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# THE HERPETOLOGICAL BULLETIN

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*The Herpetological Bulletin* is produced quarterly and publishes, in English, a range of articles concerned with herpetology. These include society news, selected news reports, full-length papers of a semi-technical nature, new methodologies, natural history notes, book reviews, letters from readers and other items of general herpetological interest. Emphasis is placed on natural history, conservation, captive breeding and husbandry, veterinary and behavioural aspects. Articles reporting the results of experimental research, descriptions of new taxa, or taxonomic revisions should be submitted to *The Herpetological Journal* (see inside back cover for Editor's address).

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# On the origin of the asp viper *Vipera aspis hugyi* Schinz, 1833, on the island of Montecristo, Northern Tyrrhenian Sea (Tuscan archipelago, Italy)

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**ABSTRACT** - For some time there has been debate regarding whether the asp viper, *Vipera aspis* (Linnaeus, 1758), belonged to the original fauna of the small island of Montecristo, Northern Tyrrhenian Sea (Tuscan archipelago, Italy). It has long been believed that the asp viper population of this island is made up of the subspecies *Vipera aspis hugyi* Schinz, 1833, also found in southern continental Italy and Sicily. A recent genetic study confirmed that this colonisation was exclusively mediated by humans, but also revealed that the extant vipers of Montecristo displayed closest relationships with those found in the Palermo region of Sicily, and southern Italy. It might be assumed that the animals that were introduced onto Montecristo originated from western Sicily. In light of recent contributions the aim of this paper is to make an original contribution regarding the times and mode of such an importation that was performed possibly around the 5<sup>th</sup> Century.

**M**ONTECRISTO has traditionally been regarded as a remote sea-bound world, cloaked since time immemorial in the mists of its own legend. It is a small island of the Tuscan archipelago (Fig. 1), located in the Northern Tyrrhenian sea (N42°20', W10°9') about half-way between Corsica (23 marine miles) and the coast of central Italy (24 marine miles). It rises to 645 m above sea level and has an area of 10.39 km<sup>2</sup>. Its perennial supply of fresh water is provided by a number of springs in various parts of the island. Declared as a Natural Reserve in 1971 by the Italian government, Montecristo is a remnant of the primeval Mediterranean phytocenosis (Filippello & Sartori, 1980-1981; Pavan, 1989). The island is characterised by the occurrence of a peculiar vertebrate fauna comprising relics of the Tertiary geological era. Examples include the Tyrrhenian painted frog, *Discoglossus sardus* Tschudi, 1837 (see Lanza et al., 1984; Capula, 2006; 2007) and wild goat *Capra aegagrus pictus* Erhard, 1858, that were introduced possibly from the Near East in prehistoric times (Masseti, 2008a,

2009a). Wintering and migrant birds are also well represented on the island (Baccetti et al., 1981; Baccetti, 1994).

For some time there has been debate within the international scientific community regarding whether the asp viper *Vipera aspis* (Linnaeus, 1758) belonged to the original fauna of Montecristo. The main reason surrounding this query is that there are practically no palaeontological records of the taxon. Osteological fragments referred to the species complex as characterised by a morphology similar to that of *V. aspis* and *Vipera ammodytes* (Linnaeus, 1758) (Delfino & Bressi, 2000; Delfino, 2006). This evidence is not considered unusual among the Quaternary deposits of continental Italy. Apart from Montecristo and Elba, the majority of the remaining Tyrrhenian islands, such as Corsica, Sardinia, Gorgona, Capraia, Giglio, Pianosa, Giannutri, the Pontino and Flegrean archipelagos, Capri, and others, have not been colonised by vipers. According to Barbanera et al. (2009), Elba was likely colonised by asp vipers moving through land bridges with peninsular Italy during marine





**Figure 1.** Habitats of *Vipera aspis hugyi* on Montecristo.

regressions. However, it should not be excluded that today's population of *Vipera aspis francisciredi* (Laurenti, 1768) on Elba is the result of a human mediated introduction that occurred in former or recent times. The external features of the extant Elban vipers show an almost complete overlap with the phenotypes of the species dispersed in opposite areas on the Italian peninsula, but the vipers of Montecristo display unmistakable features of the subspecies *Vipera aspis hugyi* Schinz, 1833, (Fig. 2) which is more characteristic of vipers in southern continental Italy and Sicily (Zuffi & Bonnet, 1999; Zuffi, 2002). This is likely the reason why several scientists assumed that the snake was introduced onto Montecristo by humans. Among the first authors who cast doubts on the non-indigenous nature of the local viper were Mertens (1956), La Greca & Sacchi (1957), Müller (1967), and Bruno (1968). Bruno & Sauli (1976), Pozio (1980), Bruno (1984, 1985, 1988), and Bruno & Maugeri (1990) noted the affinities between the external characters of the Montecristo viper and

*V. a. hugyi*. The hypothesis was later agreed by Corti et al. (1991), Zuffi & Bonnet (1999), Zuffi (2001; 2002), Carpaneto (2002) and Masseti (2005; in press).

In light of recent new specimen acquisitions, the aim of this paper is to make an original contribution regarding the possible times and modes of the importation of the viper onto the island of Montecristo.

## BACKGROUND

To estimate the time of colonisation we took into account the authors' data (above) and hypotheses. A genetic study carried out by Barbanera et al. (2009) confirmed the hypothesis that the colonisation of Montecristo by the asp viper was exclusively mediated by humans, as the island was never connected with the mainland, or with other islands (see Krijgsman et al., 1999). To judge this factor effectively we considered information on the translocation of different zoological taxa by humans between northern and southern Italy, a



**Figure 2.** *Vipera aspis hugyi*.

process that has taken place for many years (see Masseti, 2005).

Barbanera et al. (2009) demonstrated that the *V. a. hugyi* clade included all Montecristo vipers with the closest relationships existing with the Sicilian populations, especially specimens from the Palermo region (Table 1). The results of the genetic analyses showed closest apotypic affinities between the specimens of Montecristo (AM944786, AM944787, AM944788) and western Sicily (AM944789, AM944791, AM944792), rather than with those of eastern Sicily (AM944793, AM944794, AM944797, AM944795). Barbanera et al. (2009) quote that; "This is the first genetic evidence that *V. a. montecristi* Mertens 1956 should be placed in synonymy with *V. a. hugyi*, as suggested by Pozio (1980), Corti et al. (1991) and Zuffi & Bonnet (1999)".

Thus, it appears that the animals introduced onto the small Tyrrhenian island originated from western Sicily. Since southern Italy and Sicily correspond to the boundary of ancient Magna

Graecia, a geographical area inhabited since the 8<sup>th</sup> Century B.C. by Greeks (see Masseti, 2008b), Barbanera et al. (2009) assumed that vipers might have been exported from there to Montecristo. In support of this hypothesis, the same authors cite the reports of the classical scholar Strabon (58 BC-25 AD, in: Lassère, 1967). The geographer Strabon reported that vipers were thrown as weapons during attacks on vessels coming from Africa and Sardinia intending to pirate rich Etruscan towns. They were protected as commercial partners by Greeks, who, for the purpose, established a military base on Montecristo Island (Barbanera et al., 2009). As a consequence, Barbanera et al. (2009) suggested that the colonisation of Montecristo by asp vipers very probably originated from *V. a. hugyi* specimens that were imported by the ancient militia from Magna Graecia between the 8<sup>th</sup> and the 3<sup>rd</sup> Centuries B.C.

However, there is no reference to the island of Montecristo in any passage of Strabon's work. In Book V (7) of his "Geographia", the Greek author simply records that certain indigenous Sardinian

Phenotype	Ref.	Specimen	Field/Collection	Collection Site	mtDNA Haplotype	Accession Code
<i>V. aspis hugyi</i>	34	9	Field	Montecristo (LI)	H49, H50 (7), H51	AM944786 AM944787 AM944788
<i>V. aspis hugyi</i>	73	1	Zoological Museum	Firenze, Madonie (PA)	H52	AM944789
<i>V. aspis hugyi</i>	70	1	Zoological Museum	Firenze, Bosco Ficuzza (PA)	H54	AM944791
<i>V. aspis hugyi</i>	71	1	Field	Mazara del Vallo (TP)	H55	AM944792
<i>V. aspis hugyi</i>	69	3	Field	Etna (ME)	H56, H57, H60	AM944793 AM944794 AM944797
<i>V. aspis hugyi</i>	74	2	Field	Anapo (SR)	H58	AM944795

**Table 1.** Genetic results of the investigation on specimens of *Vipera aspis hugyi* Schinz, 1833, from the islands of Montecristo (Northern Tyrrhenian Sea, Italy) and Sicily performed by Barbanera et al. (2009).

peoples neglected cultivation “...preferring rather to plunder what they find cultivated by others, whether on the island or on the continent, where they make descents, especially upon the Pisatæ.” Lopes Pegna (1953) is perhaps the only author to confirm that the Greeks called the island “Ocrasia”, while Angelelli (1903) and Pardossi (1971) are of the opinion that there is no explicit reference to the island of Montecristo in the whole ancient Greek literature. Both these latter authors, together with Repetti (1835), instead consider that, apart from Pliny the Elder who makes a fleeting mention, referring to the island as Oglasa (Naturalis historia, III: 80), there are no references to Montecristo in Latin literature either. The presence of the Etruscans and of the Romans on the island was, however, suggested respectively by Giuli (1833) and by Degli Albizzi (1854), on the basis of finds of elements of material culture.

However, the fact is it was not the Greeks but the Carthaginians who were in the habit of launching terracotta jars filled with snakes against enemy ships to frighten the crews. This practice had already been referred to by Bruno (1985) in the attempt to explain the origin of the population of Montecristo vipers: “We know from the historians that the snakes used for this purpose were captured regularly in Sicily and in Dalmatia”. Bruno (1985) does not, however, provide the historic sources for such claims, and we have no alternative but to return to the page of the De Viris Illustribus (chapter X) of Cornelius Nepos where the Roman biographer reported that the Carthaginian Hannibal Barca: “Imperavit quam plurimas venenatas serpentes vivas colligi easque in vasa fictilia conici. Harum

cum effecisset magnam multitudinem, die ipso, quo facturus erat navale proelium, classarios convocat hisque praecipit, omnes ut in unam Eumenis regis concurrant navem, a ceteris tantum satis habeant se defendere. Id illos facile serpentium multitudine consecuturos” (= “He ordered as many venomous serpents as possible to be brought together alive, and to be put into earthen vessels, of which when he had collected a large number, he called the officers of his ships together, on the day on which he was going to fight at sea, and directed them all to make an attack upon the single ship of King Eumenes, and to be content with simply defending themselves against others, as they might easily do with the aid of the vast number of serpents”).

Nepos described the naval battle of 184 BC between King Eumenes II of Pergamon (r. 197-159 B.C.) and King Prusias I of Bithynia (c.228-182 B.C.). Hannibal served as commander of the Bithynian fleet. He used catapults to hurl pots filled with venomous snakes into the enemy ships; the Pergamese panicked and fled, allowing the Bithynians to win (Sabin et al, 2007). Pergamon and Bithynia were regions of Asia Minor, respectively located in western and in north-western Anatolia (McEvedy, 1967). The setting of these events is, thus, a considerable distance from the coasts of Sicily and Dalmatia where, according to Bruno (1985) the serpents employed by the Carthaginians in the sea battles were habitually captured.

In effect, however, there is no historical evidence support an even hypothetical origin of the present vipers of Montecristo that could be placed between the 8th and the 3rd centuries BC. Even if we accept



that the animals may have been transported from Sicily to the islands of the northern Tyrrhenian Sea for the purpose of warfare, there remain other problems to be addressed.

### VIPERS, SAINTS AND DRAGONS

Calibration of the molecular clock based on mtDNA markers was not possible in *V. aspis* due to a lack of fossils (Barbanera et al., 2009). However, calibration for Cyt-b based on geological evidence (the emergence of the Isthmus of Panama, 3.5 Mya) is available for the Viperidae, with a suggested divergence rate of 1.4% My<sup>-1</sup> (95% confidence interval = 1.09–1.77%: as in Wüster et al. [2002]; cf. Ursenbacher et al. [2006]). If this supposed divergence rate is correct, we could hypothesise a 0.0014% rate 1000 y<sup>-1</sup> (ranging 0.0011–0.0018%, that is 1100–1800 years), that could be around 1400 years ago. We realise that our data set is fairly small. Genetic characterisation of only ten samples from Sicily and Montecristo prevented us from performing additional robust phylogeographical analysis and, as a consequence, our final results may remain controversial. However, these results suggest that the introduction of the viper onto Montecristo might be many centuries after the chronological span indicated by Barbanera et al. (2009). Thus placing the introduction no longer at the height of the consolidation of Greek civilisation in the central Mediterranean, but rather around the middle of the first millennium AD, at the time of the fall of the Western Roman Empire. Consequently, it could also be ruled out that the importation of the viper onto Montecristo from Sicily was possibly performed not earlier than around the 5<sup>th</sup> Century of the current era. As explained by Fo (1992), the historical context is that of the major Barbaric invasions perpetrated throughout the peninsula, comprising the sacking of Rome by the Visigoths in 410. At this time, that is from the beginning of the 5<sup>th</sup> century AD, the islands of the Tuscan archipelago began to be populated by anchorites fleeing the devastation of civil society to take refuge in prayer in isolated and remote places. These were people who, as their contemporary Rutilius Claudius Namatianus, praefectus urbi of Rome in 414, explained in his work *De reditu suo*: “... call themselves ‘monks’

using the Grecian name, because they wish to live alone, observed by no-one. They fear the blows of fortune and dread her gifts”. The monks arrived in the Tuscan archipelago from all parts of Italy, now utterly defenceless and exposed to the destructive fury of the Barbarians, and even from Rome (Fo, 1992). An ancient popular tradition holds that the anchorites that took refuge on Montecristo were from Sicily. The legend in fact records that the bishop of Palermo, Saint Mamilian, landed on Montecristo with a handful of followers to escape the persecution of Genseric, king of the Vandals (Angelelli, 1903; Pardossi, 1971; Brizzi, 1986). The saint settled on the little Tyrrhenian islet, vanquished the dragon that lived on the highest peak, and changed its name from Mons Iovis to Monte Christo.

At times legends can conceal events that really took place. Thus the anchorites of Saint Mamilian, who had settled on the island in the 5<sup>th</sup> Century AD, later founding an important monastery, could have transferred the vipers to Montecristo from western Sicily. It is not immediately apparent why humans would have wished to introduce these animals. The snakes might have reached the island hidden in containers of victuals or agricultural provisions. However, it cannot be ruled out that the pharmacopoeia of the monks envisaged the extraction and study of the poison of venomous snakes to obtain theriac, a medical concoction, originally formulated by the Greeks in the first century AD, which was an alexipharmic, or antidote that was considered a universal panacea. Ethnozoological enquiries document that venomous snakes were utilised as medicine from very ancient times (Masseti, in press). The zoologist Augusto Toschi (1953) set the presence of the viper on Montecristo in direct relation with that of the monks, observing that: “The quantity of ophidians in Montecristo and the danger that they can represent would appear to find confirmation in tradition and legend, and in particular in the story of the life of Saint Mamilian”.

Among the biological affinities between the biocenoses of Montecristo and the circum-Sicilian archipelago, we should also mention the occurrence on the Tyrrhenian islet of microgastropod, *Deroceras* cf. *golcheri* Van Regteren Altena, 1962,

(Giusti, 1976). Up until 1976, the taxon *D. golcheri* had been regarded as a Maltese endemic. It cannot be excluded that this mollusc too could have been imported involuntarily by man. However, in view of the marked polymorphism that characterises the bodies and genitals of snails, Giusti (1976) himself has not, at least to date, been able to diagnose with certainty the specific taxonomic classification of the gastropod, limiting himself to recording it with the name of *D. cf. golcheri*. Thus, at present, only further studies will be able to make an illuminating contribution to a better understanding of this taxon and the definition of its zoogeography. Should it prove to be a snail endemic to Malta. In which case an involuntary introduction together with the seeds of lettuce and other vegetables cannot be ruled out. These are in fact animals typical of turned soil, such as that of kitchen gardens (F. Giusti, pers. comm.).

The importation into the Tuscan archipelago of another invertebrate, the freshwater planarian, *Dugesia sicula* Lepori, 1948, has also been attributed to involuntary introduction. The taxon was described on the basis of sexual specimens from a population comprising both sexual and fissiparous individuals from the Sicilian locality of Cardillo near Catania (Lepori, 1948). It was then also recorded on the island of Elba by Benazzi (1950), who suggested passive transfer of the taxon on this island. Recent studies revealed, however, that the species occurs in the whole Mediterranean region (Pala et al., 1995).

The effect of human activity has not always ensured a decrease in overall species richness but more generally a change in community composition, often with the settlement of species adapted to environments originally extraneous to their natural distribution, but which they have inhabited since ancient times (see Masseti, 2009b). In any case, human activity must be considered one of the main factors to explain some present day composition of animal communities, as well as a key factor that explains most of the recent island extinctions (Williamson, 1989; Corti et al., 1999). For taxonomic groups such as the reptiles, biogeographical data suggests that humans have introduced several taxa on the Mediterranean islands (Corti et al., 1999; Masseti, 2009c). This may be the case among other herpetofauna such

as the *Bufo viridis* Laurenti, 1768 complex, on the Gymnesic and Pityusic islands (Hemmer et al., 1981), *Testudo marginata* Schoepff, 1795, on Sardinia (Arnold & Burton, 1978), *Macroprotodon cucullatus* (Geoffroy Saint-Hilaire, 1827), on Menorca and Mallorca (Pleguezuelos et al., 1994), *Chamaeleo chamaeleon* (L., 1758), in southern Spain (Talavera & Sanchiz 1985; Pleguezuelos & Feriche, 2003) and on Malta (Baldacchino, 1995), and perhaps even *Lacerta laevis* Gray, 1838, on Cyprus (Böhme, 1996). These ecological and cultural transplantations may not have been the result of casual maritime prospecting, but of the outcome of expeditions planned and prepared with a specific objective - the colonisation of the islands (see Masseti, 2009b).

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# Hibernation in *Duttaphrynus melanostictus*, a life in the cold lane

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**ABSTRACT** - Hibernation occurs with exposure to low temperatures and, under normal conditions, during winter seasons when there are lengthy periods of low environmental temperatures. This investigation reports the effect of hibernation on the blood-plasma and biochemical parameters - plasma protein, plasma glucose, cholesterol, blood haemoglobin, bilirubin thyroid hormone and serum ion in the Indian common toad (*Duttaphrynus melanostictus*). Metabolic rate and blood cell count was also investigated to elucidate adjustments in hibernation. Adaptation during hibernation is crucial for the toad's winter survival.

**H**IBERNATION is a unique phenomenon of depressed metabolism that enables different animals, including anurans, to survive during hostile winter temperatures. Metabolic rate is strongly reduced during this time and the hypothalamic set point for core body temperature is lowered. Amphibians are a sensitive group of vertebrates adapting to small changes in temperature and moisture (Duellman & Trueb, 1986). Changes in global weather patterns (e.g. El Ninos or global warming) can alter their breeding behaviour, affect reproductive success, decrease immune function and increase sensitivity to chemical contaminants (Kats & Ferrer, 2003; Vredenburg 2004). Understanding natural reactions like hibernation to climate shifts is therefore important to further understanding amphibian life cycles.

*Duttaphrynus melanostictus* (Schneider, 1799) is the most common and widely distributed anuran species in the Midnapore region. It regularly hibernates and its breeding period ends in the middle of autumn. Heart rate, metabolic rate and haemoglobin concentration of hibernating toads can decrease significantly during this period. This study aimed to focus on the role of different biochemical parameters in metabolic depression and the regulatory controls that allow these energy-expensive processes to be suppressed when organisms enter a hypometabolic state.

## MATERIALS AND METHODS

Ten adult *Duttaphrynus melanostictus*, each

weighing between 80 to 100 g, were collected from a selected site at Midnapur (22015 N / 87039 E), West Bengal India in late October and mid November, 2010 (ambient air temperature 22.4°C) before the onset of hibernation. A second group (n = 10) were collected in mid January (7.4-9.2°C), from the same mud hole site, when hibernation was at its deepest. A third group (n = 10) was collected from the same site in late February (20.0°C) when the toads were aroused from hibernation. Other groups were collected from similar sites throughout the remaining months of the year (March, April, June, and July; n = 10 for all groups).

Blood samples were drawn immediately after animals were euthanased. Animal handling and euthanasia was performed following the ethical guidelines laid down by the Committee for the Purpose of Control and Supervision of Experimental Animals (CPCSEA) constituted by the Animal Welfare Division of Government of India on the use of animals in scientific research.

Blood samples were collected by cardiac puncture using a 21 gauge needle and a 5 ml syringe. These were transferred to EDTA coated vacutainer tubes for determination of protein, and in sodium fluoride coated vacutainer tubes for determination of glucose. Plasma was separated by centrifugation (1500×g) and the supernatant was taken for biochemical analysis. Plasma protein was estimated photometrically using a standard mathematical projection predicted against the known protein levels following the Lowry method

(Lowry et al., 1951). Plasma glucose was estimated photometrically by glucose-oxidase protocol using Merck diagnostic equipment (Merck-Diagnostica-PDLFT0879). Serum cholesterol was also analysed using standard laboratory equipment (Nice chemical; S20750). Serum T3 and T4 were analysed by using ELISA kit (Ranbaxy, Diagonova.1063062.1063073). Serum magnesium and calcium were analysed using Bioassay's Quantichrom™, Magnesium (DIMG-250) and Calcium (DICA-500) assay kit.

A cardiogram was used to record mechanical activities of the heart as it records the systole and diastole of the different chambers of the heart. The mechanical activities of the amphibian heart were directly recorded by connecting the heart to the writing lever with a thread which transmits the waves of contraction and relaxation from the heart to the liver. The cardiac activities were recorded on a moving drum. Metabolic rate was measured following the methods described by Navas (1996) with few modifications. Metabolic rate was measured within 10 days of capture, using only animals that appeared to be in good health. Animals were fed commercial crickets with vitamin and mineral supplements. To measure the resting metabolic rate, animals were placed in a metabolic chamber in a constant temperature for six hours to adjust the new environmental conditions. Air samples were then taken with a syringe and oxygen concentrations measured.

Haemoglobin was measured by using Bioassay System Quantichrom™ haemoglobin assay kit. This technique was based on the Triton/NaOH method, in which haemoglobin is converted into a uniform colored end product. The intensity of colour, measured at 400 nm was directly proportional to the haemoglobin concentration in each sample. Direct Bilirubin reacts with the diazotized sulphanilic acid in aqueous solution to form Azobilirubin, a purple coloured compound, within one minute. The subsequent addition of methanol accelerated the reaction of unconjugated bilirubin in the serum, and a value for total bilirubin was obtained after letting each specimen stand for 30 minutes. Serum was used to quantitatively determine bilirubin in blood.

### **Total Count of Erythrocytes**

4.0 ml of red cell diluting fluid (Trisodium citrate – 3.13 g, commercial formaldehyde – 1.0 ml, distilled water – 100 ml) was taken into an Erlenmeyer flask (25 ml). 0.2 ml of anti-coagulated blood sample was then added to the diluting fluid. Then a small drop of diluted blood was taken into the counting chamber of a haemocytometer. The counting chamber was placed under the microscope and numbers of red cells counted on a small square (0.2 x 0.2 x 0.04 sq. mm.) of the upper left of corner which was divided into 16 smaller squares to facilitate counting. Total cells were counted in five squares. The same was repeated on the other side of the chamber and an average of the two chambers was taken.

### **Total Count of Leucocytes**

0.38 ml of white cell diluting fluid (glacial acetic acid – 2 ml, distilled water – 100 ml, aqueous methylene blue solution, 0.3% w/v – 10 drops) was placed into an Erlenmeyer flask (25 ml). 0.2 ml of anti-coagulated blood specimen was added into diluting fluid. The solution was mixed and kept for 2 minutes for complete haemolysis. Then a small drop of diluted blood was placed into the counting chamber of haemocytometer. The counting chamber was placed under the microscope and the numbers of white cells counted on the small square (1 mm<sup>2</sup>) plate (16 x). Again total cells were counted in five squares. The same was repeated on the other side of the chamber and an average of two chambers was taken.

### **Differential White Blood Cell Count**

A homogenous blood specimen was transferred with a pair of applicator sticks to a clean, grease free slide. A blood smear was drawn by a spreader slide at the angle of 30 to 45 between the two slides. The blood smear was dried quickly by air drying. Then the slide was stained with Leishman's stain for 2 minutes. The buffered water was added on the slide of about the volume of stain and was kept for 10 to 15 minutes. The stain was washed off and the slide was observed under oil immersion microscope. The cells were counted to the nearest 100 and the number was expressed as a percentage.

### Serum Immunoglobulin

Nephelometry is a technique used in immunology to determine levels of IgM, IgG and IgA. It is performed by measuring the reduction in the intensity of the incident light after it passes through the sample being measured. It is based on the principle that a dilute suspension of small particles will scatter light (usually a laser) passed through it rather than simply absorbing it. The amount of scatter is determined by collecting the light at an angle (usually about 70 or 75 degrees).

Statistical analysis was performed using Microcal 6.0™ statistical analysis. Each biochemical experiment was replicated at least three times with 10 toads in each experimental group. A Student t-test was performed to compare the means of results to a significance of  $P < 0.05$ . Results herein are represented as mean  $\pm$  SD unless mentioned otherwise.

### RESULTS

Metabolic depression played a crucial role during the period of hibernation. During this phase metabolic rate decreased by 6% of the basal resting rate of the active animals. In active animals the metabolic rate was  $0.117 \pm 0.014$  ml  $O_2$ ·g<sup>-1</sup>·h<sup>-1</sup> which decreased significantly to  $0.110 \pm 0.017$  ml  $O_2$ ·g<sup>-1</sup>·h<sup>-1</sup> during the hibernating period. Body weight and heart rate also dropped during hibernation. Haemoglobin concentration was significantly reduced to  $8.4 \pm 0.18$  g/dl from  $9.2 \pm 0.23$  g/dl. On the contrary bilirubin concentration increased markedly from  $0.89 \pm 0.004$  mg/dl to  $0.93 \pm 0.005$  mg/dl during hibernating period. Plasma protein was significantly decreased in the hibernating toads compared with non-hibernating toads. Available reports indicate that cold exposure in winter inhibits protein synthesis in blood and causes changes in enzyme activities of *Lithobates pipiens* in the hibernating season (Churchill & Storey, 1993). Environmental cold stress increases protein catabolism. Sugar showed a significantly lower ( $t = 12.21$ ,  $P < 0.05$ ) concentration during the deep hibernation phase, compared to that in the non hibernating phase. Results showed, a marked increase in serum cholesterol during the hibernating phase ( $154 \pm 2.56$  mg/dl) compared with non hibernating ( $93 \pm 2.26$  mg/dl) periods.

T3 levels changed little throughout the year but to the contrary T4 level varied significantly ( $t = 15.53$ ,  $P < 0.05$ ). TSH expression was found to reduce significantly ( $t = 14.83$ ,  $P < 0.05$ ) during hibernation. The number of total red blood cells (RBC) were less in hibernating toads compared with non hibernating toads. Increases in total count of white blood cells in hibernating individuals was possibly due to increases in first line defence during hibernation as has been shown for *Anaxyrus americanus* (Forbes et al., 2006). Eosinophil and lymphocyte number was greater in hibernating toads. Minimal changes were found in monocyte levels. Our results also indicate that IgM was significantly higher in hibernating individuals than non hibernating toads. It was clear from our findings that the serum magnesium ( $t = 6.42$ ,  $P < 0.05$ ) and calcium ( $t = 5.25$ ,  $P < 0.05$ ) differed significantly before hibernation and during deep hibernation.

### DISCUSSION

The purpose of metabolic depression is to maximize the survival time of an individual when environmental conditions are unfavorable for normal life. Throughout episodes of hibernation metabolism must be sustained by endogenous fuel reserves alone and the problem of accumulated metabolic wastes must be addressed to prevent self poisoning. A new balanced body chemical state must be achieved that includes both a general reduction of rates of all cellular processes plus an induction of selected adjustments, specific to a depressed state. The mechanisms of metabolic depression appear to involve the coordinated reduction of a specific subset of key regulatory enzymes or proteins in the cell and activities of that process that are controlled.

For *Bufo spinulosus*, metabolic rate decreased during hibernation by 7.8% (at 50°C) and 13.6% (at 150°C) of summer value (Naya & Veloso, 2009). Heart rate and body weight of hibernating toads decreased significantly. Body weight reduction is a prominent feature throughout animals that experience hibernation. This is usually because hibernating animals solely depend on reserve foods that are stored in muscle and fat tissues under the skin. Milsom & Burlington (1993) also found that



in hibernating squirrels, vagal stimulation reduced heart rate in half of the animals and the amplitude of auricular and ventricular contraction decreased during hibernation.

In this study haemoglobin concentration was significantly reduced and this was probably due to reduced metabolic rate and oxygen consumption. No other haemoglobin deformities have been found in the band patterns of haemoglobin electrophoresis. To the contrary, bilirubin, the end product of haemoglobin metabolism, also significantly increased in the toads during hibernation. Baker & Breukelen (2009) also found similar results in the hibernating golden mantled ground squirrel. The recurring nature of metabolic rate depression as a survival strategy of animals suggests that the regulation of metabolic arrest has fundamental principles and mechanisms that are expressed not only in all cell types of an individual animal, but also, across phylogenetic lines.

Significant seasonal variations in plasma protein, plasma glucose and serum lipid profile have been found in hibernating *Duttaphrynus melanostictus* (Pratihar et al., 2006). The reason for this may be due to the qualitative and quantitative difference in the availability of food. The increased metabolic dependency towards lipids in hibernating toads may not only be in response to low temperature but is also a part of circannual homeostatic adjustment that is at least partly regulated by thyroid hormones (Pratihar & Kundu, 2009a). The decreased serum thyroxine in the toads suggested a state of hypometabolism and decreased metabolic rate that could allow further conservation of energy during hibernation. The decline in thyroid hormone concentration has a behavioural and physiological response that leads to an increased and sustained cholesterol level in serum, that seems to be the most important metabolite during the hibernating phase. Forbes et al. (2006) commented that a significant increase in total white blood cell count (WBC) occurs in response to an increase in bodily defense mechanisms during hibernation. Pratihar & Kundu (2010) found significant increases in WBC during hibernation for *D. melanostictus* compared to the non hibernating toads. Increased numbers of eosinophils also enables increased engulfment of antigen and antibody complexes.

Lymphocytes were also more numerous in the hibernating individuals. The toads were producing  $\gamma$ -globulin and an antibody that induces immune system response during hibernation. No significant changes in the number of monocytes however could be observed in the hibernating toads in this study. As such it appears that the migration of monocytes and formation of macrophage in different tissue play a rather insignificant role in the development of immunity during hibernation. IgM was significantly greater in hibernating individuals than non hibernating toads.

In this study it was clear that during hibernation the immunity of the organism was specifically antibody dependent. Cell mediated immunity plays a small role during that phase. Humoral immunity appeared to play a central role during hibernating period and cell mediated immunity also plays a smaller role during this period (Pratihar et al., 2008). The lower serum calcium levels indicated that during the entrance to hibernation period, and during the arousal from hibernation, the utilisation or excretion of calcium exceeded the mobilisation of calcium. It is therefore possible that during hibernation the circulation and the kidney function is not consistently adequate to meet the tissue demands for calcium and at the same time maintain the constant serum level of calcium. Serum chloride ion and bicarbonate ions do not play significant roles in temperature regulation throughout the hibernating phase (Pratihar & Kundu, 2009b). An investigation on the causes of changes in magnesium ions and passive alteration in water balance would further this study because such changes may be due to the excess water that is being removed by the renal tubules.

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# ***Leiolepis* (Squamata: Agamidae) farming in southern Vietnam and a new size record in butterfly lizards**

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**O**RIENTAL Asia is famous for its traditional use and consumption of reptiles and amphibians. Besides hunting reptiles and amphibians from the wild as a food resource for millennia, farming of big reptiles for food production increased markedly in the last few years.

In southeast Asia, especially in Thailand and Cambodia, crocodylians (Siamese crocodile *Crocodylus siamensis*; hybrids of *C. siamensis* and the saltwater crocodile *Crocodylus porosus*) are commercially reared for skin and meat production (Magino et al., 2009). To cover the immense food demand of the kept crocodiles in Cambodia millions of homalopsine water snakes are harvested and used as crocodile fodder every year (Handschuh & Müller, 2008).

The second major group of farmed reptiles in southeast Asia is snakes. Farming of snakes is intended for different purposes such as antivenom, skin, meat and snake wine production (Somaweera & Somaweera, 2010). Several hundred snake farms reported from China are producing more than 400,000 specimens of three commonly traded species (*Deinagkistrodon acutus*, *Bungarus multicinctus* and *Ptyas dhumnades*) (Guo et al., 1996). Nguyen & Nguyen (2008) reported on commercial snake farming in Vietnam. The authors indicated that more than 100 tons of snakes (primarily *Naja naja*) were produced annually.

Several terrapin and turtle species are commercially reared for their meat, but most important is the Chinese soft-shelled terrapin (*Pelodiscus sinensis*) which is cultivated throughout Southeast Asia (Silpachai, 2001).

So far trade of butterfly lizards as food-items has been reported from Thailand (Pianka & Vitt, 2003) and from Vietnam (Ziegler, 1999; Grismer & Grismer, 2010), whereas farming of lizards has

only been reported from Central and South America. Large iguanid lizards (green iguana *Iguana iguana* and the black iguana *Ctenosaura similis*) are farmed for producing meat for human consumption throughout Central and South America (Eilers et al., 2002). Besides iguanid lizards, farming of large teiid lizards is reported from Argentina where omnivorous tegus (*Tupinambis* spp.) are reared for their skins and meat (NRC, 1991). Herein we present the first documentation of commercial farming of agamid *Leiolepis* spp. lizards for meat production.

## ***Leiolepis* Farms in Southern Vietnam**

In spring 2009 Peter Geissler conducted an excursion along coastal dune habitats of Binh Thuan Province east of Ho Chi Minh City. These areas reach inland for several kilometres and are covered with a unique dry forest vegetation community adapted to dry and windy conditions (Sterling et al., 2006). Moreover, this area inhabits specialized open-habitat herpetofauna, of which the spotted butterfly lizard (*Leiolepis guttata*) is a prominent member. These diurnal, terrestrial agamid lizards are sand-dwelling and live in burrows (Weitkus, 1999).

Besides observing several *L. guttata* in the wild (front cover), many were also seen in enclosures in small coastal villages where they are farmed. The roofless enclosures (Fig. 1) measure up to half a hectare and are surrounded by a fence made out of corrugated metal sheets that are dug deeply or placed on top of a solid brick fundament. The bleak sandy ground is sporadically planted with cashew trees (*Anacardium occidentale*). The stocking density of lizards in these areas seems to be very high. Up to 40 burrow entrances were counted.

The lizards were fed on a diet of pumpkin



**Figure 1.** Enclosure at a *Leiolepis* farm near Mui, Ne, Binh Thuan Province, southern Vietnam. Photograph by P. Geissler.



**Figure 2.** Largest known specimen of *Leiolepis* held by a Bonn student. Photograph by P. Geissler.



slices and green vegetables. Due to the pumpkins' rich content the animals looked very well fed and were surprisingly large.

When for sale the animals are caught in rat traps and sold alive to local restaurants or to middlemen who sell them at local markets all over the area, and even at markets in neighbouring provinces. Local people usually consume the muscular tail. With 300.000 Vietnamese Dong (approximately £9.50)/kg the price of living *Leiolepis* is astonishingly high.

We could not be certain if these traded lizards were bred at the farms or if they were wild caught animals that were fattened at farms. If they are taken from the wild, the trade will consequently have a strong negative impact on populations in the area.

#### Identification and Size of Farmed Specimens

The biggest farm animal seen (Fig. 2), now stored in the Institute of Ecology and Biological Resources in Hanoi (IEBR A.2010.1920) has an impressive length of 73 cm (SVL: 25 cm). Previously biggest known butterfly lizard was documented by Peters (1971), and had a total length of 55.3 cm (SVL: 18.4 cm; TL: 36.9 cm). This specimen of *L. guttata* was collected in 1936 in Vietnam (without an exact locality) and deposited in the collection of the American Museum of Natural History, New York (AMNH 99295).

Due to the well known heterosis effects in farmed crocodile-hybrids and the occurrence of triploid, parthenogenetic forms of *Leiolepis* (that developed via hybridization) we carefully checked the species of the farmed animals as *L. guttata* to avoid overlooking evidence of hybridization that could create erroneous identification. All the farmed butterfly lizards matched the diagnosis of *L. guttata*. Firstly, the unique colour pattern of alternating black and white transverse bars on the flanks in males identified the farmed animals as *L. guttata*. Also, the presence of more than 16 rows of enlarged scales on each ventral side of the tibia, midway between ankle and the knee, is only known in *L. guttata* (Peters, 1971; Darevsky & Kupriyanova 1993; Schmitz et al., 2001; Grismer & Grismer, 2010). The occurrence of male specimens among the groups at the farm is further

evidence against hybridization because all proven cases of hybridization are known only from parthenogenetic lineages.

In conclusion, no indications of hybridisation were found, so perhaps intensive feeding may be responsible for the new size record for *Leiolepis guttata*.

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# On the nomenclature and taxonomy of the south Indian colubrid snake *Ahaetulla perroteti* (Duméril, Bibron & Duméril, 1854)

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THE vine snake *Ahaetulla perroteti* (Duméril, Bibron & Duméril, 1854) is endemic to the Western Ghats mountain range of southern India, with precise distribution records from North Canara (Jerdon, 1854), Nilgiris (Theobald, 1868; Wall, 1919; Kannan & Bhupathy, 1996), Silent Valley (Balakrishnan, 2007), High Wavys (Hutton, 1949; Hutton & David, 2009), Periyar Tiger Reserve (Zacharias, 1997), Kalakkad-Mundanthurai Tiger Reserve (Kumar et al., 2001; Ishwar et al., 2001), Eravikulam, Coorg, and Courtallam (Anonymous, 2001). Apart from these, an erroneous record from Pegu in Burma [now Myanmar] also exists (Sclater, 1891). Although all these localities are present in the Western Ghats they have varying habitats and topography. North Canara has evergreen and semi-evergreen forests covering its low hills, rising rarely over 700 m asl (Ali, 2006) while all other above mentioned localities, in the Southern Western Ghats, i.e., N 8-11° have montane shola grassland habitat covering high hills raising over 1500 m asl (Lockwood, 2006; Shanker, 1997).

*A. perroteti* has not been recorded from North Canara except for the holotype of its subjective synonym *Leptophis canarensis* Jerdon "1853" 1854 and some implicit reports (for example, Günther, 1864). Field surveys conducted in North Canara (Ali, 2006; Ganesh et al., 2007) failed to record the snake. Its micro-and meso-habitat associations are also unequivocal in literature. Wall (1919) and Kannan & Bhupathy (1996) remark that the species is common on the grassy hills of Nilgiris, while Kumar et al. (2001) and Ishwar et al. (2001) document sightings of *A. perroteti* in the rainforests of Kalakkad-Mundanthurai Tiger Reserve. Their opinions were concurred by Anonymous (2001) who stated the species to be arboreal, inhabiting evergreen forests.

Due to inconsistencies in the occurrence of this snake we herein report data based on field observations of four male and two female live conspecifics sighted from 14 to 18 June 2008 in Mukurthi National Park (N 11°20.44', E 76°33.22'; 2200-2250 m asl), Nilgiri district, Tamil Nadu state, India.

## MATERIALS AND METHODS

Visual encounter surveys (Crump & Scott, 1994) was used to collect basic ecological data in the field. Meristic, metric and morphological data were recorded from live individuals in-situ and all snakes were released after data collection. Scale counts were taken following Ganesh et al. (2009), using a magnifying hand lens. Measurements were taken using a standard measuring tape and the values reported to the nearest millimetre. Sex was determined using a thin, smooth, metallic probe. All photographs of the snake were taken in life and in-situ, using a Canon Powershot A620™ camera. Geographic coordinates and altitude of sighting localities were recorded using a Garmin™ 12 channel GPS. Nomenclatural discussions strictly comply with the 4<sup>th</sup> edition of the International Code of Zoological Nomenclature, ICZN (1999).

## OBSERVATIONS

### Morphology

Pupil horizontally elongate; rostral scale without dermal appendage; loreal absent; supralabials 8, 4<sup>th</sup> and 5<sup>th</sup> entering orbit; infralabials 8, 1<sup>st</sup>-5<sup>th</sup> touching genials; internasals and prefrontals in contact with supralabials; preocular 1, reaching the upper surface of head; loreal region strongly concave, ridged above with a notch of preocular and prefrontal scales; postocular 1; temporals 2+2; scales in 15:15:13 oblique rows, sacral scales

keeled, more so in males; vertebral scalerow not enlarged; prefrontals 1-2; ventrals, males: 133-137, females: 147-156, angulate laterally, bicarinate; subcaudals, males: 63-79, females: 59-63 pairs excluding terminal scale; anals 2; snout to vent length, males: 224-323 mm, females: 484-512 mm; tail length, males: 86-125 mm, females 152-160 mm; relative tail length males: 27-28%, females: 23%; in life colour, males: light or pale green to greenish yellow, females: brownish orange or brownish ochre, with a pale lateral stripe along the outermost scale rows (Fig. 1).

### Field Observations

These snakes were actively moving around during daytime (09:30-15:45), on grassland, bare ground and the floor of old, dilapidated buildings. Two adults, a male and female, were once observed together in accompaniment, on bare ground near a tar road surrounded by pinewood plantations and grassland patches with pockets of shola forests in between (Fig. 1). Four specimens were found on the ground and two were found about 1-2 feet above ground, on rocks but not on plants or trees. We observed the snakes to be thermophilic, basking during sunny times of the day. Our searches within tree-cover, both in shola forests, as well as man-made plantations, failed to yield any sightings.

### DISCUSSION

Our field observations on the natural history of this species agree with Wall (1919) and Kannan & Bhupathy (1996), in that, this species is common on the montane grasslands of the Nilgiris. Morphological data of our specimens are, for the most part, consistent with, though slightly outranging the features given in historical literature (Günther, 1864; Boulenger, 1890; Wall, 1919; Smith, 1943). Our ventral counts were 133-156 (vs. 136-146 in Smith [1943]; 137-146 in Wall [1919]) and our subcaudal counts were 63-79 in males (vs. 65-75 in Smith [1943]; 71-81 in Wall [1919]), 59-63 in females (vs. 71-86 in Smith [1943]; 65-75 in Wall [1919]). From these data, it is apparent, that Smith (1943) had, possibly by mistake, interchanged the subcaudal counts (largely based on Wall [1919]) of the males measured, with the females. We believe that this factor likely accounts

for the large difference in the subcaudal counts of our measurements that are more consistent with that reported in Wall (1919). We also report the largest length for this species: 670 mm (vs. < 590 mm in Wall [1919]). Literature (Günther, 1864; Boulenger, 1890; Wall, 1919; Smith, 1943) states the life colour of this species to be green. Our observations and photographic vouchers reveal the presence of a predominantly brown coloration in females. These vouchers are, to the best of our knowledge, the first published photographs for this species, illustrating it in life and in natural habitat. Thus we slightly expand the characterisation of this species, by providing intraspecific variation from novel conspecifics. Even after Wall (1919) extensive data on scalation, dentition, morphology, natural history, breeding, habitat associations, and a good sample size of 57 specimens, there is still much more to reveal with *A. perroteti* than previously realised.

Of all the congeners, *A. perroteti* has the smallest relative tail length (0.24 in *A. perroteti* vs. 0.31 in *A. fronticincta*; 0.33 in *A. dispar*; 0.34 in *A. prasina*; 0.38 in *A. nasuta*; 0.41 in *A. pulverulenta*) and subcaudal scale counts (65-86 in *A. perroteti* vs. 78-119 in *A. dispar*; 139-148 in *A. fronticincta*; 135-180 in *A. nasuta*; 141-192 in *A. prasina*; 151-208 in *A. pulverulenta*); data from Smith [1943] and Whitaker & Captain [2004]). Considering the above data it is reasonably clear that the morphology of *Ahaetulla perroteti* is inconsistent with the rest of its long-tailed congeners. This view was also concurred by Jerdon (1854) and Günther (1858). The short and stocky habitus could be the result of environmental selection pressures (see Aubert et al., 2004). To add more support, we provide literature accounts on “terrestrial” behaviour of some “arboreal” *Ahaetulla* spp. Whitaker & Captain (2004) state that *A. nasuta* is mainly arboreal but rarely found on the ground and further state that it has been observed feeding on fish, tadpoles and shield-tail snakes, all of which support terrestrial behaviour. Such terrestrial behaviours exhibited by *A. nasuta* could perhaps be considered as facultative traits. However, since our surveys revealed that *A. perroteti* was never found on branches of shrubs and trees but always on bare, open grasslands, *A. perroteti* could be regarded as





**Figure 1.** (from top left to bottom right) - live adult male; live adult female *Ahaetulla perroteti*; holotype MNHN 1994.1074 (photo courtesy: Patrick David); map of southern India showing Nilgiris and North Canara; topography of upper Nilgiris (Mukurthi National Park); topography of North Canara (Sharavathy Wildlife Sanctuary).



an obligate terrestrial snake, until further arboreal observations confirm its habitus. Despite being a member of a genus comprising primarily arboreal taxa, its unique, short and stout build, together with complete absence of any dermal protuberance on the rostrum are perhaps regarded as adaptive traits to the open grassland environments that it uses. This situation parallels that of some other shola grassland-dwelling taxa which are supposed to be “arboreal” like the rhacophorid frogs *Ghatixalus* spp. and *Raorchestes resplendens* that are in fact terrestrial (Biju et al., 2008; 2010).

### Taxonomy and Status of *Leptophis nilagiricus*

Günther (1864), whilst writing the accounts of *Ahaetulla perroteti*, stated: “Judging by the figure in W. Elliot, Esq., the “*Leptophis? nilagiricus?*” n. sp. of Jerdon’s Journ. As. Soc. Beng. xxii. p. 529 would belong to this genus. The celebrated Indian ornithologist describes it thus: Green above, yellow beneath; ventrals 140, subcaudals 73, thirteen rows of scales. Very common on the grassy hills of Neelgherries.”

Our perusal of Jerdon (1854) revealed that the original description of *Leptophis nilagiricus* contained just these two lines quoted above, and is not clearly informative. *Leptophis nilagiricus* Jerdon, 1854 “1853” currently meets the conditions of Article 11.9 of the International Code of Zoological Nomenclature, ICZN (1999) (hereafter, “the Code”) as an available name. In order to assess the status of this nominal taxon *Leptophis nilagiricus* Jerdon, 1854 we first analysed the taxonomic history of *Ahaetulla perroteti*, the valid species with which this nominal taxon was originally associated with by Günther (1864).

The taxonomic history of *A. perroteti* is fraught with several issues. Duméril et al. (1854) described *Psammophis perroteti* based on a single specimen from “Indes Orientales”. Jerdon (“1853”1854) described *Leptophis? canarensis?* based on a single specimen originating from “North Canara” (now Uttar Kannada district of Karnataka state, India). Günther (1858) described *Dryophis tropidococcyx* based on several syntypes from “Madras”, “India” and “East Indies”.

Günther (1858), who first recognized *D. tropidococcyx* as a species of the genus *Dryophis*,

later, in 1860, established conspecificity between Duméril et al.’s *Psammophis perroteti* and Jerdon’s *Leptophis canarensis*, and his own *Dryophis tropidococcyx*. Since Günther (1860) believed this taxon as neither belonging to the genera *Psammophis*, *Leptophis* or *Dryophis*, he described a new genus *Tropidococcyx* and transferred the taxon “*perroteti*” to it, thus naming the specimen *Tropidococcyx perroteti*. Günther (1864) gave a good taxonomic history of this species, with a list of synonyms, but unfortunately misspelled Jerdon’s “*canarensis* as *canariensis*” and also incorrectly attributed this name to Jerdon, 1855, instead of 1854. Theobald (1876) also misspelled it as “*kanariensis*”. Boulenger (1890) and Smith (1943) attributed *Leptophis canarensis* to Jerdon 1853 (instead of 1854), in which case, the species name of Jerdon (1853) would be applicable to this taxon, as it preceded Duméril et al.’s (1854) “*perroteti*”, according to Article 23 of the Code. However, volume 22 of the Journal of the Asiatic Society of Bengal published sensu Article 8 of the Code as only in the year 1854, as is evident from the front section of the volume and the taxon-author name of *Trigonocephalus (Cophias) malabaricus* Jerdon, 1854 which appeared on page 524 of the very same issue.

Additionally, Smith (1943), in his list of synonyms, did not mention any names that Günther erected. Subsequent generic reallocations produced several combinations such as *Tragops perroteti*, *Dryophis perroteti* and lastly, the currently-accepted name *Ahaetulla perroteti* (see Theobald, 1876; Boulenger, 1890; Savage, 1952; Whitaker & Captain, 2004). After Günther (1864) few taxonomic actions apart from these generic reallocations, happened for the species. Günther (1864) quoted *Leptophis nilagiricus* in the species accounts of *Tropidococcyx perroteti*, but did not list *Leptophis nilagiricus* as a valid species of his genus *Tropidococcyx* (which he still maintained to be monotypic), nor did he place *Leptophis nilagiricus* in the synonymy of *Tropidococcyx perroteti*. Therefore, Günther (1864) and no other subsequent authors, fully recognised *Leptophis nilagiricus* either as synonym of *Ahaetulla perroteti* or as a distinct, valid species.

*Leptophis? nilagiricus?* Jerdon, “1853” 1854

is consistent with *A. perroteti* in all characters except for its 13 scalerows (15 in *A. perroteti*) and absence of lateral stripe on the belly (present in *A. perroteti*). Therefore, it would be careful to suggest that it is not yet clear whether *Leptophis nilagiricus* is conspecific with *Ahaetulla perroteti*. It is also noteworthy that *A. perroteti* has 13 posterior scalerows (Wall [1919]; herein, this study) and that, some of our live individuals discussed herein, had nominal lateral striping. Since, Günther, (1864) did not fully assess the status of *Leptophis nilagiricus* Jerdon 1854, we believe this name has remained obscure in the literature (see Günther, 1864; Boulenger, 1890; Smith, 1943). We therefore suggest that the name *Leptophis nilagiricus* should be brought back to notice from obscurity and clarified by further taxonomic investigation of *Ahaetulla perroteti* (the valid species with which Günther [1864] associated the name *Leptophis nilagiricus*).

There is uncertainty over the existence of any deposited specimen(s) of *L. nilagiricus* and to provide details about this issue we here quote Jerdon's own lines as they appear on the introductory part before his systematic accounts on squamate reptiles and amphibians; "*The following is merely a brief and imperfect resumé of the serpents and frogs of S. India, drawn up from my drawings, with a few rough notes attached to them; as circumstances have prevented my giving a more full account at this time; but a detailed account will be drawn up, as soon as again I have access to my collection.*" (verbatim from Jerdon 1854: p 522). Here Jerdon admits that he had based his accounts only on drawings and was yet to examine his collected specimens. This also could imply that preserved specimen(s) of *Leptophis nilagiricus* possibly existed. However, no information on the repository/museum where the specimen depicted by W. Elliott was preserved and deposited appeared in Smith (1943).

Because Elliott's figure forms the basis for the description of *L. canarensis*, the figure becomes the only unambiguous "referred material" [if not the iconotype] for this name. Moreover, to the best of our knowledge, no snake in Nilgiris or elsewhere in its vicinity, fits the exact description of *L. nilagiricus*. Only some species such as *Dryocalamus nympha*,

*Xylophis perroteti* and *Calliophis* spp. have 13 midbody scalerows. Furthermore, none of these valid species have a green dorsum as described by Jerdon (see Wall [1919] and Smith [1943]).

In conclusion the status of *Leptophis? nilagiricus?* Jerdon "1853" 1854, based on W. Elliott's figure, from Neelgherries, is *incertae sedis*. We believe that further taxonomic work involving the ancient types of the synonyms could solve this fascinating history and taxonomic conundrum.

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# Vegetation structure at basking sites of the adder *Vipera berus*: Implications for site management

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THE European adder *Vipera berus* (Linnaeus, 1758) has the largest geographic range of the world's terrestrial snakes (Nilson, 1980; Herczeg et al., 2007) and is arguably one of the most studied snakes in the world (Phelps, 2007). Studies of this species and its response to vegetation structure are, nevertheless, scarce. Changes to vegetation dynamics, resulting from inappropriate habitat management schemes, have been observed to influence population density (Phelps, 2007) and removal of heath vegetation by fire can increase the risk of predation due to the lack of adequate cover, especially for males during spring emergence (Phelps, 2004).

This study investigates habitat structure and use by thermoregulating adders, comparing vegetation at spring basking sites with that of adjacent heath and grassland. The analysis of the influence of vegetation structure on the local distribution of this species following emergence from hibernacula and during lying-out periods may allow site managers to take account of adder populations in habitat management plans.

## MATERIALS AND METHODS

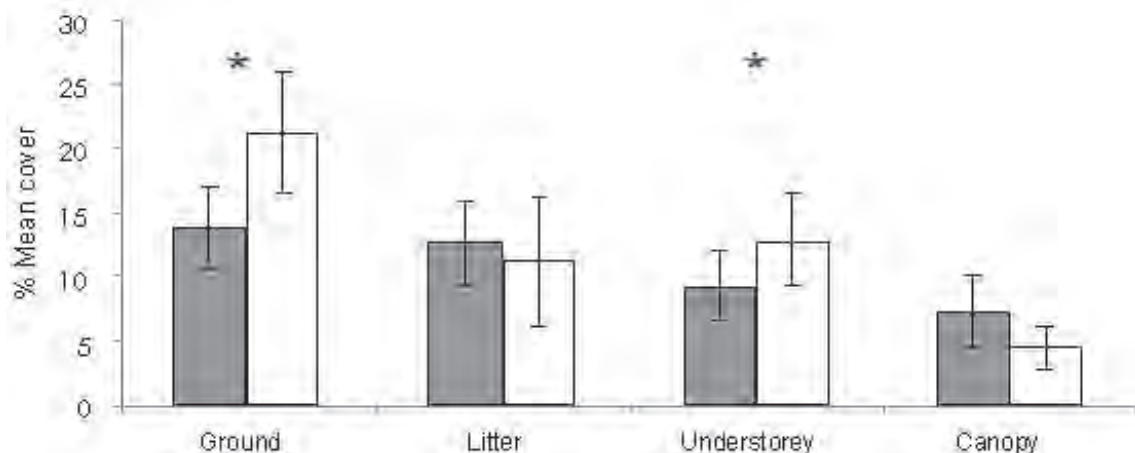
Surveys were conducted across six habitat patches, with various vegetation types, across two localities in the UK; Blackmoor Reserve (n = 1) and Quantock Common, Somerset (n = 5). Blackmoor Reserve (51°18'N, 2°44'W) covers 0.25 km<sup>2</sup> of the central plateau of the Mendip Hills Area of Outstanding Natural Beauty (AONB), 244 m above sea level. Habitat consists of a mosaic of calcareous grassland and limestone heath. Patches of bare ground and lead slag reflect its former use for mining. Quantock Common (51°08'N, 3°13'W) covers 18.31 km<sup>2</sup>, 250-350 m above sea level, and is part of the Quantock Hills AONB. It compromises

mostly lowland heath, acid grassland and ancient woodland.

The survey of basking sites was conducted over 56 days between late February and early May 2008, following the spring emergence of snakes and subsequent establishment of lying out areas. The six study areas were surveyed for basking sites on six separate occasions. For the purpose of this study, a basking site is a location where an adder was considered to be attempting to thermoregulate in direct sunlight. Sites were surveyed from a network of pathways established by anthropogenic activity and grazing stock. The collection of data was conducted between 1000 and 1700 hours in relatively dry conditions. Upon finding a basking site, all snakes were removed to allow for vegetation surveys to be conducted safely and for morphological measurements to be made (for another study). Snakes were returned to the point of capture after the vegetation survey.

Vegetation was assessed within four layers, defined as follows. "Ground" vegetation comprised lichens, mosses, herbaceous shoots and short swards of grass shoots. "Litter" was dead material sitting loosely on the ground layer and typically comprised dead gorse (*Ulex* spp.), heather (*Calluna* and *Erica* spp.) leaves and bracken (*Pteridium aquilinum*) leaves and stalks. "Understorey" comprised grass tussocks, and low-growing vegetation, both herbaceous and woody plants (including small heather, gorse and bracken plants). "Canopy" vegetation included established, tall (> 80 cm) woody plants, including predominantly heather, gorse and birch. Bracken is widespread on the Quantock Hills; during spring dead bracken contributed most of the vegetation in the litter layer, and young bracken shoots made up most of the ground layer.





**Figure 1.** Extent (%) of vegetation cover ( $\pm$  SE), within ground, litter, understorey and canopy layers. Shaded bars signify random quadrats and unshaded bars signify basking sites. \* denotes statistically significant results.

A 50 x 50 cm quadrat was centred on each basking site, and the percentage cover of each of the sward layers was estimated. General vegetation structure of each study area was assessed using the same approach, but randomly locating quadrats (twenty quadrats on the five Quantock Common study areas and forty on Blackmoor Reserve, a larger site).

A mixed-effects linear model with a binomial error structure was used to determine the factors that were significantly related to adder presence. Results with a probability of less than 0.05 were treated as statistically significant. Statistical analysis was conducted using R 2.6 software.

## RESULTS

Adder basking sites were found in three of the study areas known to contain hibernacula. 202 quadrats of vegetation were sampled, of which 34.07 % ( $n = 62$ ) were adder basking sites and 65.93 % ( $n = 140$ ) were randomly selected. The mean percentage cover by ground vegetation was greater at basking sites than at randomly sampled locations ( $\pm$  SE 0.001,  $df$  190,  $P < 0.001$ ), as was the mean percentage understorey vegetation cover ( $\pm$ SE 0.001,  $df$  190,  $P < 0.001$ ) (Fig. 1). There was no significant difference in the extent of vegetation cover in the litter and canopy layers between basking sites and the surrounding vegetation.

## DISCUSSION

Microhabitat use by basking snakes was positively associated with ground and understorey vegetation cover. Snakes must trade-off the costs and benefits associated with the selection of habitats and thermoregulation (e.g. avoiding predators and obtaining basking sites) (Howard et al., 2003). Vegetation cover at the ground layer provides a warm substrate on which some UK reptile species can thermoregulate (House & Spellerberg, 1983). Understorey vegetation cover can provide a refuge from potential predators, whilst also allowing enough light to penetrate to the ground so that snakes can thermoregulate in the litter layer below. Predation pressure on adders by foraging mammals and human persecution is most frequent during basking following spring emergence (Prestit, 1971). Often only a relatively small amount of open ground is required for basking, but from observations, dense vegetation cover is nearly always close by (House & Spellerberg, 1983).

Although the extent of canopy cover was not significantly different between basking and random sites, it was present only in small amounts. More extensive canopy cover may lead to the shading out and loss of basking sites (House & Spellerberg, 1983; Urbina-Cardona et al., 2006), yet may serve as cover, particularly against avian predators during

episodes of spring basking activity (Chris Glead-Owen, pers. comm.).

In summary, this study found differences in vegetation structure between adder basking sites and adjacent microhabitats. Basking sites had more extensive areas of low growing vegetation (ground and understorey layers). It is likely that patches of relatively low growing vegetation, within a mosaic of other vegetation structure, provide structural microhabitat suitable for both basking and as cover to escape predation.

### Implications for Habitat Management

The management of understorey and canopy vegetation is important in managing habitat for snakes (Pringle et al., 2003). Unmanaged habitats with mature, tall stands of woody vegetation, and continuous canopy cover, may lack basking sites. A mosaic of vegetation heights enhances thermoregulatory opportunities and provides protective cover (Tracey & Christian, 1986; House & Spellerberg, 1983). However, habitat requires particularly careful management near hibernacula because loss of vegetation here can increase predation pressure on adders following spring emergence (Phelps 2004; 2007). Management may therefore have to include cessation of spring fires at known sites of hibernacula and adopt alternative management methods. Habitat management should seek to maintain or create a mosaic habitat at adder hibernacula, where both open basking areas and mature cover are available (House & Spellerberg, 1983).

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## Captive breeding of the reticulated python *Python reticulatus* in Andaman and Nicobar islands, India

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**ABSTRACT** - Captive breeding of a wild reticulated python *Python reticulatus* was conducted in the Mini Zoo at Port Blair, Andaman and Nicobar islands during 2010. The female laid three eggs and two hatched. The details of breeding activity are discussed in this paper.

THE Andaman and Nicobar Islands, popularly known as 'Bay Islands', are situated in the Bay of Bengal, mid way between peninsular India and Myanmar. The islands are located between 6°45' and 13°41' N and 92°12' and 93°57' E. There are 572 islands lying 193 km away from Cape Negrais in Myanmar, 1255 km from Kolkata and 1190 km from Chennai. The total geographic area of the Andaman and Nicobar Islands is 8249 km<sup>2</sup> of which the Andaman group covers 6408 km<sup>2</sup> while Nicobar covers 1841 km<sup>2</sup>. The islands attain a maximum altitude at Saddle Peak (730 m) that is formed mainly of limestone, sandstone and clay. Two islands of volcanic origin are found in the Narcondum and the Barren islands. The former is now apparently extinct while the latter is still active. The climate is typical of tropical islands of similar latitude. It is always warm but with sea-breezes. Rainfall is irregular, but usually dry during the north-east, and wet during the south-west, monsoons.

Studies on reptiles commenced with the notes on the Fauna of Nicobar Islands by Blyth, (1846) followed by Steindachner (1867), Gray (1842), and Sclater (1891). During the twentieth century many research organisations have been involved in the taxonomy of reptiles and amphibians in Andaman and Nicobar Islands (Smith, 1935, 1940, 1943; Cherchi, 1954; Biswas & Sanyal, 1965; Tiwari & Biswas, 1973; Pillai, 1977; Whitaker, 1978; Mehta & Rao, 1987; Das, 1996; Stoliczka,

1873). Recently, Das & Gemel (2000), Ghodke & Andrews (2001a & 2001b), Vijayakumar (2005) and Vijayakumar & David (2006) carried out studies in Andaman and Nicobar Islands. Reviewing this literature reveals that no studies have been carried out on breeding by *Python reticulatus*.

*Python reticulatus* is the longest snake in the world and among three old world pythons. It is a beautiful, appealing and large snake. It is relatively slender and characterised by an attractive pattern, diamond-shaped outline highlighted by white spots with a light brown background (Smith, 1943). It is native throughout Southeast Asia from the Nicobar Islands, Bangladesh, Burma, Thailand, Laos, Cambodia, Vietnam, Malaysia and Singapore, east through Indonesia and the Indo-Australian Archipelago and the Philippines (McDiarmid, 1999). *P. reticulatus* inhabits evergreen forest and is semi-aquatic in habit. It feeds mostly on small mammals, birds and reptiles. It occasionally feeds on mammals like wild boar, deer, cattle, and even humans. It lays eggs in large clutches of up to 100. The female python exhibits considerable parental care till the eggs are hatched.

### MATERIALS AND METHODS

This study was carried out during 2010 at Mini Zoo, Haddo, Port Blair. A healthy adult pair of *P. reticulatus* was selected for breeding. The male was eight feet long and female was twelve feet

	J	F	M	A	M	J	J	A	S	O	N	D
Wet season												
Dry season												
Mating												
Egg laying												
Hatching												

**Table 1.** Relationships between reproductive activities and season.

long. Both snakes were originally caught from the Great Nicobar Island. The breeding pair was kept in a 3 x 3 x 3 m concrete room. The front of the room was covered with wire mesh with an entrance. The pair was fed domestic fowls, weighing 1.5 kg on a fortnightly basis.

## RESULTS AND DISCUSSION

The female was introduced into the male's enclosure during the first week of October, 2009 and mating and courtship behaviour was observed from October to January. The highest mating frequency was observed during the months of December and January (Table 1). Mating was observed 10 times during night, morning and evening. Copulation varied from 25 to 30 minutes.

### Gestation, Clutch and Egg Size

The gestation period was considered from the date of last mating to the date of egg laying (Table 2). The last mating was observed on 12 January 2010 and a total of five eggs were laid on 2 April 2010. The gestation period of study was 81 days. During incubation, the female completely avoided food and shivered her body regularly over the eggs. The average egg length was 10.6 cm and 210 g. All the eggs were allowed to incubate naturally and the

Gestation period (days)	81
Number of eggs	5
Egg length (cm)	10.6 (Average)
Egg weight (g)	210 (Average)
Incubation period (days)	72
Incubation humidity (%)	80-90 %
Incubation temperature (°C)	31-32°C
New born length (cm)	70 (Average)
New born weight (g)	39 (Average)

**Table 2.** *Python reticulatus* captive breeding data.

Hatchling	Measurement (cm)		
	20.6.10	10.10.10	10.11.10
1	80	84	86
2	60	71	72

**Table 3.** Growth measurement of hatchlings.

incubation period was 72 days. Out of five eggs only two hatched and the hatchlings were identified individually. The average total body length was 70 mm and 39 g. The growth in body length of hatchlings varied between the individuals (Table 3).

During this study, the mating of *P. reticulatus* was observed from December to January. This indicates that temperature may influence reproductive activity of this species. Temperature ranged from 31 to 32°C and humidity was 80 to 90% RH. The observed period of mating was similar to *Python molurus* (Ross & Marzec, 1990). The gestation period of 81 days was higher than *Python molurus* (Dattatri, 1990; Ross & Marzec, 1990). The variation in weight and size of hatchlings can be a result of temperature during incubation period. According to Vineger (1973), temperature not only affects the metabolic activity in ectothermic animals but also plays a vital role in the development of embryos. This example of captive management of *P. reticulatus* emphasises that if certain basic parameters are provided for the species, combined with individual care, breeding can be successful.

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**HEMIDACTYLUS BRASILIANUS** (Amaral's Brazilian gecko) and **CNEMIDOPHORUS OCELLIFER** (Spix's whiptail): PREDATION. Many arthropods are predators of lizards (McCormick & Polis, 1982). However, few studies are known regarding prey-predator relationships between reptiles and arthropods within Brazilian communities (Rocha & Vrcibradic, 1998). *Hemidactylus brasilianus* (Fig. 1A) is a nocturnal gekkonid from the semi-arid Caatingas of northeastern Brazil (Vanzolini et al., 1980). *Cnemidophorus ocellifer* (Fig. 1B) is a diurnal, neotropical, teiid occurring in Argentina, Bolivia, Paraguay, and Brazil, excluding Amazonia (Vanzolini et al., 1980). Herein, we report predation of *H. brasilianus* and *C. ocellifer* by the ant *Dinoponera quadricipes* (Hymenoptera, Formicidae) in Caatinga area.

The ant genus *Dinoponera* contains species with body sizes varying from 30 to 40 mm total length (Paiva & Brandão, 1995). *Dinoponera* ants belong to the subfamily Ponerinae, ranging from humid forest soil to dry savannas, and they are described as solitary foragers with carnivorous habits (Fourcassié & Oliveira, 2002). The neurotoxic venom of the ponerine ants is injected through a gland connected to a sting in the abdomen. It is used for killing and defence. Ponerine ant prey is diverse and includes insects and other arthropods, birds and small mammals (Hermann et al., 1984; Schatz et al., 2001). *Dinoponera quadricipes* is a typical queenless ponerine, found in the semi-arid Caatingas, Cerrado and Atlantic Forest (Paiva & Brandão, 1995).

At 08:30 on 22 October 2009, during a study of lizard assemblages, we found an adult *H. brasilianus* (38 mm SVL, 24 mm tail) in Dizimeira (06°10'80"S, 36°43'38"W; datum: WGS84, elev. 751 m), municipality of Tenente Laurentino Cruz, Rio Grande do Norte, Brazil. On 10 March 2010 ca. 09:00 in the same municipality, we found a juvenile *C. ocellifer* (size not measured) in Nascimento (06°08'14"S, 36°44'81"W; datum: WGS84, elev. 680 m). These lizards had been captured together with *D. quadricipes* in a 37.5 litre bucket pitfall trap in a forest enclave. The lizards had been killed by the ants. Immediately after we took the ants out of

the traps they proceeded to carry portions of the lizards bodies in their jaws, possibly in search of their nests (Fig. 2. A-B).



**Figure 1.** Adult specimens of *Hemidactylus brasilianus* (A, above) and *Cnemidophorus ocellifer* (B, below) from Caatinga, northeastern Brazil.

Records for Brazilian lizards as prey of arthropods include a juvenile *C. ocellifer* predated by a centipede *Scolopendra viridicornis* (Bocchiglieri & Mendonça, 2009) and an adult *Tropidurus oreadicus* eaten in a pitfall trap by a wolf spider *Lycosa erythrognatha* (Bocchiglieri & Mendonça, 2010). In addition, Sousa & Freire (2010) observed an adult *C. natalensis* predated by the ant *D. quadricipes* in a remnant of the Atlantic Forest. The findings reported here from Tenente Laurentino Cruz represent the first record of predation by *D. quadricipes* on *H. brasilianus* and *C. ocellifer*.

The *H. brasilianus* (CHBEZ 2949) was deposited in the herpetological collection of Universidade Federal do Rio Grande do Norte, Natal City. We thank the Programa PELD/CNPq - Caatinga: Estrutura e Funcionamento and the

municipal government of Tenente Laurentino Cruz for logistical support. This study was supported by doctorate and postdoctorate fellowships from Coordenação de Aperfeiçoamento de Pessoal de Nível Superior (CAPES) awarded to M. Gogliath and L.B. Ribeiro, respectively, and by a research fellowship granted by CNPq to E.M.X. Freire (304077/2008-9). IBAMA issued the required permit (Permit 206/2006 and Process 02001.004294/03-15).



**Figure 2.** Juvenile *Cnemidophorus ocellifer* predated by *Dinoponera quadricaps* in Nascimento, Tenente Laurentino Cruz, northeastern Brazil: (A) Anterior portion of the lizard's body cut off by the ant. (B) ant carrying part of lizard's trunk with its jaws.

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***OXYRHOPUS CLATHRATUS*** (false coral snake): DIET. Feeding and behaviour are important ecological characteristics in the natural history of snakes (Leite et al., 2009). The most common method to study prey in a given snake is examining the digestive tracts of preserved specimens in scientific collections (Shine 1988, 1989; Andrade & Silvano, 1996; Ruffato et al., 2003; Hartman & Marques, 2005; Leite et al., 2009). The feeding behaviour of *Oxyrhopus* is only known from one study of the diet of *Oxyrhopus guibei*. Andrade & Silvano (1996) found an ontogenetic shift in prey choice; snakes smaller than 40 cm had only lizards in their stomachs while larger snakes preyed on solely rodents. No data on ecology and natural history is available for the false coral snake *Oxyrhopus clathratus* (Bernardo, 2010). *O. clathratus* is a rare snake which occurs only in the forested areas of the Atlantic Forest in Brazil and north Argentina. Here we provide the first record on feeding behaviour of *O. clathratus*.

On 21 January 2010 a young male *O. clathratus* (360 mm SVL + 79 mm TL) was collected in a pitfall trap at the base of the Peak of Marins (22°30'29.7" S, 45°08'55.5" W, WGS84 Datum, 1580 m asl), Piquete, São Paulo, Brazil. This locality forms part of the Environmental Protection Area of Mantiqueira (*APA da Mantiqueira*). This region is characterised by rugged terrain with altitudes between 1200 to 2400 m asl. The climate is subtropical with average temperatures of 20°C, highs of 35°C and lows below 0°C. Annual rainfall varies between 1,250 and 1,500 mm. The area has typical vegetation of high altitude environments, with "Alto Montana" forests and "Campus de Altitude". However, habitat alteration in the region includes *Eucalyptus* plantations, deforestation for grazing cattle and construction of houses. The collection location of the *O. clathratus* was a secondary forest with *Eucalyptus*.

After an incision for tissue collection, the researchers found an adult female *Colobodactylus dalcyanus* (Gymnophthalmidae) (42 mm body length, 74 mm total length) in the snakes stomach. *Colobodactylus dalcyanus* is a rare species known only from just two localities above 1400 m elevation: *Brejo da Lapa*, Itatiaia National Park, on the Rio de Janeiro-Minas Gerais border (Vanzolini

& Ramos, 1977) and Campos do Jordão in the state of São Paulo (Manzani & Sazima, 1997), both localities in the Serra da Mantiqueira in the Brazilian Atlantic Forest. This species has been assessed as Data Deficient on the IUCN Red List (Doan, 2009) and is considered "Near Threatened" in the region (Marques et al., 2009). The biology of *C. dalcyanus* is almost completely unknown but field observations suggest this species is more active at night during the dry season and occurs only in "Campus Montanus" environments. Finding both rare species together in the same area may suggest suitable habitat in the area for both species. Local efforts to keep this area preserved are essential to maintain viable populations.

The size of a juvenile male *O. clathratus* is between 195 and 500 mm and the largest male recorded for this species is 904 mm SVL (Bernardo, 2010). This record of diet agrees with the observations made by Andrade & Silvano (1996), in that juvenile *Oxyrhopus* prefer to eat lizards.

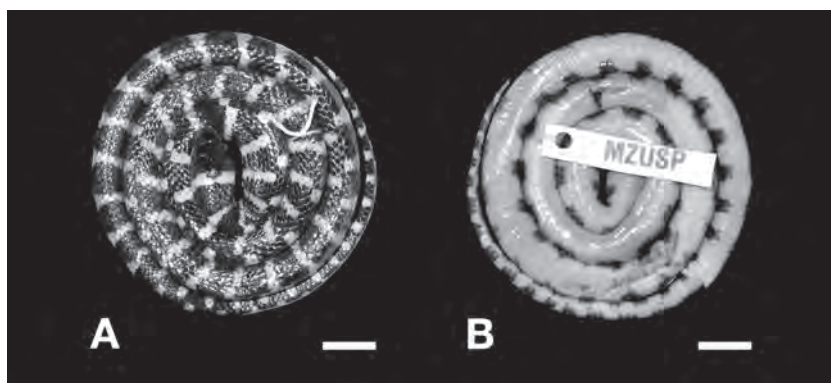
Both, *O. clathratus* (MZUSP 18030) and *C. dalcyanus* (MZUSP 100320) specimens were deposited in the herpetological collection at Museu de Zoologia da Universidade de São Paulo.

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**Figure 1.** *Oxyrhopus clathratus* deposited specimen (MZUSP 18030).



**Figure 2.** *Colobodactylus dalcyanus* deposited specimen (MZUSP 100320).

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**SORDELLINA PUNCTATA** (water snake): DIET AND BEHAVIOUR. Colubrid snakes occur in many environments worldwide. In Brazil approximately 267 have been described amounting to 75% of Brazil's serpents. In spite of such diversity many species still have little known about them. This is the case for *Sordellina punctata*, an uncommon species that is rare in scientific collections. It occurs mostly in tropical forests of southeastern Brazil (Hoge & Romano, 1978). It is not an aquatic species, but inhabits wet environments like floodplains and soak soils (Marques, 1996; Marques et al., 2001; Pereira et al., 2007). It is a diurnal, oviparous snake with seasonal reproduction. Its young are born mainly between May and June (Marques, 2001; Marques et al., 2001). There are few notes about diet of the species that note Minhocuçu (Glossoscolecidae) and other oligochaetes (Marques, 1996), and a *Gymnophiona* ingestion (Procter, 1923). The diet of young *S. punctata* is unknown.

Herein, we present feeding of *Sordellina punctata* in captivity. One young female (160 mm snout-vent length, 27 mm tail length, and 3 g), collected in Santos-SP (23°57'42.62"S, 46°19'56.15"W), was captured in Mata Atlântica, close to a stream, in March 2007. The animal was maintained at the Biological Museum of Butantan Institute, in a terrarium with a substrate of earth and coco fibre and abundant water. Food was offered to the snake weekly comprising earthworms of approximately 100 mm and 1 g.

The snake fed spontaneously on many occasions (Fig. 1) for a period of three months, consuming 12 earthworms in total. In three feedings the snake ingested more than one prey in the same day and for two occasions it ate three earthworms in succession. The weight ratio for the triple meal was 0.75 (WR = prey mass / predator mass) and for the double and single meal, 0.50. These values are high when compared to others for most colubrids, perhaps due to the type of ingested prey. It was not possible to determine the snake's hunting strategy because the food was seized as soon as it was placed in the enclosure. During rest the snake mostly remained under the coco fibre.

In the colubrids, subjugation of prey varies according to the potential capacity of a prey

item to cause injury (i.e., seizing prey directly, constriction, biting/envenomation - in the case of snakes with Duvernoy glands). Snakes of small size and/or fossorial habit feed preferentially on vermiform prey, more specifically earthworms (Annelids). Such prey does not offer difficulties in capture, so energy costs are low, even though the energy gained from the meal is also low. This is most probably the case for *S. punctata* and may be the reason the serpent accepted feeding weekly.



**Figure 1.** Above, *S. punctata* feeding spontaneously; Below, consuming prey.

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***HYPASILURUS MODESTUS*** (modest forest dragon): REPRODUCTION. *Hypsilurus modestus* occurs in Indonesia (Aru Island), New Guinea and Oceania (Bismarck, Archipelago and the Admiralty Islands). In this note we provide, to our knowledge, the first information on the reproduction of *H. modestus*.

A sample of 24 *H. modestus* from Papua New Guinea consisting of 14 males (mean SVL = 78.4 mm  $\pm$  8.4 SD, range = 58-98 mm) and ten females (SVL = 82.0 mm  $\pm$  3.2 SD, range = 73-108 mm SVL) was examined from the herpetology collection of the Louisiana State University, Museum of Natural Science (LSUMZ). Lizards were collected under licence in 1999, 2004, 2006 in Sanduan Province: LSUMZ 92385-92390, 92396-92398, 92404-92409, 92416-92420; Northern Province: LSUMZ 93586; Madang Province: LSUMZ 93588, 93589; New Ireland Province: LSUMZ 94077.

The left gonad was removed for histological examination and embedded in paraffin. Enlarged ovarian follicles (> 4 mm) or oviductal eggs were counted. Histological sections were cut at 5µm using a rotary microtome and stained with Harris haematoxylin followed by eosin counterstain. Histology slides were deposited in LSUMZ.

Two stages were observed in the testicular cycle; spermiogenesis in which the lumina of the seminiferous tubules are lined by sperm or clusters of metamorphosing spermatids, or recrudescence, in which there is a proliferation of spermatocytes to be utilized in the next period of spermiogenesis. Ten males from July all exhibited spermiogenesis. The smallest reproductively active male (spermiogenesis) measured 73 mm SVL (LSUMZ 92418). One smaller male (58 mm SVL) from June exhibited recrudescence (LSUMZ 92387) and was considered a juvenile.

Clutch size for nine females was an invariant 1.0. The presence of either one enlarged ovarian follicle (> 4 mm) or one oviductal egg with concomitant yolk deposition in a smaller follicle for a subsequent clutch (Table 1) indicated females of *H. modestus* produce multiple clutches of one egg. The smallest reproductively active female (oviductal egg and concomitant yolk deposition for subsequent clutch) measured 73 mm SVL and was from August (LSUMZ 93589).

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Month	N	Early yolk deposition	Enlarged follicle (> 4 mm)	Enlarged follicle (> 4 mm) + yolk dep.	Oviductal egg	Oviductal egg and yolk dep.
June	1	0	0	0	1	0
July	6	1	0	1	0	4
August	2	0	0	0	0	2

**Table 1.** Monthly stages in the ovarian cycle of *Hypsilurus modestus* from Papua New Guinea.

**OXYBELIS FULGIDUS: DIET.** *Oxybelis fulgidus* is a neotropical arboreal colubrid snake, that occurs from Mexico through mainland Central America south to Amazonian Bolivia and Brazil (Cisneros-Heredia & Touzet, 2007). It is also found on some islands in the region, for example; Cozumel, Mexico (Martínez-Morales & Cuarón, 1999) and Patos Island, Venezuela, but not on Trinidad & Tobago (Hayes, 2002). It is found in similar habitats as its congener *O. aeneus*, which include open areas, grassland with scrub, forest edges, clearings within forest, abandoned pastures, riparian premontane wet forest, premontane rain forests and lowland wet and dry forest (Franzen, 1996; Savage, 2002). Like *O. aeneus*, it is a diurnal forager with a similar diet that includes lizards and amphibians, arboreal mammals, small rodents and small birds. In comparison, however, birds seem to make up a larger dietary component for *O. fulgidus*, and descriptions of predation or predation attempts on birds are plentiful in the literature (Henderson, 1980). Known avian prey includes birds from the Fringillidae (Henderson, 1980), Furnariidae (Leenders & Watkins-Colwell, 2004), Bucconidae (Endo et al., 2007), Pipridae and Thraupidae (Rodrigues et al., 2005), and Tyrannidae (Rodrigues et al., 2005). Female *O. fulgidus* feed more frequently on birds than males (Scartozzoni et al., 2009).

Herein I document a predation attempt by an adult *O. fulgidus* to kill and consume an *Amazilia tzacatl* (rufous-tailed hummingbird, Trochilidae) that was caught in a 12 m wide mist net at a bird monitoring site in Tortuguero, Costa Rica. On 29 October 2010, around midday, while routinely checking a series of mist nets, I encountered an adult *O. fulgidus* in the top rung of a mist net, at approximately 2 m from the ground, trying to consume a hummingbird. The snake had most likely just killed the hummingbird, that was trapped in the mist net 80 cm from the edge. Two-thirds of the snake's body was hanging in the net while one-third remained wrapped around a nearby small tree for support (Fig. 1). The hummingbird was already dead, possibly killed by the snake's Duvernoy's gland secretion venom or by its bite, but was too entangled in the net for the snake to consume it (Fig. 1). The hummingbird, a locally common

species, was aged as a hatch year individual based on a 50% score of bill striations. The snake was approximately 1.5 m in length and was released after removal from the mist net.



**Figure 1.** Above, hummingbird seized by *Oxybelis fulgidus*, below, hummingbird tangled in net.

A similar case of *O. fulgidus* opportunistically attempting to take a bird caught in a mist net was described from El Imposible National Park in El Salvador, where the snake pursued a larger avian prey, *Dendrocincla homochroa* (ruddy woodcreeper) (Leenders & Watkins-Colwell, 2004). I have not encountered any previous literature on vine snakes preying upon hummingbirds.

I wish to thank the US Forest Service, INBio, Klamath Bird Observatory, and the Sea Turtle Conservancy, for providing the opportunity to conduct mist netting at the Costa Rica Bird Observatory Tortuguero Station, and Todd Lewis and Oliver Komar for helpful suggestions in writing this note.



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**BRACHYTARSOPHRYS FEA** (Kakhien Hills spadefoot toad): CALLING SITE. Frogs of the genus *Brachytarsophrys* are considered rare and the ecology of its five species is poorly known. *B. feae* is known from northern Vietnam, north-east Myanmar, northern Thailand (Chan-ard et

al., 2007) and south-western Yunan in China, and presumed to be present in Laos (IUCN, 2006).

Observations herein were made in Tam Dao hill station in Tam Dao national park located in Vinh Phu province, northern Vietnam at 990 m asl. Between 19:30 and 22:30 six male *B. feae* were heard vocalising from small caves under rocky overhangs in a very shallow, slow moving, clear water stream. For more detail on calling sites of *B. feae* see Wogan et al. (2002). Despite similar and therefore presumably suitable habitat further downstream no other individuals could be seen or heard and thus it is likely that males of this species may form chorusing groups with strong site fidelity as reported for other Megophryd frogs (Malkmus et al., 2002). Wogan et al. (2002) recorded frogs from caves in the stream bed. In Tam Dao the frogs dug out tunnels under rocks in the sandy substrate of the stream. Tunnels measured 20-30 cm long and terminated in large chambers beneath rocks. The size of these chambers could not be ascertained as the rocks forming the roof of the chambers were too large to move. The frogs moved to the entrance of these tunnels, which were situated under rocky overhangs, to vocalise (Fig. 1), but retreated rapidly into the rock chambers as soon as they were disturbed. In some *Leptobrachium* spp. males dig submerged nesting sites under stones by digging sand away and call from them to attract females. Upon entering such a nest site females are amplexed by males and deposit eggs that are attached to the underside of the stone (Zheng & Fu, 2007; Zheng et al., 2010). Whether or not mating and subsequent egg deposition occurs in the chambers excavated by *B. feae* requires further investigation.

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**Figure 1.** *Brachytarsophrys feae* in water below rocky overhang.

**MEGOPHRYS NASUTA** (Bornean horned frog): **HABITAT AND SIZE.** *Megophrys nasuta* is a large anuran with a pointed snout, triangular and pointed dermal eyelid projections, calcified skin behind the head, tympanum hidden by skin, dorsolateral groin folds, granular reddish-brown dorsum and brownish venter, webbed toes, and blunt digits (Malkmus et al., 2002; Inger, 2005). *M. nasuta* occurs from southern Thailand, Peninsular Malaysia, Singapore, Indonesia (Sumatra, Bintan Island, and Natuna Island) and

Borneo (Sabah and Sarawak of Malaysia, Brunei Darussalam and Kalimantan of Indonesia) from sea level to 2,000 m (van Dijk et al., 2004; Inger, 2005, op. cit.). The species has been reported to inhabit leaf-litter of rainforests and uses streams to breed in (Inger & Stuebing, 2005; Das, 2007). It has a maximum snout-vent length (SVL) of 125 mm (Malkmus et al., 2002, op. cit.).

On 8 December 2010 at 19:29, a gravid female *M. nasuta* was found in the middle of a village road (5°59.161'N, 116°32.181'E, 1,251 m elevation), Kampung (=Village), Sokid, Bundu Tuhan, Ranau District, West Coast Division, Sabah, Bornean Malaysia. The night was drizzling, 20.6°C and 78.7% RH. The site where the individual was found was not adjacent to forest and had no stream that could be determined as natural habitat or a breeding site for *M. nasuta*. However, the village road had leaf-littered drains on both sides. This observation suggests that *M. nasuta* could be capable of adapting to different habitats than presently known. The observation also strengthens the suggestion by Kueh (2006) for equal effort to be given to research on diversity and natural history of anurans in human populated localities as well as in pristine and protected areas. Populated localities with secondary vegetative growth and forest edges may become more important habitats for anurans due to increasing shrinkage of primary forests from anthropogenic pressures. To the best of our knowledge this is the first occurrence of *M. nasuta* outside of forested habitat.

The *M. nasuta* was 134 mm SVL, 172.9 g. The individual was photographed *ex-situ* in captivity, and in the interests on conservation, was then released near the collection site, away from passing vehicles along the road. The specimen represents a new maximum size for *M. nasuta*.

We are grateful to Agnes James Lintanga for field assistance, Johnny Bulangai for field transportation, and Haleluyah Retreat Centre for lodgings support. Sampling was conducted under the permission granted by the Jawatankuasa Pemegang Amanah Hutan Simpanan dan Tanah Perumahan Bumiputera Kampung Bundu Tuhan, Ranau, to KBH. We thank the Institute for Tropical Biology and Conservation, Universiti Malaysia Sabah for support.

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**TRITURUS CRISTATUS** (great crested newt): MALFORMATION. Abnormalities arise in amphibian populations as a result of genetic mutations, environmental pollutants, parasites, trauma and UV radiation damage (Blaustein & Johnson, 2003; Johnson et al., 2002; Velo-Anton et al., 2007). Amphibians seem particularly prone to polymelia (additional limbs) and polydactyly (additional digits), which may be induced by environmental retinoids or parasitic cysts (Hecker

& Stanley, 2001). The latter may cause mechanical perturbation within the limb bud, which results in the growth of extra limbs/digits (Johnson et al., 1999). Other abnormalities involve alterations in body colour including masking patterns in the great crested newt *Triturus cristatus* (Sewell, 2007) and hypomelanism in the alpine newt *T. alpestris* (Gvozdk et al., 2007).

In this note I describe three abnormalities in a great crested newt population in Epping Forest, Essex, Southern England. Adult newts were captured by bottle trapping (Griffiths, 1985) twice a week in three breeding ponds as part of research into metapopulation dynamics. Over two years 573 individual great crested newts were captured and identified using belly pattern recognition (Hagström, 1973).

Three individuals exhibited forms of bidactyly (a mutation rate of 0.5%). In all cases bidactyly occurred in toes on the front feet. One individual had three toes on the left side and five on the other (Fig. 1). These mutations did not seem to affect behaviour as the newts appeared to swim and crawl effectively.

A second abnormality occurred in an adult female (SVL 75 mm), which had a partially absent lower jaw (Fig. 2). With the mouth closed, there was a gap of 5 mm between the end of the lower jaw and end of the snout. Thickened tissue around the end of the lower jaw suggests that this may have been the result of an injury that had healed. How such an injury would be sustained is unknown but a possibility could be damaging the mouth whilst attempting to feed. The newt's ability to feed seems to have been affected as it weighed 5.13 g whereas most breeding females in this population were heavier than 7.0 g (pers. obs.). In addition the bones were prominent under the skin and the newt was lethargic. It was caught by hand at the pond edge and made no attempt to swim away.

The final abnormality was observed in an adult male, which was encountered under a terrestrial refuge. The lower spine appeared fused and the rear legs did not function properly; the newt dragged the lower half of the body along using the front legs. This abnormality greatly affected the locomotor ability of the individual on land. It was

underweight (2.75 g), only slightly above the average weight of a healthy one-year-old juvenile (pers. obs.). It seems probable that this was a genetic mutation, which may have been present since birth. It is unknown how long the individual had managed to survive but it was encountered for several months under the same refuge.



**Figure 1.** Great crested newt with three toes on left fore foot and five on the right.



**Figure 2.** Female great crested newt with malformed lower jaw.

Overall, abnormalities were rare in the population with an incidence of below 1%; mutation rates normally range from 1 to 5% (Blaustein & Johnson, 2003), which indicates that these abnormalities are probably not unusual. Such occurrences were probably noticed only due to the intensive nature of this study and the relatively large number of individuals captured. It demonstrates that great crested newts suffer from several types of abnormality, caused by a variety of factors.

I would like to thank Epping Forest Field Centre for providing resources and the City of

London for granting access to ponds. This research was carried out under licence from Natural England.

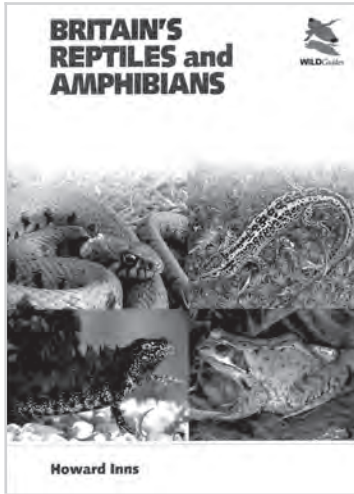
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### *Britain's Reptiles and Amphibians*

Howard Inns  
2009, WildGuides UK. 165 pp.



In its slimline, daysack friendly, paperback form, *Britain's Reptiles and Amphibians* packs a huge amount of information on British herpetofauna – both native and non-native, being void of waffle and padding. The book is more than simply an identification guide, with strands of conservation and ecology weaving throughout the text.

The foreword by Chris Packham begins with an anecdotal account of his first encounter with a grass snake discussing his “paradoxical fascination” with reptiles and amphibians. It provides a brief evolutionary synopsis, details distinguishing morphological characteristics and touches on the limitations incurred by ectothermy. The introduction is complimented by the first of over 200 photographs.

The introduction narrows its focus to British herpetofauna, the colonisation of both native and non-native species – putting them into a convenient tabular format with common name and “most recently accepted” scientific name – a nice little disclaimer for any future alterations! As the topic of distribution and status is opened, reference to population decline and range contraction is made, reinforcing the importance of these issues, and the

importance of alterations of land use.

A section on reptile and amphibian sites depicts landscape photographs of the types of habitat synonymous with British herpetofauna. These photographs convey more information than that of several paragraphs of text – a theme that is carried throughout the book. It then summarises the birth of herpetological conservation in the UK and tips on ‘herping’.

Whilst more seasoned naturalists may find the section on identifying reptiles and amphibians (e.g. frog or toad), a little redundant, it is a fantastic quick reference to those starting out, being accessible and succinct, and once again coupled with a suite of beautifully detailed photographs. More technical descriptions and charts also include differentiation of water frogs by leg length and notes on the appearance of amphibian larvae.

The book then switches into field guide mode, with a two page guide annotating the sub-headings and explaining annual activity clocks – a useful addition. The species accounts begin the lizards. A simple yet effective generic lizard diagram is provided to highlight the main features used in identification. The text then describes the life cycle, referencing ovipary and vivipary whilst introducing correct anatomical terminology.

Each species account provides detail on the appearance of the adult and hatchling forms as well as a description of a slough. Comparatively detailed sections on behaviour, reproduction, population and conservation, provide a greater insight into the wider ecology of the species in question.

The section dealing with snakes follows the same format with a simplified anatomical diagram and some explanation of taxonomy. The species account for the adder highlights in a large, red-bordered box, the potential danger posed by the mishandling and aggravation of adders. The photographic plates comparing the head scalation and side profile of the three snake species are effective at highlighting some of the diagnostic features.

The section on Chelonia is a nice inclusion, concentrating on marine turtles, and whilst it lacks the generic anatomical diagram it continues with its subtle use of scientific and anatomical terms. With

the leatherback (*Dermochelys coriacea*) being the UK's only regular visitor, this section is brief, but does not overlook other species that may occur in British waters as vagrants. Anthropogenic pressures negatively affecting this group are noted.

The chapters covering Anura and Caudata follow the previous format with both sections discussing life cycles, detailing the different stages and noting the dependence of metamorphosis on temperature. The species accounts vary slightly, owing to the differing life cycles of amphibians. Accordingly there are segments covering adult, tadpole/larva and spawn/eggs too. It also details the unique trait of anurans – voice.

The introduction into anurans takes a separate look at genetics of the water frogs, in a succinct manner, taking the time to explain the definition of kl. found in the scientific name of the edible frog. The section also reiterates the correct methods to distinguish between pool, marsh and the hybrid edible frogs, accompanied by a useful photograph depicting the correct handling technique.

The preface to newts includes a beautifully clear landscape plate of three palmate newt eggs at successional stages of development. The author once again brings in the use of technical terminology, such as spermatophore, with great ease, whilst touching on neotony – a phenomenon not uncommon in newts. This portion of the book does spectacularly well in providing clear underwater photographs detailing the appearance of all the lifestages, with the quality of the plates even managing to convey the differences in skin texture between species.

The inclusion of accounts of non-native species both established and otherwise, works well both as an intriguing spectacle and also as a tool to note the problems this may cause for our own native herpetofauna and the very current problem of escaped/released pets.

The book culminates in some practical advice on enhancing local amenities for herps, tapping into the popular trend of wildlife gardening. Furthermore, it provides some important information on legislation, tabulating species and their respective protective status. It also skims over Biodiversity Action Plans and IUCN classification criteria. The provision of useful starters for further reading along with

details of societies and equipment suppliers is a good platform for those readers wishing to further their interests.

Numerous topical issues such as chytridiomycosis, toad road fatalities and the detrimental effect of wall lizards on native common lizard populations are raised in this section, emphasising the author's passion for the long-term conservation of these animals. He also takes care to note the requirement of appropriate licenses to search for particular species.

Photographs are the most prominent feature of this book, depicting not just the species themselves (labelled either M, F or J for male, female and juvenile respectively), but also their habitats which is vitally important. They go further than detailing the form of each species and also touch on various colour morphs and behavioural traits, such as death feigning by grass snakes (*Natrix natrix*).

*Britain's Reptiles and Amphibians* is a comprehensive, well thought out book which is difficult to fault. It reads smoothly with only a few minor grammatical errors and the rather more obvious spelling mistake of "natterjack" in the caption of a plate on page 12. The text is informative, succinct and accessible. The author's ability to blend concepts such as chemoreception and metapopulations, simultaneously into the text without fear of alienating novices is one of the key successes of this book. The book portrays a holistic view of herpetology and conservation, being far more than an identification guide. The breadth of information and practical knowledge contained within its short 164 pages is testament to Howard Inns' experience and part in the development of UK herpetological conservation.

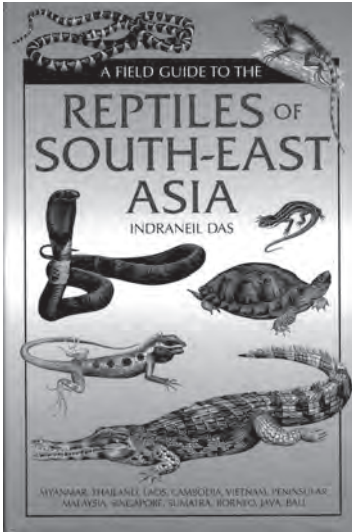
In short, this book will undoubtedly be of use to anyone with an interest in British reptiles and amphibians, from complete beginner, to seasoned naturalist and will most likely be a key guide for years to come. The added bonus of course, is by purchasing this book you are actively supporting the conservation of Britain's reptiles and amphibians – and what could be more appropriate.

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*A Field Guide to the Reptiles of  
South-East Asia*

Indraneil Das  
2010, New Holland Publishers Ltd. 376 pp.



When I heard that a comprehensive field guide to the reptiles of South-east Asia was due for publication I was very excited. The publication of a book on this subject is long overdue so I eagerly anticipated the arrival of this review copy. That anticipation and excitement quickly gave way to disappointment as I looked through the 74 illustrated plates. Several well known and acclaimed wildlife artists have been used to produce the plates and unfortunately the quality of the illustrations in some cases leaves a lot to be desired with some species looking indistinguishable or deformed. Some of the plates are exquisite. It is just a shame that they are not of a consistent quality.

Having used this book in the field I can say that the species information is very accurate and useful, as one would expect from such a distinguished author, save for the lack of a complete bibliography that has been referenced in the text. This I found particularly annoying when trying to follow up on information on a given species for which no reference can be easily found or seems to exist in the bibliography.

Unfortunately there are some serious errors contained within this book. In the introductory sections there is a diagram showing the definitions of scalation in a colubrid snake and while the names are in the correct position the head is upside down so that the supralabials are labelled as internasals, prefrontals and supraoculars. Some curious statements are made in the introductory text in the definitions of snakes and lizards. For example, the characteristics that are used to show the close relationship between varanids and snakes are also shared with helodermids, as well as several other groups of lizards. While there is a growing amount of evidence to suggest the close relationship between snakes and monitor lizards the statement is slightly ambiguous.

Then when attention is paid to the plates some serious editing errors have been allowed to go to print. Two plates that come to mind are: plate 1. Crocodylidae and Gavialiidae where the presence or absence of postoccipital scutes in marsh, and saltwater, crocodiles have been reversed; and plate 38. Acrochordidae, Anomochilidae and Pythonidae where all the species of the Pythonidae that occur in the region have been mislabelled so that, for example, the reticulated python (one of the most recognisable species of snake) is labelled as an Indian rock python and one of the blood pythons is labelled as a reticulated python! Unforgivable!

So, while this book is of use in the field and is obviously a very valiant effort at tackling what is certainly a vast subject, I am sad to say it has been seriously let down by poor editing and proof reading and inconsistent illustration. Without any prior knowledge of the herpetology and the herpetofauna of South-east Asia it is a very limited resource that needs to be used in conjunction with other material. Alternatively wait for the second edition (if one is published) in which these issues have been addressed. Let's face it - it is badly needed and I truly hope the author and publishers are pursuing this.

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