

STATUS AND HABITAT ECOLOGY OF THE YELLOW MONITOR, *VARANUS FLAVESCENS*, IN THE SOUTHEASTERN PART OF KANCHANPUR DISTRICT, NEPAL

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Abstract.—The Yellow Monitor, *Varanus flavescens*, is protected in most of its range, but there are few studies and little is known of its ecology. We studied *Varanus flavescens* in the southeastern part of Kanchanpur District in Parasan Village Development Committee to gather information on status and habitat ecology of this species. We assess the distribution, threats, and habitat characteristics of *V. flavescens*, and its habitat separation from the Bengal Monitor, *Varanus bengalensis*, using field observations and information from local people. *Varanus flavescens* was found to be distributed throughout the study area. We document new global records for total length (TL: 952 mm) and weight (1450 g) for the species. Indiscriminate killing is a major threat for survival of the species and most of the killing we found was done by children in agricultural land. Our study suggests that habitat modification might not be as serious a threat as first thought and the species seems to be able to tolerate habitat modification by agriculture. Ground cover was preferred by the species as compared to trees and the species was found to be associated closely with the shrub *Impomoea carnea*. The habitats of *V. flavescens* and *V. bengalensis* were found to be partially separated, with *V. flavescens* mostly associated with wetter areas and few large trees, whereas *V. bengalensis* was closely associated with large trees. As *V. flavescens* does not prefer forests with large trees, conservation programs focusing only on forest protection may not help conserve this species.

Key Words.—Bengal Monitor; conservation; distribution; habitat separation; threat; *Varanus bengalensis*

INTRODUCTION

Reptiles are decreasing worldwide (Gibbons et al. 2000) and are more threatened than birds and the percentages threatened are comparable with mammals in numbers (Bohm et al. 2013). Nine species of monitor lizards are reported from Asia (Lauprasert and Thirakhupt 2001) among the 46 species worldwide (Bennett 1995). However, only two species of monitors, Bengal Monitor (*Varanus bengalensis*) and Yellow Monitor (*Varanus flavescens*) have been reported from Nepal (Shah and Tiwari 2004).

Varanus flavescens (Fig. 1) is a carnivorous lizard and its food ranges from insects to small mammals (Shah and Tiwari 2004). The monitor has been categorized as Lower Risk/Least Concern in IUCN Red Data List (World Conservation Monitoring Centre. 1996. *Varanus flavescens*. In IUCN, 2012. IUCN Red List of Threatened Species. Version 2012.2. Available from: <http://www.iucnredlist.org> [Accessed 18 June 2013]) but listed in Appendix I of CITES (CITES.

Convention on International Trade in Endangered Species. 2013. Appendices I, II and III valid from 12 June 2013. Available from: <http://www.cites.org/eng/app/appendices.php> [Accessed 19 June 2013]). In addition, it is a legally protected species in Nepal (Government of Nepal. 1973. National Parks and Wildlife Conservation Act. Available from <http://www.mfsc.gov.np/downloadfile/NPWLC%20Ac>

[t.%20Rules%20adn%20Policies_1334465970.pdf](http://www.mof.nic.in/sites/default/files/WildLifeAmendmentAct2006%20.pdf)

[Accessed 13 May 2014]) and most of the countries in its range; India (Ministry of Law and Justice. 2006. The Wildlife (Protection) Amendment Act. Government of India. Available from <http://www.moef.nic.in/sites/default/files/WildLifeAmendmentAct2006%20.pdf> [Accessed 13 May 2014]), Pakistan (Government of Pakistan. 1971. The Pakistan Wildlife Ordinance. Available from http://www.falcons.com.pk/Wildlife_acts_and_rules.pdf [Accessed 13 May 2014]), and Bangladesh (Ministry of Law, Justice, and Government Affairs. 1973. The Bangladesh Wildlife (Preservation) Order. Available from http://bdlaws.minlaw.gov.bd/pdf/452_Schedule.pdf [Accessed 13 May 2014]), although not in Bhutan (Royal Government of Bhutan. 1995. The Forest and Nature Conservation Act of Bhutan. Available from http://www.nationalcouncil.bt/wp-content/uploads/2011/02/Forest_Nature_Conservation_En_95.pdf [Accessed 13 May 2014]). However, the species has low consideration in research and conservation in its entire range, including Nepal. In addition, *V. flavescens* is a poorly known species (Auffenberg et al. 1989) and its assessment has not been updated since 1996 in the IUCN Red Data List (IUCN 2012 *op. cit.*). Both *V. flavescens* and *V. bengalensis* use almost the same resources; they both live in burrows and their food resources overlap. Based on ecological principles, it is expected that these two species are partitioning their habitats. We assess



FIGURE 1. The Yellow Monitor (*Varanus flavescens*) found in the Parasan Village Development Committee (VDC) of Kanchanpur District, Nepal. (Photographed by Hemant R. Ghimire).

distribution, threats, and habitat ecology of *V. flavescens* in a study area of Kanchanpur District, Nepal, through observations and interactions with locals.

MATERIALS AND METHODS

Study sites.—Our study area was the Parasan Village Development Committee (VDC) of Kanchanpur District, Nepal (see Ghimire and Phuyal 2013; Fig. 2). The VDC lies in southeastern part of the district (28°37'30"N and 80°30'0"E) with an average elevation of 160 m. The study area has a tropical monsoon-dominated climate with temperatures ranging from 2.5 °C in winter to 44 °C in summer and average annual rainfall of 210 cm (Ghimire and Phuyal 2013). The VDC has higher central land and lower land in both northern and southern sides with an altitudinal range of about 15 m. The slope on the northern side is gentle but on the southern side it is steep. The Jana Jagaran Community Forest (CF) is the only community forest in the VDC with the major part in the central high land of the VDC. The CF extends along the entire southern slope as a thin line with width ranging from 20 m to 100 m. The Doda River flows along the northern side of the VDC. Agricultural land exists between the CF and the Doda River, and includes barren land and a sandy shore. The eastern boundary of the VDC is connected with Dudhwa National Park (India).

Sal (*Shorea robusta*), Simal (*Bombax ceiba*), Sindure (*Mallotus philipensis*), Sissoo (*Dalbergia sissoo*) and shrub Banmara (*Lantana camara*) and

Besaram (*Impomoea carnea*) are major floral species of the study area. Besides the two species of monitors, the Marsh Crocodile (*Crocodylus palustris*), pythons (*Python* sp.), Sarus Crane (*Grus antigone*), porcupine (*Hystrix* sp.), otter (*Lutra* sp.), Chital (*Axis axis*), Wild Pig (*Sus scrofa*), Asian Elephant (*Elephas maximus*), and large cats are important faunal species that inhabit or visit the study area. Pyara Tal (lake) of the VDC provides habitat for six species of turtles and is the only reported habitat for the Crowned River Turtle (*Hardella thurjii*) in Nepal (Aryal et al. 2010).

Field methods.—We conducted the study during June-September 2011 and spent more than two months in the field. We used visual encounter survey (VES) for observations because it is cost effective and does not disturb the habitat of the subject species (Doan 2003; Flint and Harris 2005). We studied distribution using randomized VES (Campbell and Christman 1982) and habitat separation by using intensive time constrained VES (Crosswhite et al. 1999). We surveyed all of the VDC by walking and observing likely habitat for the species to assess the distribution. We conducted the survey for nine hours per day during four days in July and three days in August (63 survey hours total).

For the habitat separation study, we visually identified three habitats; the main CF, the northern floodplain, and the southern slope (Fig. 2). The main CF extends from the southern slope up to the northern floodplain and most of it has been protected with barbed-wire fence since 2002. The main CF is important for its timber value as it contains many large



FIGURE 2. Topographic map of the Parasan Village Development Committee (VDC) of Kanchanpur District, Nepal showing the location of three study areas for the Yellow Monitor (*Varanus flavescens*).

S. robusta trees as well as planted Teak (*Tectona grandis*) and eucalyptus (*Eucalyptus* sp.) trees. The main CF has an area of about 120 ha out of the total 200 ha of the CF (Fig. 3). The northern floodplain is agricultural land with scarce trees, plus the sandy shore and barren land between the main CF and the



FIGURE 3. Habitats in the Parasan Village Development Committee (VDC) of Kanchanpur District, Nepal where surveys of the Yellow Monitor (*Varanus flavescens*) occurred in 2011. Top: the main community forest; Middle: the southern slope of the community forest; Bottom: flooded area of the northern flood plain from the community forest. (Photographed by Hemant R. Ghimire).

Doda River. Sometimes the entire northern floodplain gets flooded for more than four or five days in the rainy season, and herding is regularly practiced in the area (Fig. 3). The southern slope is the extended part of the CF and some of it has been fenced since 2008 (Fig. 3). The southern slope has fewer large trees but due to the presence of saplings and herbaceous vegetation, this region has high ground cover compared to other areas. We surveyed each of three habitats for six days (18 d total) to determine the abundance of *V. flavescens* and *V. bengalensis*. Because rain affects the detection of these species, we made observations only during rain-free days (dry or rain for no more than 30 min/d) for the habitat separation study. The survey times were 0700–1000, 1200–1500, and 1600–1900 during June and July, and 0730–1030, 1200–1500, and 1530–1830 during August and September. During the survey, a single researcher (HRG) walked along a transect and recorded individuals of both monitor species within 20

m on both sides of the line. The distance between two consecutive transects in a day was at least 40 m. We only considered the observation of adults and sub adults (no juveniles) for the habitat separation study.

During the field visit, we also conducted informal interviews with local people. We documented killing of the species and we measured the weight and length of the dead specimens if they were not deteriorated. We also tried to document reasons for the killing, locality of the killing, and other aspects of these mortalities. We did not capture or harm any living animals for the study.

RESULTS

During the distribution survey, we observed 10 individual *V. flavescens* in the VDC. However, according to the local inhabitants, the species was found in all areas of the VDC. Interaction with the local people also revealed that the range of *V. flavescens* in the VDC is decreasing and presently its abundance is scarce near human settlements. We also observed the species in agricultural land in both distributional and habitat separation portions of the study. In addition, local inhabitants knew the species by five different names in the study area.

We found six dead specimens, among which four were partially destroyed or had been submerged in water and were not suitable for all measurements. We measured length on four specimens and weight for two. The largest specimen was 448 mm snout-vent length and 952 mm maximum total length (leaving 504 mm as tail length; Table 1). The greatest weight was 1450 g.

Local people kill this species in the area. During the study period, we observed six dead and one seriously injured *V. flavescens*. Children were responsible for more than 85% of the killing and injuring of the species (six of seven lizards). Similarly, more than 85% of the killing and injuring occurred in and around agricultural land. Domestic dogs (*Canis* sp.) were involved in killing some lizards. They either directly killed lizards (smaller individuals) or helped people by locating larger individuals. We also observed a local trade of the species, as a Tamang (indigenous group) villager of the VDC bought an adult *V. flavescens*, paying 80 Nepalese Rupees (approximately US \$1) for meat from neighboring Tribhuvan Basti VDC.

TABLE 1. Measurement of dead Yellow Monitor (*Varanus flavescens*) examined in the Parasan Village Development Committee (VDC) of Kanchanpur District, Nepal. An asterisk (*) indicates measurement is a new record for the species. Measurements were snout-vent length (SVL), tail length (TLL), total length (TL), and weight.

Number	SVL (mm)	TLL (mm)	TL (mm)	Weight (g)
1	310	420	730	--
2	372	412	784	1450*
3	392	472	864	850
4	448	504	952*	--

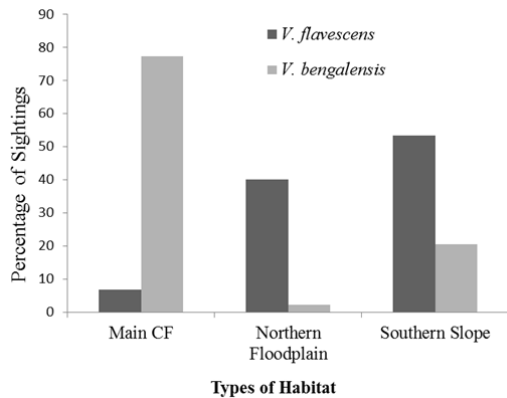


FIGURE 4. Relative percentage of sightings of the Yellow Monitor (*Varanus flavescens*) and Bengal Monitor (*Varanus bengalensis*) found in three habitats in the Parasani Village Development Committee (VDC) of Kanchanpur District, Nepal.

We observed 25 *V. flavescens* during the study; 10 during the distribution study and 15 during the habitat separation study, 8% of observations were in open areas of agriculture land, 52% were associated with bush, and 40% were associated with *I. carnea* in or around agricultural land. The vegetation where we found lizards consisted of saplings of large trees like *S. robusta*, *M. philipensis*, and shrubs including *L. camara*. We did not observe any *V. flavescens* using trees during the study, although it does climb according to local people. We observed one individual swimming in standing water that had accumulated on a road in the northern floodplain. We observed 15 *V. flavescens* and 44 *V. bengalensis* in the three habitats during the habitat separation study (Fig. 4).

We found *V. flavescens* was more associated with the southern slope and the northern floodplain (53.33% and 40% respectively) than the main CF (6.66%). In contrast, *V. bengalensis* was more associated with the main CF (77.27%) as compared to the southern slope (20.45%) and the northern floodplain (2.27%). Observation of these two species of monitors had significant association with these three habitats ($\chi^2 = 29.01$, $df = 2$, $P < 0.001$).

DISCUSSION

Although *Varanus flavescens* was thought to be distributed throughout the lowland of Nepal (Shah and Tiwari 2004), its present distribution is uncertain especially outside protected areas. It is reported from the Jagadishpur Reservoir in Kapilvastu District (Baral and Thapa 2008) and Chitwan District (Khatiwada and Ghimire 2009) and we found them in a new location. According to earlier studies, the highest weight of *V. flavescens* was 1050 g, the longest total length was 920 mm, with a snout-vent length 410 mm and tail length 510 mm (Auffenberg et al. 1989). We found both longer and heavier individuals.

The highest period of activity (mating period) of *V. flavescens* is June and July (Auffenberg et al. 1989), which coincides with monsoon vacation in schools of

the study area. During the vacation, children have more leisure time and often spend time herding livestock. This increases their possibility of encountering *V. flavescens*, which may result in increased rates of killing. One child reported killing of six individuals during the single year. Other studies have suggested that the killing of species in or near agricultural land was due to nuisance (Khatiwada and Ghimire 2009). However, during the field visit, it was evident that students also killed the lizards to show their bravery. Locals are afraid of the species due to the risk of injury caused by the flattened tail, which may be the reason for killing these animals. Furthermore, there is a misconception that the meat of *V. flavescens* can be used as a medicine, and the skin has various traditional uses. Local trade, common in other parts of Nepal (Shah and Tiwari 2004), was also evident in the study area. This can be detrimental for survival of the species as it is hard to control, and international treaties like CITES are irrelevant. Additionally, the locals poison the rivers and lakes for fishing, which could also be detrimental to the survival of monitor lizards.

Ground cover is essential for reptiles (Crosswhite et al. 2004). In addition, *V. flavescens* has short toes on the hind feet and, consequently, is not an efficient climber (Auffenberg et al. 1989). Hence, most individuals of this species were associated with bushes rather than trees. Its preference for bushes is likely to be for cover rather than for food. This may be the reason for using the bush of *L. camara* (an invasive species). *Varanus flavescens* prefers wetter areas, which may also be a reason for preferring the *I. carnea* bush. Both the *L. camara* and *I. carnea* have high ground cover, which may act as protective cover for the species. It seems that *V. flavescens* may be able to tolerate some habitat modification for agricultural purpose.

In contrast to *Varanus flavescens*, *V. bengalensis* often uses trees (Dryden et al. 1992) and in this study, 47% (16 of 34) of our observations of *V. bengalensis* were inside the main CF and were associated with trees. This may be the reason for the higher number of *V. bengalensis* inside the main CF as compared to other two habitats. In the main CF, *V. bengalensis* may be a superior competitor to *V. flavescens* because of its larger size, higher activity rate, and efficient climbing ability (Bennett 1995; Basset and Angelis 2007; Hemant R. Ghimire, pers.obs.). *Varanus flavescens* prefers wet area and can swim, so in the northern floodplain it may be superior competitor to *V. bengalensis*. The southern slope may be optimum habitat for *V. flavescens* due to high ground cover, wetter area on the lower side, sandy soil for burrowing, higher land for egg laying and less interspecific competition. The lower abundance of *V. bengalensis* on the southern slope may be primarily due to the lower abundance of large trees.

These two closely related species prefer different habitats, so conservation practices for one species

seldom helps to conserve others. As species vary in their requirements, conservation is more effective in mosaic habitats including forest, shrub land, and agricultural land (Law and Dickman 1998). *Varanus flavescens* was rarely found in forests with large trees but was often found in agricultural land. Therefore activities focused only on forests might not be helpful for the conservation of this protected reptile.

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