

NATURE WATCH

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Volume 18 No 4 Oct-Dec 2010



Featuring:
Hose's Civet
Wildflower Safari
New Fern in Singapore
Herpetologist Champion



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Message from Editor

Few people have ever seen the Hose's Civet in the wild, not even the author of our first story in this issue, John Mathai. Although John and his team have studied small carnivores in prime Hose's Civet habitat for months and years, they have only camera trap images to show as proof that the animal still exists. These images are important documentation, but technically they are not quite good enough for a magazine cover. Then we could just show a photograph of a captive civet, right? Wrong, there aren't any of those around. So instead we commissioned former *Nature Watch* editor and long-time NSS-supporter, Andrew Tay to capture the animal in artwork; I think that Andrew completed that assignment excellently. Please take time to read John Mathai's story in full, it is compelling reading from a core biodiversity hotspot in eminent danger of being erased from the earth.

Most of the material we receive at the editorial team for *Nature Watch* is fairly ready-to-print. However, K.F. Yap's submission featuring wild flowers from Western Australia needed a bit of work, that is to put it mildly. Yap loves plants, this region during spring-time was heaven for him, and he gave us a material consisting of 17 pages of text and no less than 170 photographs, all huge TIFF-files. This was enough to do a book! It took me two days just to go thru all the images, and another two to finally edit them into shape with the text. The text itself I passed over to my assistant, Margie Hall, who prepared it for the format that we need at the magazine. Thank you, Margie, you more than earned your keep for this issue! Our final presentation, although substantial, does not do full justice to Yap's enormous effort, but we hope it gives our readers a taste of the beauty of Western Australia.

Due to the wide-ranging coverage of Australia this time, the designer and I could only find room for four features in Volume 18(4). We had to push an excellent feature we are holding by a young up-and-coming Singaporean scientist. Stay tuned for this important feature, we will bring it in Volume 19(1) out first week of January 2011.

In this issue however, we are happy to bring an interesting new botanical discovery from long-serving naturalist and conservationist Joseph Lay; and from one accomplished herpetologist to another, Dr. Leong Tzi Ming features his Borneo-based guru Prof. Indraneil Das, relevant today with a brand new important reptilian field guide.



The Assistant Editor in a happy moment with daughter Kate.

Thank you for showing an interest in our natural world,

MORTEN STRANGE

Editor-in-chief

October 2010

Share with us

Your stories, articles, surveys, observations and brilliant photographs and send them to the address on page 1. If you are not sure, please send an e-mail to contact@nss.org.sg with a proposal and we will get back to you. Articles can be e-mailed across as a simple Word document (no funny fonts or colours or inserts, please) or saved on a CD and mailed with the illustrations as separate high res. files. Digital pictures must be in 300 dpi, absolutely sharp and as large as possible, jpeg compression is OK. Do NOT crop, brighten or sharpen, we will do all that as necessary. Thank you very much.

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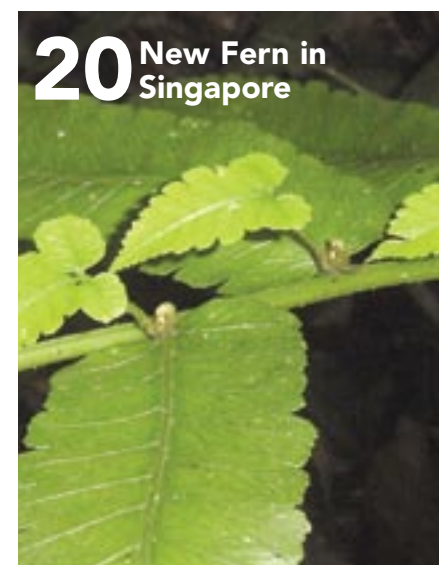
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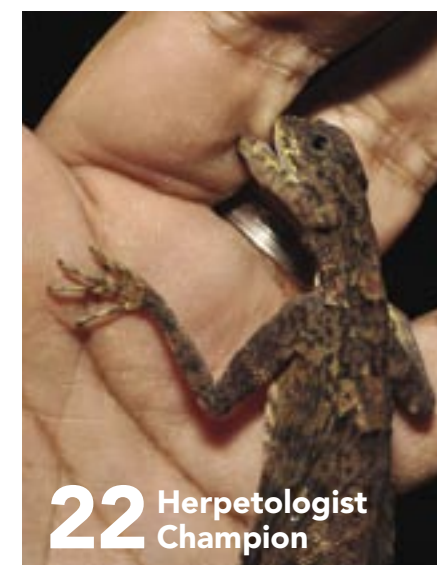
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ON THE COVER A Hose's Civet *Diplogale hosei* on location in the wet rainforest of Borneo, captured in artwork by Andrew Tay. © Andrew Tay & Nature Society (Singapore).

NATURE WATCH

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Hose's Civet

Borneo's mysterious carnivore

A research team from the Wildlife Conservation Society (WCS) Malaysia Program, led by **John Mathai**, is fighting against time and a severe shortage of funding in an effort to study the habitat and ecology of the elusive Hose's Civet.

Text by **John Mathai**

Photos by **Wildlife Conservation Society (WCS) Malaysia**

Twenty years from now, the introductory sentence to the Hose's Civet *Diplogale hosei* in journals, magazines and textbooks may very well read: 'This rare, mysterious civet once roamed the mountainous forests of Borneo'. Like so many animals already, the Hose's Civet may, in the future, be extolled in extinction, yet at present, when alive and perhaps under severe threat, it is completely ignored.

However, the Hose's Civet still has a chance. It has been detected at high encounter rates in a logging concession deep in the interior of Sarawak, Borneo, and is now the focal species of a research team from the Wildlife Conservation Society (WCS) Malaysia Program. The team, led by myself, aims to understand the major threats to the species and hopes to recommend improved timber harvesting techniques and management strategies to ensure that not just the Hose's Civet, but the whole guild of small carnivores, vital to the health and integrity of forest ecosystems, can persist in the vast areas of forest designated for logging in the state.

The state of Sarawak in Borneo currently suffers high levels of deforestation, with forests outside protected areas rapidly being degraded by timber extraction, conversion to oil palm plantations and other land developments. With just 4% of the land area gazetted as protected areas compared to 35.2% earmarked for logging activities (Sarawak Forest



Hose's Civet.

Apart from diverse vertebrate and invertebrate prey, carnivores in Sarawak eat many fruits and regularly pass intact seeds in their faeces, indicating their importance as seed dispersers.

Department, 1997), it is critical to document the status of mammals in forest remnants within logging concessions and in the modified habitats themselves so as to determine conservation priorities and management strategies.

Small carnivores can be good indicators of forest health, provided sufficient data are available. Carnivores sit high in

the food chain and regulate populations of prey and other carnivores through predation and competition. Apart from diverse vertebrate and invertebrate prey, carnivores in Sarawak eat many fruits and regularly pass intact seeds in their faeces, indicating their importance as seed dispersers.

They thus have cascading effects on



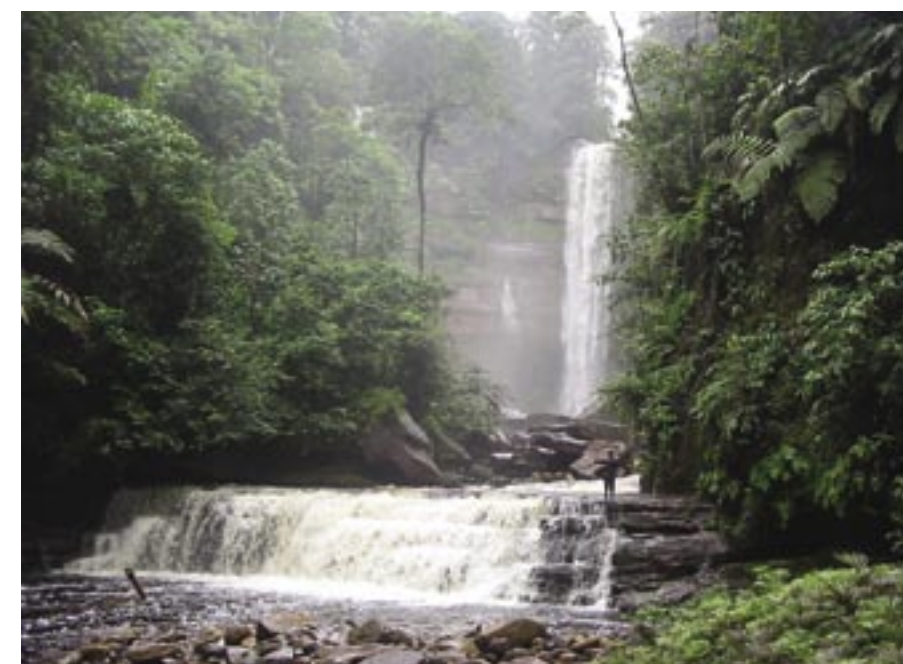
Mossy forest in the Forest Management Unit.

the entire forest trophic system and play a vital role in forest regeneration.

Borneo was identified as one of the seven global priority areas for small carnivore conservation by the IUCN/SSC small carnivore action plan in 1989 (Schreiber *et al.*, 1989). It has more endemic carnivores than any other island except Madagascar (Meiri, 2005). In spite of the undoubted importance of Borneo to small carnivores, credible, accurate and up-to-date information about their distribution and ecology in Sarawak is scarce, with few systematic studies having been undertaken till date.

To understand status and ecology of wildlife in logging concessions in Sarawak, and to evaluate conservation priorities and management recommendations, a long-term monitoring programme was launched by WCS Malaysia in 2004 in the Sela'an-Linau Forest Management Unit (FMU), the first of only two logging concessions in the state which were once certified under the Malaysian Timber

Three methods recorded small carnivores: line transects (diurnal direct observation), sign surveys, and camera-trapping.



Waterfalls in the FMU.

Certification Scheme. The main objective was to document the diversity and distribution of mammals and birds within the FMU. Small carnivores were simply part of the general remit, and reported here are records of them from the first 54 months.

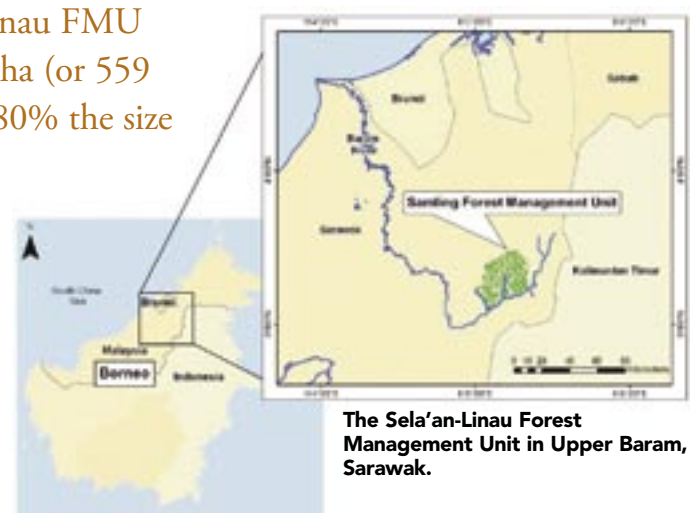
Study Area

The Sela'an-Linau FMU covers 55,949 ha (or 559 km², roughly 80% the size of Singapore), and lies in the hinterland of northern Sarawak, north of the upper Baram River. Samling Strategic Corporation (Samling) is the licensed concessionaire. In the FMU live many indigenous human communities such as the Kayan, Kelabit, Kenyah and Penan, many of whom depend on forest for their livelihood and on wildlife for their protein.

The Sela'an-Linau FMU is undulating in nature, with altitudes from 300 m above sea level (a.s.l.) in its southwest to about 2,000 m a.s.l. in the Tama Abu Range on its eastern edge. Much (60%) supports mixed dipterocarp forest, with some montane forest on higher ground (4%) and tropical heath forest (*kerangas*) on infertile soils (21%). Old and current swidden (*temuda*) covers 15%. Enrichment planting with native timber species is being done in some 3,000 ha that burnt during the 1997–1998 El Niño event. About half the forest was logged conventionally in the past, but since 2003 a reduced impact logging (RIL) is applied. The area receives high rainfall (3,400–5,900 mm annually) with no distinct wet or dry season. Temperatures in low-lying areas average around 26°C, falling to 14 °C on summits.

Surveys were concentrated in 14 sites in the western, northern and central Sela'an-Linau FMU. The survey areas were divided into sectors based on differences in logging regime, time elapsed after logging, elevation, hunting pressure, proximity to settlements and slash and burn fields, proximity to logging roads, and forest contiguity (Mathai *et al.*, 2010). This was done to allow investigation of occurrence patterns for regularly encountered species; however, no small carnivore was found frequently enough to allow an analysis of such spatial precision. Most of the survey efforts were conducted in the Protected

The Sela'an-Linau FMU covers 55,949 ha (or 559 km², roughly 80% the size of Singapore)

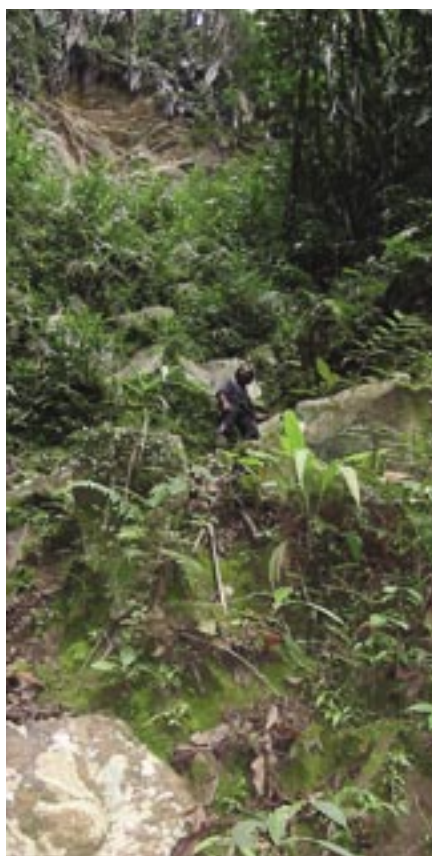


The Sela'an-Linau Forest Management Unit in Upper Baram, Sarawak.

Zone (PZ), an area which is set aside for conservation, with no timber harvesting planned in the FMU's current Forest Management Plan. The PZ, however, is not gazetted under the state government and hence has no legal protection. It is mainly montane and submontane forest, ranging from 900 m to almost 2,000 m a.s.l.

Methods

Field work spanned March 2004 to September 2008, using multiple meth-



Transect lines are not necessarily straight and flat; in fact, they are very often steep and treacherous.

ods. Three methods recorded small carnivores: line transects (diurnal direct observation), sign surveys, and camera-trapping. The survey team walked 789 km of line transects, 277 km during sign surveys, and camera-trapped for 5,252 trap-nights.

Line transects undertaken separately for direct sighting and for sign surveys were the major general survey methods. 25 transect lines of approximately 2 km each were established and marked every 25 m. Transects were surveyed daily starting from 07:00 am until about 11:00 am. At each 25 m interval, surveyors stopped for 1 minute and all mammals and large birds either observed or heard were recorded.

Sign surveys were conducted along the same transect lines as direct diurnal observations. Tracks, diggings in the earth and on fallen trees, body markings, antler markings and claw marks were recorded, as were the probable size of the individual (adult or young) and time since the signs were made.

These surveys are still on-going during 2010. However, both methods yield too few small carnivore records for species-level analysis.

Camera-trapping occurred from January 2005 to September 2008, using 40 Camtrakker™ units. In 2008, two LeafRiver digital units were acquired. By the end of the survey, all 42 cameras were out of commission, mainly due to high humidity. Cameras were set at salt licks, at Great Argus *Argusianus argus* dancing grounds, and along ridges near the transect lines. Some were placed far from transect lines. Cameras were placed typically at heights of 20–30

cm above ground level, at a distance between 1 and 1.5 m from the animal trail. All cameras were set to run 24 hours a day. Images of conspecifics at the same camera location separated by at least half an hour were recorded as independent observations (O'Brien *et al.*, 2003).

Results

In total, 16 carnivore species were recorded: 14 small carnivores, Sun Bear and Sunda Clouded Leopard. Of the small carnivores, there were at least 3 species of mustelids (otters, martens and weasels) (otters could not be identified to species, so there could potentially be more), 7 species of viverrids (civets), 2 species of herpestids (mongooses) and 2 species of felids (cats). Four of these small carnivore species are listed as Vulnerable under the *IUCN Red List of Threatened Species* (IUCN, 2010): Hose's Civet (endemic to Borneo), Binturong, Banded Civet and Marbled Cat. Otters were not identified to species, but are also red-listed. One species, Collared Mongoose, is Data Deficient on the Red List. Both large carnivores are listed as Vulnerable.

The Protected Zone recorded the highest small carnivore diversity; nine of the 14 small carnivore species recorded were found there (64.3%). However, survey effort and type varied too much from site to site for comparisons between them of their small carnivore records to be meaningful.

Camera-trapping was the best survey method for small carnivores (Table 1): of 14 species recorded, 12 were detected by camera-traps, only six by line transects, and, given ambiguous species identification, sign surveys were useful only for Malay Civet *Viverra zibetha*, Sun Bear and otters. Sun Bear was the most widely found carnivore, in 12 of the 14 sites (Table 1).

This is, however, to be expected: it and Malay Civet are the only species identifiable by signs, thereby increasing recording efficiency. Small carnivores were mostly sparsely recorded. Yellow-throated Marten *Martes flavigula* was the most widely encountered, at five sites (35.7%), perhaps reflecting its position as one of the few carnivores recorded during line transects, rather than it genuinely being more widespread than all other species.



Many transects need to be negotiated over streams and rivers.



Preparing a camera trap.

Binturong, Masked Palm Civet *Paguma larvata*, Common Palm Civet *Paradoxurus hermaphroditus*, Banded Civet and Short-tailed Mongoose *Herpestes brachyurus* are also probably widespread within the FMU.

Hose’s Civet and Malay Civet, though two of the most commonly found small carnivores, were found at few sites. Malay Civet may occur mainly below 900 m a.s.l. and Hose’s Civet may be more common between 600 to 1,500 m a.s.l. Banded Linsang *Prionodon linsang*, Marbled Cat, Leopard Cat *Prionailurus bengalensis* and Collared Mongoose were detected in just one site each (7.1%). All these patterns, however, require verification through more records.

For comparison, there were 170 camera trap images for muntjac deer *Muntiacus* spp. over the same period, sign surveys gave 163 independent deer observations and line transects gave 140 independent deer observations.

Other small carnivores
The otter species present in the FMU remain unclear - Davis (1958) recorded two in the nearby Kelabit Highlands, the Oriental Small-clawed Otter *Aonyx cinereus* (IUCN Vulnerable) and the Hairy-nosed Otter *Lutra sumatrana* (IUCN Endangered). At least four more species of small carnivore plausibly in the Upper Baram were not found by this survey. Small-toothed Palm Civet *Arctogalidia trivirgata* (IUCN Least Concern) was recorded in the Kelabit Highlands by Davis (1958) and reported by local people in the FMU. It is strongly nocturnal and arboreal, and no survey methods suitable to find it were used. Local hunters’ reports suggest that two IUCN Endangered species, Bay Cat *Catopuma badia*, endemic to Borneo and one of the rarest cats in the world, and Otter Civet *Cynogale bennettii*, previously seen in the Kelabit Highlands by Tom Harrisson (Medway, 1977), occurred in the FMU. These reports date from before logging operations were wide scale. Another species, the Sunda Stink-badger (Malay Badger) *Mydaus javanensis* (IUCN Least Concern), has been collected several times in the Kelabit Highlands (Davis, 1958). This highly distinctive species seems unknown to local people, so it may have never inhabited the FMU.

In the Selaan-Linau FMU

Carnivores threatened under the IUCN Red List detected by camera trap in the Selaan-Linau FMU.



Hose’s Civet *Diplogale hosei*



Binturong *Arctictis binturong*



Banded Civet *Hemigalus derbyanus*



Marbled Cat *Pardofelis marmorata*



Sunda Clouded Leopard *Neofelis diardi*



Collared Mongoose *Herpestes semi-torquatus*



Sun Bear *Helarctos malayanus*

Table 1

Number of independent observations of each carnivore species using each method and number of sites where each species was detected.

Species	IUCN Red Listing (LC = Least concern, DD = Data deficient, NT = Near Threatened, VU = Vulnerable, EN = Endangered)	Number of independent observations				Number of sites detected
		Line transect	Sign survey	Camera trap	Total	
Malay Weasel	LC	2	0	0	2	2
Yellow-throated Marten	LC	4	0	1	5	5
Otter	Either EN, VU or NT	0	3	0	3	3
Banded Linsang	LC	0	0	1	1	1
Malay Civet	LC	0	9	12	21	3
Common Palm Civet	LC	1	0	2	3	2
Masked Palm Civet	LC	1	0	6	7	3
Binturong	VU	3	0	4	7	4
Hose’s Civet	VU	0	0	12	12	3
Banded Civet	VU	0	0	6	6	3
Collared Mongoose	DD	0	0	2	2	1
Short-tailed Mongoose	LC	2	0	2	4	3
Marbled Cat	VU	0	0	1	1	1
Leopard Cat	LC	0	0	1	1	1
LARGE CARNIVORES						
Sun Bear	VU	4	45	7	56	12
Sunda Clouded Leopard	VU	0	0	3	3	1

Threats

The main threats to small carnivores in the FMU remain unclear. They are not actively sought by local hunters, and some species were found in areas of high hunting pressure. Hunting in the FMU usually (but not always) involves dogs, which accompany local hunters in their search for ungulates, especially Bearded Pig *Sus barbatus*, muntjacs and Sambar *Cervus unicolor*. Primates, especially macaques *Macaca* and langurs *Presbytis*, and rodents are hunted to a lesser extent. Sun Bear, Binturong and other palm civets are taken as encountered, but hunters do not set out to hunt them. Local hunters usually use home-made guns, spears and blowpipes, and hunt both by day and night. Snares are often used, intended for pheasants, rodents and mouse deer *Tragulus*. However, these snares can pose a serious threat to the more ground-dwelling civets such as Hose’s Civet, Banded Civet and Malay Civet.

Many small carnivores were found in areas affected by logging, but logging may constrain Hose’s Civet and Binturong range. Otters in mainland

South-east Asia are in heavy decline through greatly increased trade-driven hunting, but this seems not to occur in Sarawak. Instead, here, shrinking habitat, pollution and siltation of rivers, as well as the use of chemicals and explosives/electricity during commercial fishing result in severe depletion of the prey base of otters (see Southeast Asian Mammal Databank, 2006). Shifting cultivation might be a threat to small carnivores mainly through the temporary loss of the areas under cultivation at any given time; most species were found near slash and burn fields. However, the ability for populations to persist in such landscapes may differ greatly.

Urgently required now are studies specifically of small carnivores to determine distribution and conservation status within the Sela’an-Linau FMU.

As encounter rates are very low and many species nocturnal and crepuscular, line transects yield very little data. Sign surveys are useful only for few species. Night-spotting may be an option, but there are no roads in unlogged areas and uneven terrain makes passage on foot noisy. Moreover, it is risky to the

surveyors: hunters regularly use firearms at night in the FMU. Camera-traps seem best to study these animals, except those species that are mostly arboreal. Modifications to the selection of sites for camera-traps so far used here could include aiming cameras towards fallen trees, and, in particular, using odours/scents in canisters resistant to rain. Otters may require camera placement nearer rivers and streams, which would also allow consideration of Otter Civet status.

Hose’s Civet

In conservation terms, Hose’s Civet stands out from the other species recorded, because it has a much smaller known range. It is named after Charles Hose (1863-1929), a Sarawak-based, British zoologist who has a number of other mammals, birds and amphibians named after him as well. This civet is endemic to northern Borneo and recorded only from a few localities in Sarawak, Sabah and Brunei, no protected area is known to hold a large population of the species. Indeed in Sarawak, no protected area is known

Hunting in the FMU usually (but not always) involves dogs, which accompany local hunters in their search for ungulates, especially Bearded Pig *Sus barbatus*, muntjacs and Sambar *Cervus unicolor*.

to even hold any. Currently, the basic factors likely to determine its long-term future, such as population densities, dependency level on old-growth forest, ranging and dispersal patterns, and others, are entirely unknown, making specific conservation measures impossible. What little is known of the species comes primarily from 17 museum specimens worldwide (the first of which was collected in 1891 from Sarawak). There have been very few field sightings of the species and only one live capture;

that was in Brunei, and this individual was subsequently released after two months. There remain no Hose's Civets in captivity anywhere in the world. Next to nothing is known about the habits and diet of Hose's Civet in the wild, though the single female captured in 1997 appeared to be entirely carnivorous, feeding on fish and meat as opposed to fruit, the preferred diet of all other civets in Borneo (Yasuma, 2004). Indeed, the Hose's Civet's partly webbed feet, extremely long facial whiskers, and surprisingly large snout, are all thought to suggest a specialist, foraging for small animals amongst mossy boulders and streams.

The first confirmed photographic image of a Hose's Civet in the wild may probably be that of a single individual photographed in early 2004 in Mount Kinabalu National Park, Sabah. Since then, only a handful of blurred, unconfirmed images have been captured from scattered localities within its range. WCS Malaysia captured 12 images of the Hose's Civet between January and December 2005, when all cameras were performing at their peak and researchers had sufficient experience in camera placement. However, there do exist 2 more images of the Hose's Civet taken in July 2004 (WCS unpublished data), when researchers were still experimenting with cameras, bringing the complete tally to 14 images from 4 separate locations in the FMU, by far the highest encounter rate ever. The previous largest series of encounters from one locality consisted of four specimens collected by Tom Harrison between 1945 and 1949 in the mossy forests of the nearby Kelabit Highlands, suggesting that this part of Sarawak may be the species' prime habitat.

It is thought that the preferred habitat of this little known species is the wet, mist-covered, mossy, montane forests of interior northern Borneo. However, it has reportedly been detected as low as 450 m a.s.l. in Brunei (Francis, 2002), begging the question whether this really is true. Of the 14 images obtained by WCS Malaysia, 13 were, in fact, from unlogged, contiguous, montane forests, with low hunting pressure and far from logging roads and slash and burn fields. One image, however, came from lower elevation forests (the camera itself was at



Photo: John Mathai

Rugged terrain and mist covered mountains of the Selaan-Linau FMU.

730 m a.s.l.) with high hunting pressure, near logging roads (but not with logging activities per se), and fragmented by slash and burn fields. Whether this is a dispersing animal or whether Hose's Civet can actually subsist in these more encroached areas, is unclear.

Urgent questions

Until recently, the semi-nomadic Penan people who inhabit the area did not have a name for the Hose's Civet in their native tongue, simply because they had never come across the species. This is now changing as more native hunters encounter it, due to a number of reasons. Local hunters may now have to venture further into the mountains in search of wild meat as populations of their primary quarry diminish in lower elevation forests and seek refuge in the mountain tops.

Up there, neither logging nor intensified hunting pressure caused by increased access via logging roads into the forest, pose major threats to wildlife. However, can all these species actually persist and breed in the mountain tops, or are they just running away from what is happening in lowland forest? Further, can the mountain tops sustain such a large number and diversity of species, especially if these mountain tops are simply islands in a matrix of logged-over forests and slash and burn fields? Will there not be increased competition,

both within and among species, for limited and ever decreasing resources? Will not inferior competitors (possibly the Hose's Civet?) be forced to flee from these mountain refuges as superior competitors come to dominate, and then be exposed to snares and other forms of hunting in the lowlands? Will warmer temperatures and drier conditions, caused by a combination of intensified logging pressure and climate change, constrict further the effective habitat of Hose's Civet? Will species such as Hose's Civet, Bay Cat and Otter Civet, which possibly have a high dependency on old growth forest, be able to disperse through a matrix of modified habitat? If not, will these isolated populations of rare and threatened species then be subjected to all the dangers of small populations such as inbreeding and both environmental and demographic stochasticity? These are all questions that urgently require answers.

Nobody has thus far attempted any autecological research on Hose's Civet because no suitable site was previously known. With these findings, the Sela'an-Linau FMU may be invaluable for detailed research on the species' conservation needs, as it seems to be common there. Sadly, small carnivore work in the FMU is currently (September 2010) stalled due to lack of funding, as individual and corporate donors seem to shy away from rare, little-known species.

The Sela'an-Linau FMU is home to one of the world's least known carnivores, and it may be under great threat. It may also be home to two other rare, little known carnivores, the endemic Bay Cat, and the Otter Civet, both of which were reported to have once inhabited the FMU before logging became widespread. Whether they are still there, and if not, whether the Hose's Civet will go their way and be lost forever from this site, is anyone's guess. Time is running out. At WCS, we need your help. 🌿

John Mathai is a Wildlife Ecologist with the Wildlife Conservation Society (WCS) Malaysia Program. He studies the impact of logging on wildlife in production forests in Sarawak, Malaysian Borneo, and uses this information to advise authorities on improved logging practices in the state. His interest is small carnivores, and their role in ecosystem dynamics in the Bornean rainforest. He is a member of the IUCN Small Carnivore Specialist Group.

For more information on Hose's Civet and other small carnivore work in the Sela'an-Linau FMU, please contact John Mathai at johnmathai11@gmail.com or visit the WCS Malaysia website at www.wcsmalaysia.org.

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Wildflower Safari

A journey through Western Australia

We frequently publish birding travelogues. Here, for a change, we have the travels of a local plant enthusiast. **Yap Kim Fatt** takes a journey down memory lane, back to the year 1997.

I had heard much about the colourful wildflowers of Western Australia (WA) and had long wished to visit the 'down under' continent during the flowering season which falls between the months of June and November each year, with periods of September and October as the best months. I made my attempt 13 years ago, combining a visit to my son, Chi, who was studying in the country at the time.

Chi, tasked with organising the trip and finding a suitable car, did an admirable job. We would first head northwards,



The author on location annum 1997.



Stylidium crosscephalum, F: Stylidiaceae.



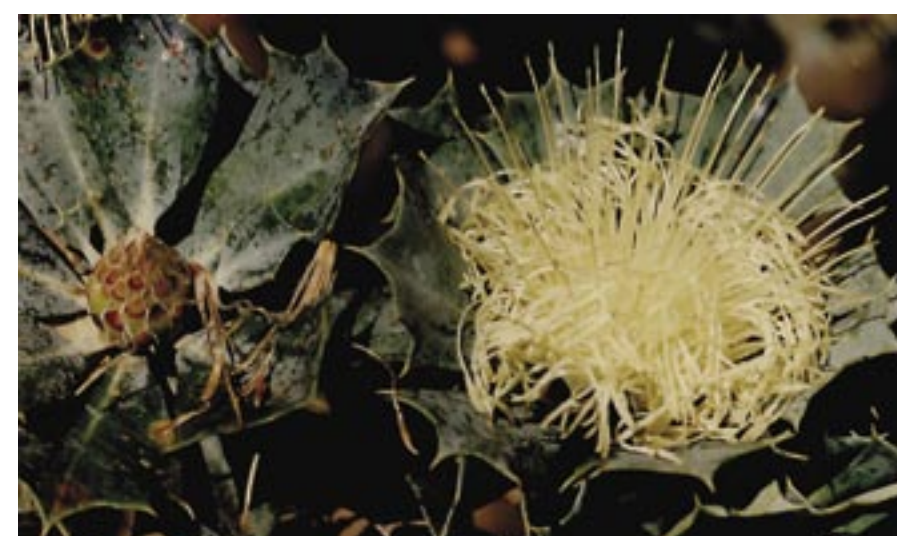
Verticordia ovalifolia, F: Myrtaceae.



Conostylis candicans in Numbang National Park.



Torndirrup Bay.



Dryandra cuneata, F: Proteaceae.



Grevillea leucopteris, F: Proteaceae.

meeting the sun in its annual migration southwards, banishing the winter chill, flooding the earth with light and heat, triggering the flowering plants into a frenzy of kaleidoscopic colours.

Departing Perth at the crack of dawn for New Norcia, we made for the Pinnacles, Nambung National Park, via the coastal town of Cervantes. After a night at the Pinnacles Caravan Park, our next day was a slow meander up the coastal road through Jurien, Green Head and Coolimba. The narrow coastal road is a must-visit place for wildflowers. Many families, genera and species, as well as, many endemics, were seen and photographed along both sides of the roadway.

In the Stylidiaceae family there are around 100 endemic species in the genera *Stylidium* and *Levenhookia* in WA. They are called trigger plants collectively, with a specially developed floral mechanism to aid the dispersal of pollens. They are adapted to surviving in dry conditions generally, but are usually found growing in West Australia's *kwongan* (sandy heathland) areas.

Myrtaceae is a large family of trees and shrubs. Australia has about 75 genera, of which 55 are endemic, and over 1500 species, of which well over half are in WA. They comprise the gum trees,

The Proteaceae family has probably the most admired flowering plants. Worldwide, the family contains over 60 genera and 1400 species.

paperbarks, bottle brushes and others. The Australian aborigines use a wide variety of myrtaceous plants for food, medicine and other uses.

From Port Denison we went via Dongara to Ellendale Pool. Wildflowers seen nearby were some *Acacia* spp. (Mimosaceae), *Dryandra cuneata* and *Grevillea leucopteris*.

The Proteaceae family has probably the most admired flowering plants. Worldwide, the family contains over 60 genera and 1400 species, mostly confined to the southern hemisphere with a few species north of the equator in South-east Asia, Africa and America. In WA alone there are 550 species, of which about 500 are endemic. They are widely cultivated as ornamental plants. There is one genus (*Helicia*) of 3 species recorded for Singapore, but all are now presumed to be nationally extinct.

We camped at Greenough Caravan Park. The Greenough Rivermouth region comprises sandy riverside and seashore dunes. An important plant group there belongs to the Goodeniaceae family. They are mainly shrubs and herbs, circa 410 species with 9 genera, almost entirely Australian with a few species extending elsewhere.



Scaevola sp.

The monoecious *Euphorbia terracina* is an invasive plant, originating from the Mediterranean coast and islands, brought over, either by accident or purpose, by the early European settlers.

I also came upon an *Euphorbia* sp. that I was unable to place at that time. It took me a long while to discover that it was an invasive plant, originating from the Mediterranean coast and islands, brought over, either by accident or purpose, by the early European settlers. It turned out to be the monoecious *Euphorbia terracina*. It is now a noxious weed in WA and its milky sap is poisonous.

On the road again, we drove north to Geraldton, then east inland to Mullewa, ending up at Pindar. Around this small town were sand plains where many wildflowers grew. I had a field day here under the hot burning sun, interrupted at one point by a sudden loud yelp from Chi, who leapt into the air in a great hurry, at the same time shaking his khaki shorts vigorously. With a horrified look in his



Euphorbia terracina.



Shingle Back (*Trachydosaurus rugosus*).

face, he pointed at something crawling sluggishly towards the only available shade of a low bush. It was the ugliest reptile I have ever seen, about 30 cm long with a fat body and a blunt short tail, bandy-legged and armoured by big rugose scales. It turned out to be a Shingle Back (*Trachydosaurus rugosus*), a monotypic genus closely allied to the blue-tongued lizards (*Tiliqua* spp.). These sluggish creatures are the frequent victims of road-kills.

Here are two pictures showing some of the species seen at Pindar:



Disphyma crassifolium, F: Aizoaceae.



Dampiera wellsiana, F: Goodeniaceae.

Our next stop was the Lynton Homestead, a little way before the coastal town of Port Gregory, in the Shire of Northampton. Lynton is a convenient spot to sally forth in search of wildflowers.

North, between Gregory and Kalbarri, is a large unspoilt area of kwongan vegetation, the abode of mind-boggling arrays of wild plants. Some of the species living in the flat backcountry are restricted in their distribution.

We aimed for the Yerina Spring/Oglivie Roads in the Hutt River Province.

The next day we made our way through the back roads to Kalbarri National Park. As we approached, the scenery changed into rocks and sand with high cliffs dropping steeply to narrow beaches and the tumultuous sea.



Banksia attenuata, F: Proteaceae.



Banksia menziesii, F: Proteaceae.



Hawkshead Lookout at Kalbarri NP showing the Murchison River below.



Calothamnus homalophyllus, F: Myrtaceae.



Pileanthus sp., F: Myrtaceae.

We headed off from Kalbarri next day up the North West Coastal Highway, through a continuous stretch of monotonous flat saltbush country. At the Overlander Roadhouse we turned left for the Hamlin Pool, home to the world's oldest organisms. Living stromatolites abound here, a primitive life form that first appeared on earth around 3.5 billion years ago. These dome-shaped cauliflower structures reach 60 cm in height at the deeper parts of the pool. Due to low tidal flows, the stromatolites grow, at less than 1 mm per year, in the hyper-saline water. They are built, layer upon layer, by single-celled organisms called cyanobacteria. The process of building continues on today. They represent an outstanding example of our earth's evolutionary history. A boardwalk takes visitors out to where the stromatolites live.

Aiming for Denham, along the peninsula road, we made a quick stop at the Shell Beach, Lharidon Bight. The long curved expanse of beach is composed of billions of tiny white bivalve shells, many meters deep. The compacted lower layers are said to be fossilised into thick strata. Some of the old houses at Shark Bay were built using blocks cut from the lower layers. Shark Bay was as far north as we travelled before starting our return journey to Perth.

Continuing south the next day we paused at the Greenough Historical Hamlet, a village in the mid-west wheat belt region, nicely restored to its original 1800s appearance.

Our last overnight stop was at the Western Flora Caravan Park, 22 km. north of Eneabba. The 65 hectares sand plains were privately owned. From July to January each year, WFCP is resplendent with colourful displays of wildflowers. The park is also a bird watchers delight and native animals are frequently seen here.

Some images from around the Western Flora Caravan Park:



Banksia hookeriana, F: Proteaceae.



Calytrix sp., F: Myrtaceae



Petrophile sp., F: Proteaceae.



Isopogon divergens, F: Proteaceae.



Solanum lasiophyllum, F: Solanaceae.



Thysanotus multiflorus, F: Liliaceae.



The Kwongan habitat at Eneabba.



Verticordia grandis, F: Myrtaceae.



Verticordia picta, F: Myrtaceae.

Heading South

After a stop in Perth we were off again heading south to experience another set of landscapes and flora. We heading for Albany and continued to the Torndirrup National Park on the very stormy and rugged south coast.

Here are a few of the pictures of flowering plants inhabiting the rocky coast and sandy pockets at Torndirrup.



Dryandra formosa, F: Proteaceae.



Banksia praemorsa, F: Proteaceae.

Heading up the highway once more back towards Mount Barker, we turned right to the town of Porongurup for two nights stay. Ascending to Castle Rock at the Porongurup National Park next day was an exiting climb. Wildflowers growing in the Porongurup area:



Hovea elliptica, F: Fabaceae.



Mirbelia dilatata, F: Fabaceae.

Late the same afternoon, we hurried to the Banksia Farm at Mount Barker and managed to catch enough sunlight to see all 76 species Kevin and Kathy Collins had growing there. They also conduct hourly guided tours for a fee, specialising in banksias and dryandras, and they run a floral business selling seeds, cones, dry flowers and artefacts made of wood. It is a must-visit place should you find your way to Mount Barker.

The genus *Banksia* was named, in 1782 by Linnaeus, after Sir Joseph Banks who collected the first known members of the genus at Botany Bay in 1770. Of the 76 Australian species, 56 are endemic to south-western Australia. Only one other species is found outside of Australia, in Papua New Guinea. They grow as trees, shrubs and a few species as herbs (*B. ripens* and *B. blechnifolia*).

Some Banksia species in bloom there at the time.



Banksia coccinea.



B. blechnifolia.



B. ericifolia.



B. serrata.

The next morning we headed for the Sterling Range National Park. The Sterling Range was gazetted in 1913 as one of the richest flora areas in the world; 90 families, 384 genera and over 1500 species occur there. Many of the species are found nowhere else. Geologically, this mountain range is different from that of the Porongurups. It is composed of metamorphic rocks made from sediments deposited during the Ediacaran Period (circa 640 million

years ago, as indicated by the presence of characteristic fossils). These sediments were subsequently metamorphosed to quartzite and shale.

At Sterling Range our goal was Buff Knoll (elevation 1075 metres), the highest point in the whole of WA. The vegetation on both sides of the path was resplendent with many flowering plants. As we proceeded up the track, Buff Knoll, was shrouded in heavy mist.



At the Sterling Range.

Some plants from the Sterling Range.



Anigozanthos menglesi, F: Haemodoraceae.



Anigozanthos humilis, F: Haemodoraceae.



Brachysema latifolium, F: Fabaceae.



Daviesia obovata, F. Fabaceae.



Elythranthera sp, F: Orchidaceae.



Drakonorchis barbarossa, F: Orchidaceae.



Drosera sp., F: Droseraceae.



Caladenia flava, F: Orchidaceae.



Hakea sp., F: Proteaceae.



Dryandra formosa, F: Proteaceae.



Hypocalymma sp. F: Myrtaceae.



Melaleuca megacephala, F: Myrtaceae.



Pimelea sp. F: Thymelaeaceae.



Asteraceae sp.

Sphenotoma dracophylloides, F: Epacridaceae.

After a night at Mount Barker, we headed southwest, stopped briefly at Green's Pool, William's Bay National Park and proceeded to the Nornalup National Park further west.



Green's Pool, William's Bay National Park.

Here are some flower images taken at the sand dunes of Conspicuous Cliff and at Ficifolia track.



Asteraceae sp.



Clematis pubescens, F: Ranunculaceae.



Pimelea rosea, F: Thymelaeaceae.



Scaevola sp. F: Goodeniaceae.



Patersonia occidentalis, F: Iridaceae.

We were now in a high rainfall zone. For the first time in the entire trip, we came upon magnificent tall trees in lush mossy forests. The Valley of the Giants at Nornalup, also called the Ancient Empire, is populated by large Red Tingle trees (*Eucalyptus jacksonii*, Myrtaceae). The older ones measure over 16 metres in circumference at their bases, with massive butts, fluted, gnarled and some hollow right through. This forest represents the westernmost

distribution of the type and is found within 15 kilometres around the town of Walpole only. There is a Tree Top Walk for visitors to visit the canopy and a boardwalk to prevent visitors from trampling and compacting the soil around the trees. Soil compaction has resulted in many tree deaths previously.

Here are two of the many flower species taken at the valley.



Chlorizama retrorsum, F: Fabaceae.



Leucopogon verticillatus, F: Epacridaceae, commonly called Tassel Flower.

At sunset, we turned in for the night somewhere near Walpole.

Early the next morning, we joined a cruise to explore the Walpole Inlet and specifically to visit the flora of the sand dunes at the outer sand splits.

This kind of habitat has its own unique flora.

Next morning, we left Walpole for Cape Leeuwin, Augusta. Typical plants from here were the very common Aizoacid of the coastal rock-sandy areas of WA, *Carpobrotus virescens*, or Pig Face. It is a succulent, and the fruit (resembling a pig's face) is eaten with relish by the aboriginals.

The Hooded Lily is not a grass but related to the Liliaceae. *Johnsonia lupulina*; it was first placed in Anthericaceae, but now shifted to the new Hemerocallidaceae family.



Carpobrotus virescens.



Conostylis sp., F: Haemodoraceae.



Patersonia occidentalis, F: Iridaceae.

The next and last day we returned to Perth.

In the intervening 13 years, I have been back to Western Australia a few more times, each subsequent visit being another entirely new experience. The parade of colourful wildflowers living there seems to be endless. As an appropriate end to the epic journeys, I quote from Shakespeare's play, Hamlet, Act One, Scene 5:

'There are more things in heaven and earth, Horatio, than are dreamt of in your philosophy.' 🌿

Assistant Editor's note: This has been edited from a much longer and more detailed travelogue, with a huge array of photos. Friends of Yap Kim Fatt may wish to request the original from him.



Sand dune flora around the Walpole Inlet.

Athyrium accedens

New botanical record for Singapore

Text and photos by **Joseph Lai**

Joseph Lai has discovered a small population of the fern ***Athyrium accedens*** (family: Woodsiaceae) in Bukit Timah Nature Reserve - a new botanical record for Singapore.

The late Professor R. E. Holttum described this species as a fern of shady mountain stream-sides, found in Malaya only on the Main Range and Taiping Hills. The specimens that I discovered were also near a stream. They are about a meter in height, simply pinnate, tufted and erect, and producing plantlets (asexually) on the rachis as well as producing the usual spores (for sexual reproduction).

This finding constitutes a new record for Singapore. A new record is a species already known to science but not known to occur previously in a certain botanical area. Now that *Athyrium accedens* has been found in its natural state here in Singapore, it can be added to our flora as an occurring species. So in total, we now have 11 species of *Athyrium* in Singapore. This finding should add new significance to the biogeography of *Athyrium accedens*. Of the 10 formerly recorded species, only one is not considered threatened. 🌿



Athyrium accedens.



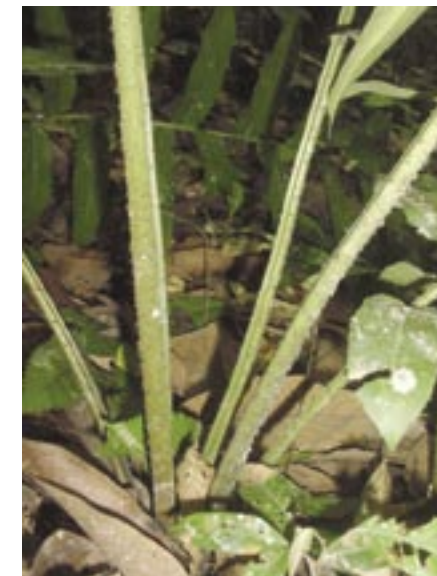
There are up to 15 pinnae per frond.



Plantlets develop from the pinna axil.



Sori near the tip of pinna.



The stipe is green, covered with minute and spiky protuberances.



The rachis is grooved above.



Close-up of spiny protuberances: each one is actually a remnant stalk that has held a scale.



Mature plantlet ready to drop off and grow on its own.



Each pinna is broad; margin crenate or shallowly lobed. The sori are linear, forming the characteristic V-shaped arrangement.

Botanist **Joseph Lai** is an active field inquirer and advocate for nature conservation in Singapore. A freelance nature guide for outdoor fun and education, he organizes nature walks and promotes environmental works (e.g. coastal clean-up) amongst schools and business corporations. More about Joseph and his work at: flyingfishfriends.blogspot.com and www.eart-h.com.

MAIN REFERENCE

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Herpetologist Champion

Having laid his eyes and hands on the newly published book, *A Field Guide to the Reptiles of South-East Asia*, **Leong Tzi Ming** decides to shed some light on the distinguished author, Professor Indraneil Das.

Text and photos by **Leong Tzi Ming**

Head over heels in love with amphibians and reptiles – that is how I would describe Indraneil Das in one sentence. Whether he is looking after hungry crocodiles in India, or for elusive snakes in Borneo, his enthusiasm is virtually unstoppable. Herpetology refers to the study of both amphibians and reptiles collectively, so people who pursue such an interest may be regarded as herpetologists. Some herpetologists tend to specialise in either amphibian or reptilian topics, while others like Indraneil have keen interests in both groups. Caecilians, salamanders, frogs, toads, turtles, crocodiles, lizards and snakes – Indraneil investigates them all with equal tenacity.

Indraneil also persistently keeps a close watch on the scientific community. He is an expert on the work of other herpetologists (past and present), and he updates himself continuously on the most current research trends and discoveries. However, he is not only a spectator to this science, he is a keen participant himself. His competence in each of the herpetological topics is recognized. He is himself an author of numerous papers on herpetology, and has described new species of amphibians and reptiles from Asia.

Apart from the technical publications, Indraneil has also committed his time and expertise to the writing of more popular herpetological books. It is important for him to help enhance the appreciation, admiration and eventual conservation of these prehistoric groups of animals. A representative selection of these titles include: *Turtles of Borneo and Peninsular Malaysia* (Lim



A tiny, new species of frog (*Microhyla nepenthicola* Das & Haas, 2010) was discovered from amongst this clump of pitcher plants at Kubah National Park, Sarawak. The finding was featured in *The Straits Times* 28 August 2010 page D11: 'Smallest frog in Asia discovered'.



In search of elusive Bornean tadpoles, Indraneil Das gets his feet (and jeans) wet in the middle of a Sarawak river.

& Das, 1999), *A Photographic Guide to Snakes and other Reptiles of India* (Das, 2002), *A Photographic Guide to Snakes & other Reptiles of Borneo* (Das, 2006), *Amphibians and Reptiles of Brunei* (Das, 2007). Ploughing through the pages of these books is a pleasure, as the text has been kept to a minimum, and a multitude of vibrant pictures truly 'tell a thousand words' instead. Indraneil is also a diligent photographer in the field, using both film and digital format, and he captured a majority of the images featured in these books.

Born in Calcutta, India in 1964, Indraneil received his early education in India and later in 1991 his doctorate from the University of Oxford. He was previously the Scientific Officer at the Centre for Herpetology, Madras Crocodile Bank Trust. Between 1991 and 1993, he was a Research Fellow at Universiti Brunei Darussalam.

He has served as Editor of the herpetological journal *Hamadryad* since 1993. From 1995 to 1996, he was a Fulbright Fellow at the Museum of Comparative Zoology, Harvard University. Since 1998, he has devoted his energies as a Professor at the Institute of Biodiversity and Environmental Conservation (IBEC), Universiti Malaysia Sarawak.

This year, Indraneil Das' latest book constitutes a major milestone – not only for himself, but also for South-east Asian herpetology in general. The hardcover, 376 page *A Field Guide to the Reptiles of South-East Asia* required more than two years to weave together. The reptiles featured in this scaly tapestry reside in diverse habitats – from seas to shorelines, from rivers to rainforests, spanning exotic destinations that include Myanmar, Thailand, Laos, Cambodia, Vietnam, Peninsular Malaysia, Singapore, Sumatra, Borneo, Java and Bali.

Out of the 1,000 species listed and succinctly described, a dynamic team of seven natural history illustrators, each with his own signature style, painstakingly painted almost 700 species. Their renditions of crocodiles, turtles, lizards and snakes have made the animals appear life-like, with some species almost 'popping' out from the page. While the styles differ from one artist to another,



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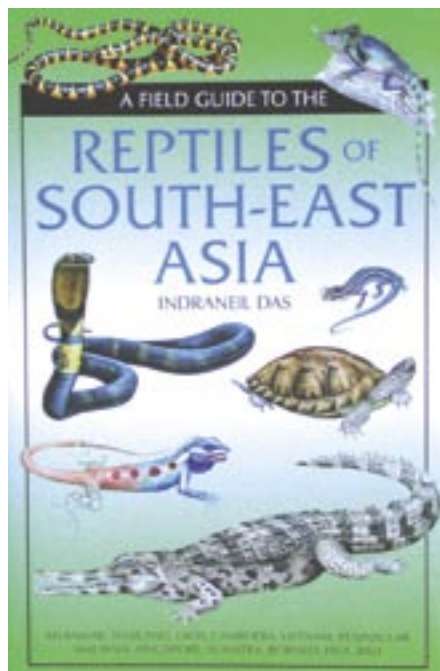
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all reptiles are accurately depicted, with natural postures and colours. One of my favourite artists would be Sandra Doyle (Plates 49–58), who painted the vipers and a portion of the colubrid snakes. Each and every serpent is crisp and clear, with not a single scale out of place. Apart from her precision in the paint-work, I also admired the sparkle she carefully created in the snake's eye.



From an artist's perspective, this highly prized book is a testimony to the critically endangered human skill of natural history illustration – which faces threat from the increasing appeal and convenience of digital photography. From a scientist's perspective, this book provides a much awaited update on the species checklist for this region, especially when a wave of new species have been discovered in just the last decade alone. If you are neither artist nor scientist, but find reptiles fascinating, this book will open your eyes to the wonderful diversity that may be found beyond Singapore's shores. From blue-headed lizards to red-headed snakes, from legless skinks to flying dragons, from saltwater crocodiles to freshwater terrapins, this spectrum of species is a celebration of the remarkable biodiversity that is indigenous to South-east Asia, and it reminds us of the need to safeguard the fragile ecosystems that they live in.

For all naturalists and nature enthusiasts in the region, it is encouraging that



Occupational hazard: Indraneil endures a bite by a feisty female flying dragon (*Draco obscurus*) while examining it closely.



Father and son (Rahul Das) explore a Bornean cave together, in search of geckoes and snakes.

a herpetologist expert like Indraneil Das has presented his labour of love in the form of this invaluable book. It is also heartening for us to know that much of his time in Borneo is devoted to field-work in the rainforests. Here he will search for elusive or new species, and his research will help us better understand the diversity and ecology of these 'cold-blooded' creatures. 🌿

***Dr. Leong Tzi Ming** is himself an accomplished zoologist who has had the privilege of accompanying Prof. Indraneil Das on various herpetological explorations within Borneo. Together they have described a new gecko species (Das & Leong, 2004).*

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