 3(3), pp. 77-80

Zoo-Ethnological Observations in Southwest Sulawesi, Indonesia: a case Study of Kembar Buaya ("Monitor Twins")

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Abstract - The spiritual relationships between human beings and nature are manifold and sometimes quite bizarre. Bugis and Makassarese people on the central Indonesian island of Sulawesi, for instance, believe that some monitor lizards (*Varanus* cf. *togianus*) have an animal's body but a human spirit. These specimens are born together with their human twins and accepted as full family members. Here, we provide new first hand data and photographs of a case of Kembar Buaya (literally "twin crocodile") from Southwest Sulawesi to document this extraordinary phenomenon. The erroneous "crocodile twin" appellation with regard to monitor lizards is discussed in the historical context of declining Sulawesi crocodile populations.

Koch and Acciaioli (2007) recently reported on the spiritual relationship between Indonesian Bugis people and the endemic black Sulawesi water monitor *Varanus* cf. *togianus* (Fig. 1). The story involved a Bugis family living in a floating house on Lake Tempe, Southwest Sulawesi. Everything was normal, except that the family's daughter was a monitor lizard named Ali Douyoung, who was born together with their son, Suardi.

No photographs could be added to the article because the information and observations were derived second hand from a TV documentary (Corillion, 1999), and due to copyrights concerns. The traditionally held belief is that some monitor lizards have an animal's body but a human spirit.

Olivier Lelievre, advisor and sound engineer of the French documentary "Les Hommes-Varans" (lit. "The Monitor Men") directed by Corillion (1999), reported to Koch after the publication of the 2007 note that he had been to Gowa, Southwest Sulawesi, again:

"I've been back in Gowa some months ago and I meet the father of Ali Mohamad, which (who?) was the go-between between men and Allah. As you wrote Ali was very old (34 was what the "parents" told me) and in fact he died two years ago. He was buried in the Muslim way, like a human being. I have seen some pictures of the funeral. The father told me that he got another "son", very young. He called him (through meditation) for 2 days because he was not at home at that time in order to let me know him but he didn't come. Maybe his son was still quite wild...!" (O. Lelievre, in litt. 6.12.2007).

Before the publication of Koch and Acciaioli (2007), J.-B. Fauvel happened to meet another family during a trip to the tip of the southwestern peninsula of Sulawesi in 2005 (Fig. 2), where a monitor was considered part of the family. The present note illustrates another case study of Sulawesi monitor twins:

In November 2005, J.-B. Fauvel witnessed an

Fig. 1. A melanistic Sulawesi water monitor, *Varanus* cf. *togianus*. Photograph by **A. Koch**.

example of the special familial relationship entertained by both Makassar and Bugis people with some monitor lizards. The village of Camba-Camba lies about 60 km southeast of Makassar (Ujung Pandang) in the Jeneponto regency, a district inhabited by Makassarese fishermen and seaweed, rice, maize and cassava farmers which is often faced with particularly long dry seasons. After hearing about a "kembar buaya" (literally "twin crocodile") allegedly living in the area, Fauvel decided to go learn more about it. As it turned out, the crocodile really was a monitor lizard ("biawak"), being raised as a child by a Makassar family (Fig. 3). The housewife claimed it was born to her on 6 December 1994 together with a baby girl. They had released the monitor into the river, but once grown up, it had come back "looking for its twin sister and parents". The family considered killing the monitor but it "raised its leg and started crying" in the most moving fashion, so the family came to believe it was really a human being with the appearance of a scaly monitor. Daeng Gerang, that is Sir Gerang, as it was named, shared a bedroom with his sister Rosnia (who was at school

Fig. 2. Map of Sulawesi showing the approximate location of the village Camba-Camba, 60 km southeast of Makassar, where Jean-Baptiste Fauvel met the monitor twin family.

at the time of the visit), enjoyed a custom-made tiled bathtub (Fig. 4), and apparently loved being cuddled by its human mother (Fig. 5). For all appearance, Daeng Gerang was considered a full member of the family.

Further inquiries about the "kembar buaya" phenomenon indicate that some Sulawesian people doubt that women really can conceive monitors and believe instead that reptile eggs may enter a pregnant woman's body when she bathes in the river. As for the erroneous "crocodile twin" appellation, it may date back to a time when crocodiles were more common in the area. Nowadays "biawak" are far more common than "buaya", but people still refer to the reptile twin as a "crocodile twin" although it comes in the form of a monitor lizard.

Acknowledgements - JBF would like to express his gratitude to the villagers of Desa Camba-Camba, Southwest Sulawesi, for their hospitality and kindness. We are grateful to Olivier Lelievre (http://www.lelievre-olivier.fr/1.html) for passing on information about his visit to Gowa in 2007. Finally, we thank Robert Neal (Brisbane, Australia) for improving the language of the present note.

Fig. 3. The water monitor Daeng Gerang as part of a family in the village Camba-Camba. Photograph by **J.-B. Fauvel**.

Fig. 4. Water monitor being bathed. Photograph by **J.-B. Fauvel**.

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Fig. 5. The adult water monitor and its human mother. Photograph by **J.-B. Fauvel**.

Received: 19 July 2009; Accepted: 14 August 2009

Biawak, 3(3), pp. 81-84

Varanus salvator (Laurenti, 1768) in Rathgama Lagoon in Galle District, Sri Lanka

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Abstract - *Varanus salvator* is very common in Sri Lanka, and is a frequent scavenger in anthropogenic environments. This short observation provides some ecological and biological data on the *V. salvator* of Rathgama lagoon in Galle District. Several individuals were found trapped in fishing nets with their axillas damaged.

Introduction

The monitor lizard diversity of Sri Lanka is limited to two species, namely *Varanus salvator* and *V. bengalensis*, with neither being endemic to the island (Das and de Silva, 2005; Deraniyagala, 1953). *Varanus salvator* is an enormous species, associated with wetlands such as mangrove swamps, but is also known to occur at elevations up to 1100 m, and is widespread around human-modified areas as well as in evergreen forests (Das and de Silva, 2005).

Materials and Methods

Observations were made on 19th June 2007 on an isolated island in Rathgama lagoon (Fig. 1), located in Rathgama, Galle District in the Southern Province of Sri Lanka. The study area is located at 06°01'N; 80°14'E and approximately 15 km from Galle city. The study site is a monastery and the habitat was quite disturbed by fishermen with minimal other human activities. The main vegetation included mangroves (Fig. 2) and poorly-maintained home gardens. The undergrowth was moderately cleared and there was an abundance of wet leaf litter on the ground. The soil was hard, saline, and sandy. The study was done from 1300 to 1500 hr on 19 June 2007. During this day, the weather was cloudy.

Air temperatures were measured using a digital thermometer and the humidity was taken with a digital hygrometer. A 100 x 100 m area of the island was used a sampling site to determine the abundance and population dynamics of *V. salvator*. Ten observers were used to survey and each person covered 1000 m^2. Some monitors were captured randomly for measurements, and then released. All morphological measurements were taken to the nearest 1 mm using a 1 m measuring tape.

Fig. 1. Rathgama lagoon, Galle District, Sri Lanka.

Scale counts: **SUP**, Supralabials were counted from the first [posterior scale of Rostral, to angle of gape, not including the median scale (when present); **INF**, infralabials were counted from the first posterior scale of mental, to angle of gape. *External measurements (in mm):* **SVL**, snout–vent length (distance between tip of snout and anterior margin of vent); **HW**, head width (maximum width of head); **DHL**, dorsal head length (distance between posterior edge of cephalic bone and tip of snout); **SL**, snout length (distance between anterior-most point of snout and middle of nostril); **NFE**, nostril – anterior eye length (distance between anterior- most point of orbit and middle of nostril); **NBE**, nostril – posterior eye length (distance between posterior-most point of orbit and middle of nostril); **IN**, inter-nasal width (least distance between the upper margins of nostrils); **UAL**, upper-arm length (distance between axilla and angle of elbow); **LAL**, lower-arm length (distance from elbow to wrist with both upper arm and palm flexed); **FL**, finger length (distance between tip of claw and the nearest fork); **FEL**, femur length (distance between groin and knee); **TBL**, tibia length (distance between knee and heel, with both tibia and tarsus flexed); **TL**, toe length (distance between tip of claw and nearest fork); **AG**, axilla–groin length (distance between axilla and groin); **TAL**, tail length (measured from anterior margin of vent to tail tip); **TBW**, width of tail base (greatest width of the tail base); **TD**, Tympanum diameter (least distance between the inner margins of tympanum); **FET**, front eye–tympanum (distance between anterior-most point of orbit and anterior most point of tympanum); **BET**, back eye–tympanum (distance between posterior-most point of orbit and anterior-most point of tympanum); **IOW**, inter orbital width (least distance between the upper margins of orbits).

Results and Discussion

During a two hour period, 27 individuals were recorded within the 10000 m^2 area. Three were captured (Fig. 3) for complete measurements (Table 1); for others, only SVL measurements were taken before they were released. Among the recorded individuals, 19 were adults and 8 were juveniles. According to the average SVL and the abundance of monitors in the area, we can conclude the *V. salvator* population inhabiting Rathgama lagoon is very healthy and stable. The livelihood of the people inhabiting the area around Rathgama lagoon has relied on fishing for ages. We observed many fish as well as body parts of fish dumped into the lagoon as waste; sometimes, fresh fish are also thrown into the lagoon when there is a surplus. For this reason, since *V. salvator* is an opportunistic scavenger, this population is likely increasing. As a result of the surplus of food resources, many individuals are obese. The absence of a predator for adult *V. salvator* may be another other reason for a likely increase in population size. On one occasion, we observed three monitors scavenging on the carcass of another *V. salvator*.

Fig. 2. Mangrove vegetation at study site.

Among the 27 individuals, two were found trapped in fishing nets and were in critical condition, with the posterior end of the jaw (Fig. 4) and the axilla damaged. Unfortunately, we couldn't keep those animals for treatments due to the rules and regulations of the department of Wildlife Conservation of Sri Lanka; and the monitors were released soon after (Fig. 5). In addition, we recorded two individuals that were missing the posterior half of their tails.

Acknowledgements - We are grateful to Dulip Ranga for support for the field visit. We are also grateful to Gayan Wijethunga, Marlon Perera, Praneeth Jayamadu and Pradeep Suranga for the field assistance.

Fig. 3. Adult *Varanus salvator*.

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Fig. 4. Adult *V. salvator* found trapped in a fishing net, with an injury to its jaw.

Fig. 5. *Varanus salvator* after release from fishing net.

Table 1. Morphometric data of randomly selected three adult *V. salvator* in mm.

	Male	Male	Female
SVL	800	720	650
FL I	40	40	36
FL II	60	50	45
FL III	75	60	54
FL IV	90	65	58
FL V	60	55	49
FEL	200	130	117
TBL	150	120	108
TL I	40	40	36
TL II	65	50	43
TL III	85	55	50
TL IV	85	65	55
TL V	55	65	58
AG	350	300	270
TAL	1450	1330	1200
TBW	390	230	207
TD	15	11	9
FET	70	49	44
BET	47	36	32
IOW	23	19	17
SUP	33	30	31
INF	33	30	31

Received: 30 May2009; Accepted: 29 September 2009

Biawak, 3(3), pp. 85-87

Aquatic Foraging Behavior and Freshwater Mussel (*Velesunio* sp.) Predation by *Varanus panoptes panoptes* in Central-Western Queensland

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Abstract – Aquatic foraging behavior and predation on freshwater mussels (*Velesunio* sp.) by *Varanus panoptes panoptes* in the Longreach District of central-western Queensland is reported. Mussel predation by *V. p. panoptes* was observed during periods of prolonged dry weather, when terrestrial prey availability was scarce. It is proposed that *V. p. panoptes* may exploit seasonally abundant prey items during drier seasonal conditions.

Introduction

In Australia, *Varanus panoptes* is widely distributed across northern parts of Western Australia, Northern Territory, and Queensland, and can be found in a variety of habitats including floodplains, riparian environments, coastal areas, savannah woodlands, mangrove fringes, and anthropogenic environments (Blamires, 2004; Christian, 2004). Reports on its diet in Australia suggest that it is a generalist (James et al., 1992), feeding on a broad range of prey items (Shine, 1986; Losos and Greene, 1988; Christian, 1995; Blamires, 2004; Christian, 2004; Shannon, 2008) as well as discarded human consumables (Shannon, 2008). *Varanus panoptes* is believed to have an incisive sense of smell (Christian, 2004) and is well-known for its ability to travel great distances in search of prey (Christian et al., 1995).

Although it has been reported to live and forage along the edges of water courses (Blamires, 2004; Christian, 2004) and will seek out water to submerge in during times of drought (Shannon, 2008), there has been little documentation of aquatic foraging behavior in *V. panoptes*. Martin (1990) reported on the diving behavior of a *V. panoptes* in Arnhem Land, NT presumed to be foraging for food underwater in a shallow creek. Here, we report a second account of aquatic foraging behavior, and document the predation of live freshwater mussels (*Velesunio* sp.) by *V. p. panoptes* in central-western Queensland.

Field Site

Observations took place at a large water retention dam (ca. 30 m in diameter, 7.6 m deep; Figs. 1 and 2) located in the Longreach District of central-western Queensland. The dam, which is used for watering livestock throughout the year, is filled by flood rains and can dramatically fluctuate in volume throughout the year. Many animals including kangaroos often seek out the dam for drinking water.

Observations

Freshwater mussel predation by *V. p. panoptes* was first observed in late 2003, when seasonal conditions in central-western Queensland were particularly dry and

Figs. 1 and 2. Freshwater dam where mussel predation was observed.

the dam was being regularly checked twice daily to extract animal carcasses (mostly sheep and kangaroos) from the muddy edges of the water. During one of these inspections, a *V. p. panoptes* (ca. 1.5 – 1.8 m in total length [TL]) was seen exiting the water with a large freshwater mussel, *Velesunio* sp. (ca. 12– 15 cm in length and 7.5 cm in width) (Fig. 3) in its mouth and proceeded to carry it onto land. It could not be determined whether or not the monitor crushed the mussel open or swallowed it whole, but given the absence of durophagic teeth in *V. p. panoptes*, it is likely the mussel was swallowed whole. Around this time, the dam was probably about a month from going dry, and at this time food options for goannas became limited. It should be noted however that there was an abundance of sheep carcasses along the water's edge which would have provided an easier meal, especially since *V. p. panoptes* is known to feed on carrion (Shannon, 2008). The *V. p. panoptes* appeared to be in quite poor physical condition, and the base of its tail was very thin.

A similar observation occurred in October 2007 at the same location, involving a larger sized *V. p. panoptes* (ca. 2 – 2.25 m TL). The monitor was first seen in 2.1-2.4 m of water, ca. 6 m from the shoreline in a clump of aquatic vegetation. The *V. p. panoptes* made several dives over the course of the observation, remaining underwater for ca. 10 min at a time. Upon surfacing each time, it paddled slowly on the surface for a few minutes before diving down again. Given the total distance traveled (ca. 38 m), and the fact that it surfaced a third time with a

Fig 3. Freshwater mussels, *Velesunio* sp. Camera lens cap for scale

mussel-sized object in its mouth, suggests that it was foraging for freshwater mussels. The *V. p. panoptes* swam to the bank with its catch, but disappeared from view before consumption could be observed.

Of interest, an adult *V. spencerii* was also seen emerging from the dam in December 2007, though no foraging behavior or predation was observed.

Discussion

The *Velesunio* predation observed in 2003 involved a sub-adult *V. p. panoptes* in poor physical condition, whereas the 2007 sighting involved a substantially larger adult individual. Since the individual sighted in 2007 was appropriately-sized for an individual that was last seen as a subadult in 2003, it is possible that both sightings may represent the same individual, though numerous *V. p. panoptes* are present in the region (Shannon, 2008).

Varanus panoptes lacks the laterally compressed tail typical of many semi-aquatic varanid species such as *V. mertensi*, *V. niloticus*, *V. salvator* and *V. indicus*, which is believed to aid in swimming. With a large and robust body plan, a tail more circular in cross-section, and nostrils situated farther back on the skull (Martin, 1990), *V. panoptes* is not expected to be a successful aquatic forager. Yet, from the familiarity the individuals seemed to have with finding, capturing and handling their prey, freshwater mussels may be a common dietary item in the area, at least during drier months when land-based prey may be scarce. Blamires (2004) reported that coastal-dwelling *V. p. panoptes* may seek out particular habitats in order to exploit seasonally abundant prey items. Likewise, *V. panoptes* from woodland and floodplain habitats are known to restrict their activity during the dry season to wetland areas where food was presumably more abundant (Christian et al., 1995). To date, freshwater mussel predation by *V. p. panoptes* in central-western Queensland has only been observed during drier seasonal conditions. Therefore, although it is possible that it may prey on mussels throughout the year, such predation may represent another example of *V. panoptes* exploiting seasonally abundant prey items. Further investigation is needed on the seasonal dietary habits of *V. p. panoptes*.

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Received: 14 July 2009; Accepted: 9 September 2009

Biawak, 3(3), pp. 88-92

Observations of Basking in *Varanus bengalensis nebulosus* from Northeastern Thailand

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Abstract - Basking activity in *Varanus bengalensis nebulosus* was observed between 3 - 10 April, 2009 at Phu Khiew Wildlife Sanctuary (northeastern Thailand). The monitor exhibits basking activity twice a day, in the morning and afternoon. Morning basking begins around 0800 h and continues until 1030 - 1100 h. Afternoon basking activity begins around 1400 - 1500 h, and continues until 1730 - 1830 h. Basking activity was delayed if it rained.

Introduction

Four species of varanids are found in Thailand. Among them, two species (*Varanus bengalensis nebulosus* and *V. salvator macromaculatus*) are recognized as having a wide distribution, almost extensive throughout the country (Taylor, 1963; Luxmoore and Groombride, 1990; Cox et al, 1998; Lauprasert and Thirakhupt, 2001; Nabhitabhata et al., 2004; Nabhitabhata and Chan-ard, 2005). Several reports have been published by various authors on the varanids of Thailand; unfortunately, the studies have focused more attention on the geographical distribution of the latter species *V. salvator* (see e.g., Lauprasert and Thirakhupt, 2001; Nabhitabhata et al., 2004; Borden, 2007; Duengkae, 2008; Duengkae and Chuaynkern, 2009).

Although the study of thermoregulation in varanids has seen much attention (see e.g., Christian and Bedfored, 1996; Traeholt, 1997; Seebacher and Grigg, 2001; Rathnayake et al., 2003), surprisingly, reports on thermoregulation in varanid taxa from Thailand are lacking. Here, we report observations on the basking activity of *V. bengalensis nebulosus* in Thailand, which should help fill in gaps of knowledge on this species and allow for comparisons with congeneric taxa from other countries.

Methods

Field observations on the basking behavior of *V. bengalensis nebulosus* were conducted by the primary author (PD) at Phu Khiew Wildlife Sanctuary (Chaiyaphum Province, northeastern Thailand) over eight consecutive days from 3 - 10 April 2009. Using binoculars (10 x 40), daily observations were made from 0600 to 1900 h at a tree hollow occurring in a Hiang tree *Dipterocarpus obtusifolius* (Dipterocarpaceae) located at 16°23'18"N; 101°34'25"E (coordinates determined

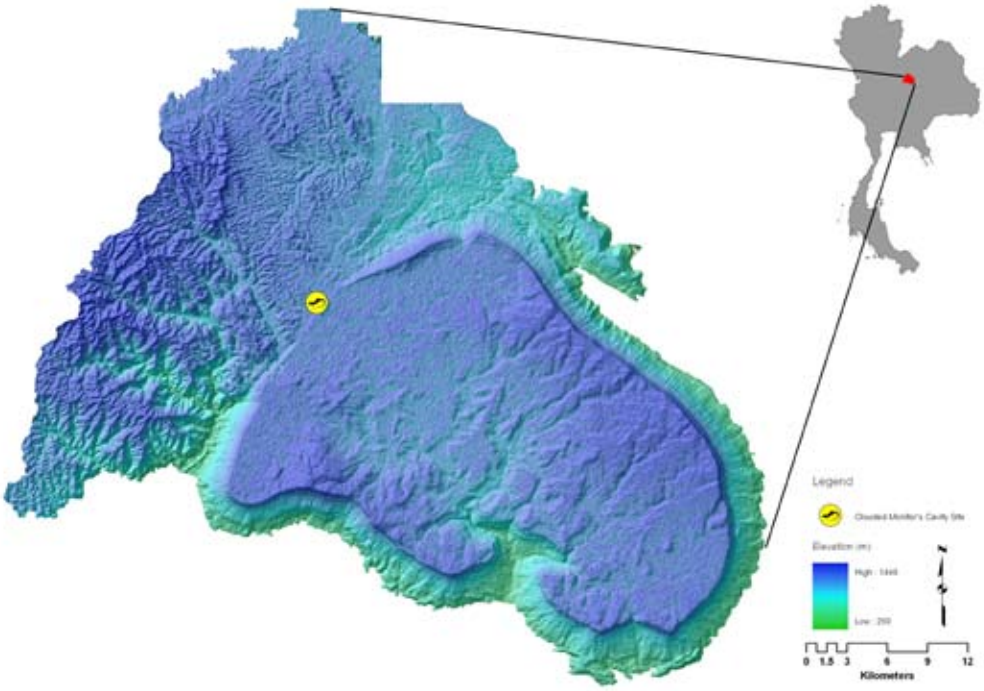

Fig. 1. Map of Phu Keiw wildlife sanctuary in northeastern, Thailand, with the location of the tree hollow occupied by the *Varanus bengalensis nebulosus*.

using a Garmin model 60CSX GPS device), and at an elevation of ca. 859 m (Fig. 1). Climatic data were obtained from the meteorological station at the Phu Khiew Wildlife Sanctuary headquarters, located ca. 1.5 km from the study site.

Results

The Hiang tree with the cavity (Fig. 2) was located in a dry dipterocarp forest (DDF) mixed with pine (*Pinus kesiya*). The tree measured 25 m tall, and at a height of ca. 1.3 m had a trunk diameter of 58 cm. The cavity was located at a height of 15 m, with the opening facing south.

Typically, the *V. bengalensis nebulosus* (total length ca. 140 cm; Fig. 3) sticks its head out from the tree hollow between 0700 - 0730 h as it waits for sunlight. When the sunlight reaches the tree around 0800 h, the monitor climbs out and moves to the east side of the trunk and begins its basking activity. When basking, its body is vertically oriented with the head directed upward. It remains motionless for a few hours (usually between

Fig. 2. The *Dipterocarpus obtusi-folius* tree with the occupied tree hollow. Photograph by **Prateep Duengkae** 6 April 2009.

Fig. 3.*V. bengalensis nebulosus* sticks its head out from the tree hollow in the morning as it waited for sunlight. Photograph by **Prateep Duengkae**. 5 April 2009

Fig. 4. *V. bengalensis nebulosus* basks on tree trunk in direct sunlight to gain heat in the morning. Photograph by **Prateep Duengkae**. 9 April 2009.

0800 - 1030 h), slowly wobbling its head when disturbed (Fig. 4). At around 1030 - 1100 h, the *V. bengalensis nebulosus* climbs down to the ground and begins other daily activities in the surrounding area.

The *V. bengalensis nebulosus* comes back to its tree in the afternoon between 1400 - 1500 h, climbing up to the same height as in the morning but in a different position. Here, the *V. bengalensis nebulosus* faces west and begins its afternoon basking activity, continuing until 1730 - 1830 h (Fig. 5) when it returns to its refuge inside the tree cavity.

During the study period, rain occurred on 3, 7 and 10 May. Daily climatic data are given in Table 1. When it rained during the morning of 3 May, the *V. bengalensis nebulosus* came out from the hollow and began basking at around 0900 - 1000 h. When it rained during the afternoon of 7 May, the monitor returned to its tree early and began basking around 1300 - 1400 h.

Discussion

Varanus bengalensis nebulosus basks by taking advantage of sun exposure as documented for other reptiles (see e.g., Johnson, 1973; Heatwole and Taylor, 1987; Vitt and Caldwell, 2009). Its body temperature is increased to the optimum level that physiological functions (i.e., heart rate, cardiovascular control and body temperature regulation) can be well operated

Fig. 5. *V. bengalensis nebulosus* faces west and begins its afternoon basking activity. Photograph by **Prateep Duengkae**. 5 April 2009.

Table 1 Climatic data of daily rainfall (mm) and mean temperature (°C) with minimum and maximum in parentheses.

Day/month/year	Rainfall	Temperature
3-Apr-09	12.8	24.20 (17.2-31.2)
4-Apr-09	0	24.25 (17-31.5)
5-Apr-09	0	23.25 (18-28.5)
6-Apr-09	0	23.70 (19-28.4)
7-Apr-09	4.1	23.20 (18.4-28)
8-Apr-09	0	22.45 (17.3-27.6)
9-Apr-09	0	23.65 (17.8-29.5)
10-Apr-09	0.6	24.25 (18-30.5)

Fig. 6. The Hiang tree acts as a good shelter for *V. bengalensis nebulosus* in northeastern Thailand.
Photograph by **Prateep Duengkae**. 6 April 2009.

(Christian and Bedford, 1996; Seebacher and Grigg, 2001). The present observations are in accordance with Traeholt (1997), in which the monitor followed sunlight to receive solar radiation and to increase its body temperature before daily activities. There are further similarities to *V. salvator* from central Sri Lanka, in which basking was seen in late morning and during the afternoon (Rathnayake et al., 2003). When it rained in the morning, the *V. bengalensis nebulosus* emerged later and basked before commencing its daily activity. This observation is in agreement with the compiled knowledge that many reptiles regulate their body temperatures by basking in the sun until the temperature rises to the level requisite for their normal activity (Heatwole and Taylor, 1987; Vitt and Caldwell, 2009). Basking before returning to its refuge should be required in order to maintain physiological activity (Christian and Bedford, 1996; Seebacher and Grigg, 2001).

V. bengalensis nebulosus does not make its own refuge. As was found in previous research (see e.g., Phophinit, 1991; Pattanavibool, 1993; Poonswad, 1997), *V. benalensis nebulosus* prefers to inhabit tree hollows or cavities rather than burrows. Hence, hollows occurring in live trees are an essential factor that supports the occurrence of *V. bengalensis nebulosus* in the area and should be considered as an important factor for the management and conservation of this species or its congeners. Pattanavibool and Edge (1996) report that 92 % of tree hollows are in live trees from Huai Kha Khaeng Wildlife Sanctuary, and the Forest Research Center (1989) reports that the Hiang tree constitutes 5 % in DDF at Phu Khiew Wildlife Sanctuary. Therefore, this tree acts as a good shelter for *V. bengalensis nebulosus* in northeastern Thailand (Figure 6).

Acknowledgements - We would like to thank Jeerawat Jaisielthum for correcting and commenting on our first draft. Michael Cota is thanked for his kind assistance on the second draft. Finally, our special thanks go to Aingorn Chaiyes and Khanchai Prasanai for preparing the map and climatic data, respectively.

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Received: 5 August 2009; Accepted: 20 September 2009

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Varanus albigularis. Okavango Delta, Botswana
Photograph by **Jim Billings**