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# Borneo's Lost World

## Newly Discovered Species on Borneo

WWF-Canon/Alain Compost

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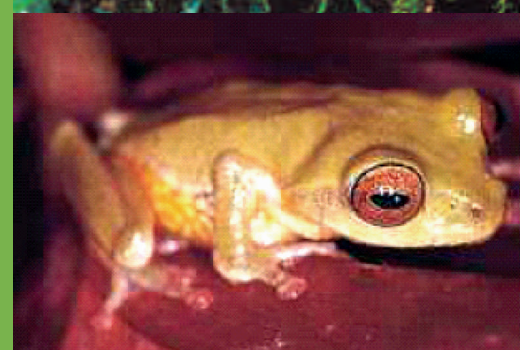
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# Borneo's Lost World

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# At a Glance

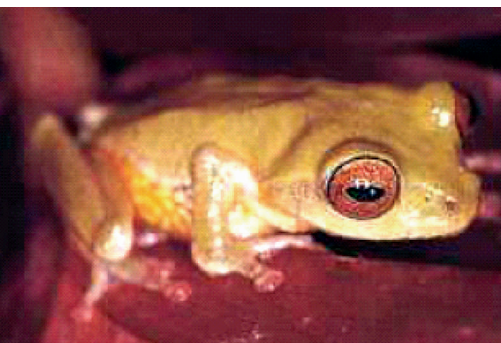
Borneo is undoubtedly one of the most important centres of biodiversity in the world. Although the world's third largest island has a long history of research and exploration, the most recent findings suggest that there are still literally thousands of species of plants and animals left to discover. The most likely area to offer new discoveries is the 'Heart of Borneo' - the relatively inaccessible inner region which harbours some of the most pristine forest left on the island.

Borneo is conservatively estimated to contain 15,000 plant species, and may well have the highest plant diversity of any region on Earth. This suggestion is borne out by Lambir Hills National Park, in Sarawak (Malaysian Borneo), which has the highest documented tree diversity in the world – 1,175 species in a 52-hectare (ha) plot. Borneo is also rich in endemic species: the 6,000 endemic plant species include 155 dipterocarp tree species - rainforest giants which produce valuable timber and aromatic oils and resins, and provide habitats and food for a vast range of plants and animals. Other endemic inhabitants of Borneo include 160 fish, 100 amphibians, 47 lizards, 44 mammals, 41 snakes and 39 birds, as well as many important sub-species that are only distantly related to their cousins on the Asian mainland.

Between 1994 and 2004 at least 361 new species have been described from Borneo: 260 insects, 50 plants, 30 freshwater fish, 7 frogs, 6 lizards, 5 crabs, 2 snakes and a toad. This is most certainly an underestimate as many species discoveries have not yet been published in the scientific literature or the press. In addition, whole groups of animals remain under-studied, including bats (which make up 40-50% of tropical mammal fauna) and other small mammal groups, which are particularly difficult to survey due to nocturnal habits and cryptic (i.e. predator avoiding) behaviour. Amongst larger mammals, key discoveries have been made about the genetic make-up of the Bornean elephant and the Orang Utan.

Large areas of forest are being cleared for commercial uses, including rubber, oil palm, and pulp production. The increase in these activities is matched by a rise in the illegal trade of exotic animals, as logging trails and cleared forest mean easy access to more remote areas. Since 1996, deforestation in the whole of Indonesia appears to have increased to an average of 2 million ha per year (an area about half the size of the Netherlands), and this alarming figure threatens to rise due to a growing population and the needs of international markets.

The 'Heart of Borneo' project is a huge transboundary initiative to conserve one of the last remaining frontier forests on the entire island of Borneo, by involving Borneo's three governments (Malaysia, Indonesia and Brunei Darussalam) and several non-governmental organizations. By acting now, we can ensure that the Heart of Borneo remains a haven for both well-known and newly-discovered species. The alternative - losing the 'Heart of Borneo' - would be an unacceptable tragedy not only for Borneo, but for all of Asia, and the planet.





# Borneo: a World. Waiting to be Discovered



## Geography

Borneo is the world's third largest island (after Greenland and New Guinea). It covers an area of approximately 745,567<sup>(30)</sup> square kilometres (sq km), which is twice the size of Germany. Most of the island (540,000 sq km)<sup>(28)</sup> is Indonesian territory (Kalimantan), with the rest occupied by the Malaysian states of Sarawak (124,449 sq km)<sup>(27)</sup> and Sabah (73,711 sq km)<sup>(27)</sup> and the independent Sultanate of Brunei Darussalam (5,765 sq km)<sup>(29)</sup>.

Borneo straddles the equator, and most of its land area receives high rainfall (4,000-5,000 mm) throughout the year. The climate is wetter during the Northeast Monsoon (October to March), although the Southwest Monsoon (April to August) also brings rainfall to the area. Daytime temperatures in most parts of the low-lying areas are 30-32°C, and humidity is constantly high. Geologically, Borneo is part of Sundaland, sitting on the eastern margin of the Sunda Shelf. Relatively shallow seas (less than 200 metres depth) separate the island from the Malay Peninsula, Sumatra and Java, and there is firm evidence of land bridges connecting Borneo to these areas during the Pleistocene period (between 1.8 million and 10,000 years ago). On its east coast, however, Borneo is separated from the island of Sulawesi by a trench over 2,000 metres (m) deep.

## Biodiversity

Borneo holds biodiversity and endemism records for most plant and animal groups. Endemic species are those which occur naturally only in a certain place, for example the kiwi is a bird species endemic to New Zealand. Within the Sundaic region, which covers the western half of the Indo-Malayan archipelago (an arc of some 17,000 equatorial islands), Borneo holds the record for the estimated minimum number of endemic plant (several thousands), bird (39), mammal (44) and fish (over 160) species, and that only covers those species already scientifically documented. In addition, about 100 amphibians, 47 lizards and 41 snake species are endemic to Borneo<sup>(3,18,20,31)</sup>. The Bornean Mountains, with 24 species confined to this area, is classified as an Endemic Bird Area (EBA)<sup>(34)</sup>. The Global 200 is a list of the 200 most important habitats for worldwide biodiversity, identified by WWF; as many as 5 of these are located in

Borneo<sup>(19)</sup>. Borneo's lowland and dipterocarp forests, which can reach heights of over 60m, figure prominently on this list, for good reason. The highest tree diversity in the world is found in Lambir Hills National Park in Sarawak, Malaysia, where a staggering 1,175 tree species were recorded in just 52 ha of the 7,000-ha park<sup>(32)</sup>. Given that Lambir Hills is just 30km from Miri International Airport, and therefore very easily accessed by researchers, the prospect of even greater biodiversity elsewhere on Borneo is very likely.



Lambir Hills National Park, Sarawak (Malaysian Borneo) - WWF

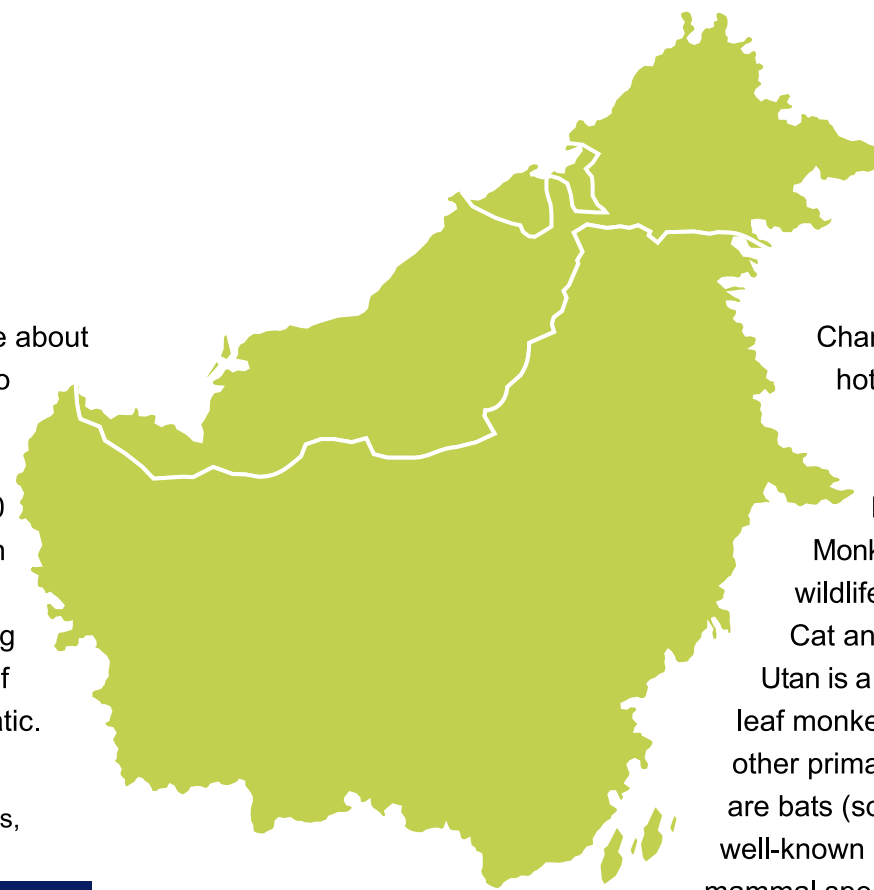


The flora of Borneo is estimated to consist of about 15,000 species<sup>(20)</sup>. There are about 3,000 species of trees, including more than 265 dipterocarp species. Borneo also has more than 2,000 species of orchids and more than 50 carnivorous pitcher plants, as well as both claimants for the title of largest flower in the world – the Rafflesia and the Amorphallus. On this island, a 6.5-ha forest may have over 700 species of trees, as opposed to only 50 in northern Europe or 171 in eastern North America<sup>(2)</sup>. A comparison with three European countries reveals the remarkable extent of plant and animal species richness on Borneo (Table 1). It is worth noting that these three neighbouring European countries share a very high proportion of their flora and fauna – a region to region comparison would be even more dramatic.

**Table 1:** Higher plant, bird and mammal species richness in Germany, the Netherlands, the UK and the Island of Borneo<sup>(23,28)</sup>

	Germany	Netherlands	UK	Borneo
<b>Higher plants</b>	2,682	1,221	1,623	15,000
<b>Birds</b>	247	192	229	620
<b>Mammals</b>	76	55	50	221

Though the number and variety of non-mammalian species discovered in recent years is high, Bornean mammals remain severely understudied. Bats, for instance, normally make up about 40-50% of any tropical mammal community, and have important roles in forest regeneration as pollinators and seed dispersers. They have also been recognised as important forest health indicators. However, few complete surveys have been conducted to describe this rich and diverse mammal community and none exist to date for the forests of the interior. The same is true for other groups of small mammals. Although they occur in complex communities with exceptional high species richness and considerable impacts on the rainforest ecosystem<sup>(21)</sup>, they have received little public or conservation attention. The lack of knowledge about these species is a result of the difficulties of conducting studies in the rainforest environment. Most species are highly cryptic (i.e. secretive, cautious or otherwise difficult to observe) in their appearance and behaviour. Further, many species are active at night, hiding in borrows or tree holes during the day. Even the capture and systematic study of those species requires considerable effort with generally low trapping success.



Charles Darwin described Borneo as 'one great wild untidy luxuriant hothouse made by nature for herself.' Darwin's definition is very apt when we consider the wealth of animals and plants found on the island. The Orang Utan, Sumatran Rhino, Clouded Leopard, Sun Bear, Borneo Pygmy Elephant and Proboscis Monkey are some of the best known and most charismatic of Borneo's wildlife. The largest feline is the Clouded Leopard, but the Leopard Cat and Flat-headed Cat are also to be found on Borneo. The Orang Utan is a well-known primate flagship species, but the gibbon, macaques, leaf monkeys, proboscis monkey, tarsier and slow loris are amongst the other primates that thrive on the island. The most widespread mammals are bats (some 90 species), the largest of which is the Flying Fox. Less well-known

mammal species include 10 species of tree shrews (squirrel-like primates), 14 flying squirrels, the Flying Lemur (or Colugo) and the mysterious Moonrat. There are also some 160 species of snake on Borneo, few of which are venomous. The freshwater crocodilian *Tomistoma schlegelii* (a flagship species for the remaining peat swamp forests) has Borneo as one of its last strongholds<sup>(33,35)</sup>. The strange looking, semi-aquatic, burrowing Earless Lizard, *Lanthanotus borneensis*, is endemic to Borneo, and still remains unknown in terms of its natural history traits<sup>(1)</sup>.

Dipterocarp forests are the key to this remarkable abundance of species – they hold the greatest insect diversity on Borneo, with as many as 1,000 species found in one tree. They are also host to thousands of plants, lichens and fungi, which in turn form the base of a food chain that nurtures a very great diversity of species.

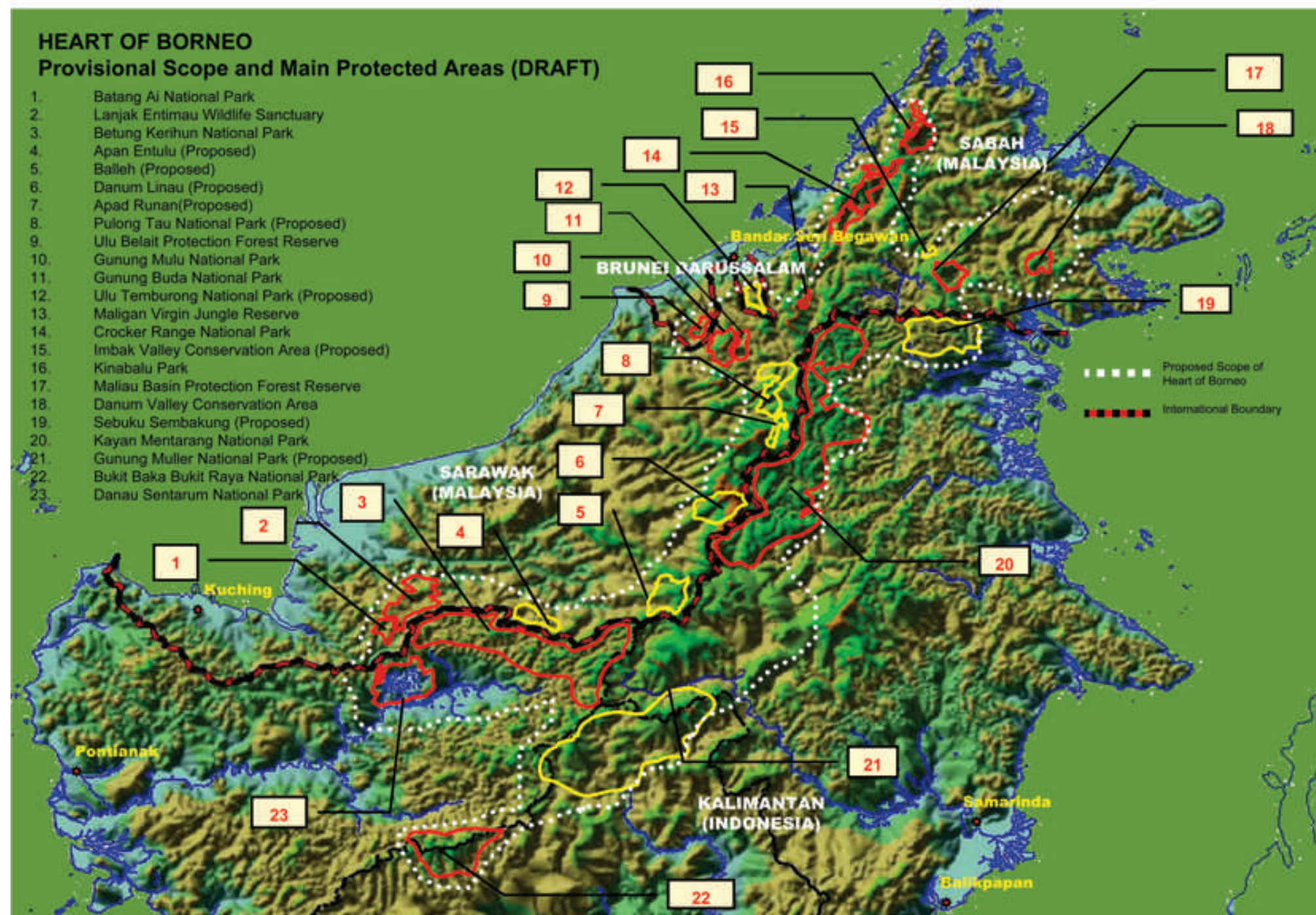
Especially significant are the mountain forests of Borneo, which can be likened to high-altitude islands in a sea of lowland dipterocarp forests<sup>(19)</sup>. This isolation has produced a unique and rich set of species, derived from both Asian and Australasian families, making it one of the most diverse montane habitats on Earth<sup>(3,19)</sup>. These montane forests derive moisture from the clouds that envelop the high mountains of this island. Oak, chestnut, and myrtle (Myrtaceae) species can all be found in abundance here. As you move higher, leaves get smaller and trees shorter until the landscape transforms into an alpine meadow. Pitcher plants, rhododendrons, orchids, and moss species are especially diverse high in the mountains.



# Nothing Left to Discover?

Borneo has been a magnet to scientists for over a hundred and fifty years, and has played a key role in the discovery of evolution - Alfred Russel Wallace's theories of natural selection were inspired by his travels in Borneo between 1854 and 1862. Despite a century and a half of study, some of the latest research suggests that taxonomists will be busy classifying new species for decades to come. The 'Heart of Borneo' appears to be especially important for future discoveries as it harbours large and, more importantly, continuous tracts of virgin montane forest, many of which remain unexplored by science.

In the last ten years, between 1994 and 2004, at least 361 species new to science have been found on the island, ranging from dwarf tree frogs, to blind lizards, to orchids, to many peculiar-looking, but equally fascinating freshwater fish. 260 species of insects, 50 plants, 30 freshwater fish, 7 frogs, 6 lizards, 5 crabs, 2 snakes and a toad have become known to man through scientific publications over the last ten years. However the published figures are most likely a gross underestimate, as twice as many species may currently be awaiting notoriety through future publications. Just as significant is the fact that important new discoveries have been made about existing species.

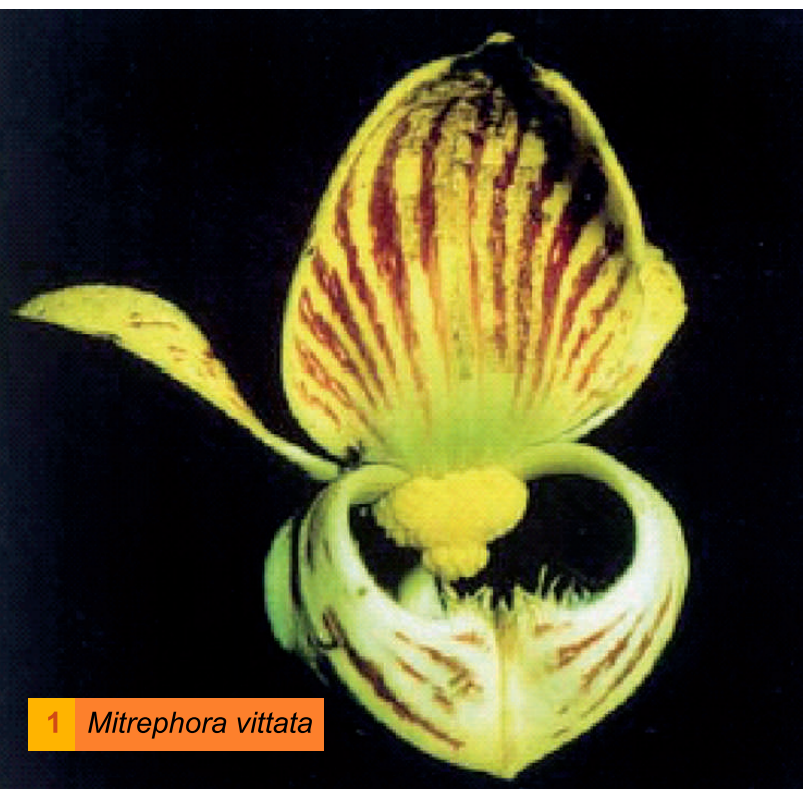




# Plants:

One of the most spectacular new finds of recent years is the beautiful *Mitrephora vittata* (2), one of three new *Mitrephora* species described from both Sabah and Sarawak in 2000<sup>(17)</sup>. This group of shrubs, small and large trees comprises 40 species, which are widely distributed across Asia, though Borneo represents their major centre of diversity. *Mitrephora vittata* is found in the Kota Belud, Keningau, Ranau, Labuk Sagut and Yawau districts (Sabah) and in Gunung Mulu National Park (Sarawak). Its habitat is typically represented by dense dipterocarp forests in valleys and near streams on sandstone, serpentine and limestone formations at between 800 and 1,220m altitude. The flowers of this particular group possess both female and male organs, but these mature at different times to avoid self pollination. Identification of these species is not always straightforward,

as flowers are subject to age-associated variation in colour, size and shape. The outer petals, for example, have comparatively light pigmentation during the 'female' phase and become larger and darker in the 'male' phase.



1 *Mitrephora vittata*



2a *Podochilus marsupialis*



2b *Trichoglottis tinekeae*

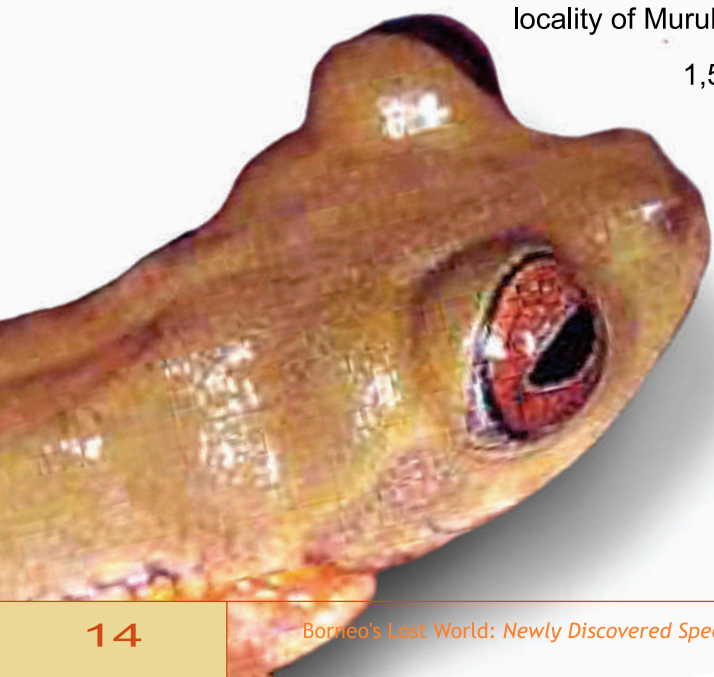
Two beautiful orchids, *Podochilus marsupialis* (2a) and *Trichoglottis tinekeae* (2b) were described in 1998 from Sabah, Sarawak and Kalimantan, and Sabah and Sarawak respectively<sup>(37)</sup>. *Podochilus marsupialis* was found on large rotting trees in primary forest, between 130-800m and *Trichoglottis tinekeae* was collected in open undisturbed kerangas, primary montane forest and in limestone forests, between 450-1,700m.



# Amphibians:

In March 1996, the twelfth member of the Ansonia toad group in Borneo was described from the highlands of Sabah<sup>(5)</sup>. This adult female was found at the Sayap Station in Kinabalu Park, Kota Belud District at 880m above sea level. *A. anotis* is distinguished by other known Ansonia by the absence of a tympanum, or hearing organ. The tadpole of this species is also curiously different as it possesses a distinct abdominal sucker, which is possibly used for climbing. The legs and fingers of this species are characteristically long and slender and its back and sides are covered in small, round bumps, each covered with a brown tip. Its eyes are very large and are as wide as the length of its snout.

In April 1999 another new amphibian was described: *Philautus erythrophthalmus* (3), a dwarf red-eyed tree frog from Sabah. This individual was described from the submontane locality of Muruk Mio in Southwestern Sabah at approximately 1,550m above sea level<sup>(16)</sup>. It was found perched on vegetation about 2m above the ground in montane oak forest. This particular genus is very unusual as it is characterised by the aerial development of eggs into froglets without going through an aquatic tadpole stage.



3 *Philautus erythrophthalmus*

In September 2001 a frog species - *Kalophrynus eok* (4) - was discovered in the Kelabit Highlands of Sarawak (North Central Borneo)<sup>(4)</sup>. This new member of the 'Grainy Frog' group (so-called because of their granular and uneven skin) is characterised by a wide head and by brick-red dorsal colouration. These ground dwelling animals are also called 'Sticky Frogs' as they secrete a very sticky, poisonous mucus when attacked by a predator. Sticky frogs are less than 30mm in size and feed on small insects. These latest discoveries suggest that the montane forests of the Central Highlands of Sabah, Sarawak and Kalimantan are indeed rich in endemic amphibian communities and are likely to harbour many other species, still unknown to science.



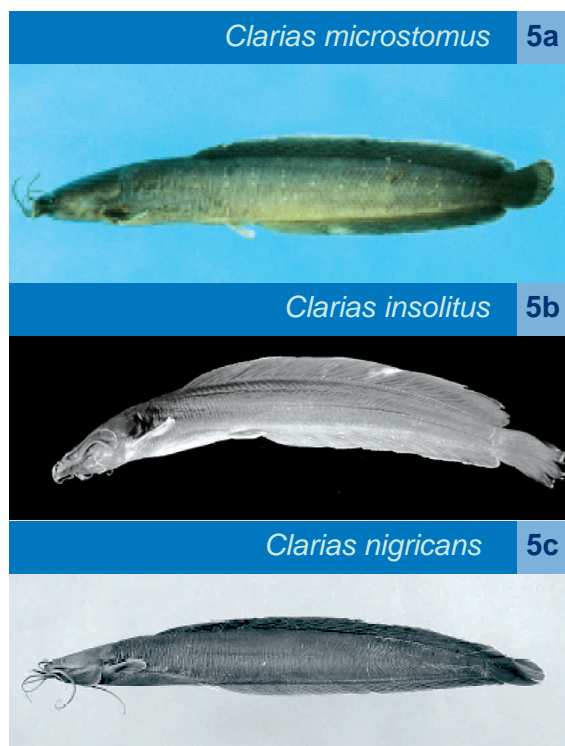
4 *Kalophrynus eok*

Photo Credit  
3 Rob Stuebing  
4 Indraneil Das





# Fish:



*Clarias microstomus* (5a) Two giant muddy rivers in Indonesian Borneo - the Mahakam (East Kalimantan) and the Barito (South and Central Kalimantan) - represent the easiest way to penetrate the interior of the island. The Barito is the longest river in Borneo (and Indonesia) at approximately 6,000 kilometres (km) and is home to astonishingly diverse freshwater communities.

Freshwater fish, especially catfish, are amongst the most important recent discoveries. Some of these represent amazing adaptations to their environment. For example, the clariids or 'Labyrinth Catfishes' are named after a labyrinthic organ arising from their gills, enabling them to use atmospheric oxygen. This peculiar group is also known as the 'forest walking catfishes' as some species are capable of travelling over short distances on land. They also show burrowing adaptations with small eyes and the absence of pectoral and pelvic fins. Their heads are flat and broad and their bodies taper to the tail. Owing to their ability to survive extended periods out of water, the walking catfishes are valued as an important food source and are the focus of both subsistence fishers and commercial farming operations<sup>(15)</sup>.

*Clarias microstomus* (5a), a new species of clariid catfish was caught in the Kayan and Mahakam River drainages in eastern Borneo during November 1999. It differs from other similar species in having a narrow snout, an egg-shaped head and a gray body with white spots<sup>(10)</sup>.

*Clarias insolitus* (5b), (insolitus meaning strange or unusual) was first described from the Barito River drainage in Central Kalimantan. It was caught in a small river flowing into the Sungai Rekut (tributary of Sungai Busang) in 1991 but only more recently described as a new species (2003). It is characterised by a flat head, peculiar fleshy lips and violet-gray colouration on side and dorsal surfaces<sup>(13)</sup>.

*Clarias nigricans* (5c) was found by catfish experts in Samarinda market, East Kalimantan in November 1999. This individual is thought to have been fished from the Mahakam river, East Kalimantan and is another member of the 'Forest Walking Catfishes'<sup>(12)</sup>.

Sometimes due to taxonomic misclassification, new species remain undiscovered for many years in museums around the world. Four species of Asian banjos (*Acrochordonichthys* sp.) (6 a-d) originally collected from the rivers of Kalimantan between February 1991 and May 1998<sup>(9)</sup> were described as new species in 2001 by catfish expert H.H. Ng. These fish are ambush predators and one of the most lethargic of catfishes, who spend most of their time lying deep down on the bottom of forest streams. Occasionally they moult and their old skin peels off in large patches. These fish have a curious defence mechanism, whereby under considerable stress they release a milky coloured substance from two special pores at the base of each pectoral fin. This mucus is poisonous to other organisms to the point that it is capable of causing instant death to fishes in the vicinity<sup>(15)</sup>.

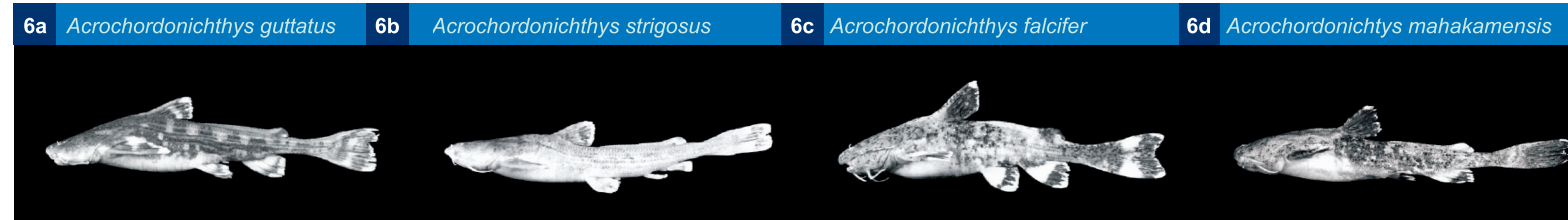


Photo Credit  
5a-c Heok Hee Ng  
6a-d Heok Hee Ng





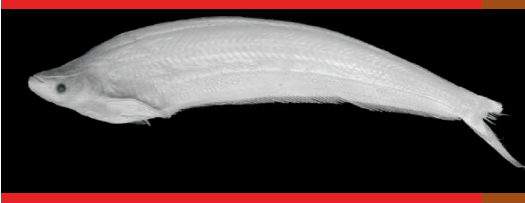
*Parakysis notialis* 7



*Mystus impluviatus* 8



*Kryptopterus platypogon* 9



*Ompok platyrhynchus* 10



Catfishes of the genus *Parakysis* are cryptically-coloured (i.e. well-camouflaged) fishes found in small forest streams of Sundaic Southeast Asia. *Parakysis* species have characteristically wrinkly skin, their barbels are branched and their tail is deeply forked. A new species, *P.notialis* (7), has been described from the Barito river<sup>(8)</sup>.

Bagrid catfishes are also known as scaleless catfishes. They are characterised by well-developed dorsal and pectoral spines, a distinct adipose fin and often deeply forked caudal fins. Some members of this family are among the largest catfishes in the world. A new species of bagrid catfish, *Mystus impluviatus* (8), was described in 2003, though it was originally fished 11 years previously in the Mahakam river drainage<sup>(11)</sup>.

The Glass Catfishes are a peculiar group of freshwater fishes also called 'Ghost Catfishes' or 'Phantom Catfishes'. This fish is virtually transparent (as the name suggests), revealing its skeleton and internal organs in a most amazing way<sup>(15)</sup>. It is characterised by the absence of the dorsal fin, a strongly arched back and flattened, ribbon-like barbels. Recently *Kryptopterus platypogon* (9), a new species of glass catfish was found in the Rajang River drainage in Sarawak.

Another member of the 'Glass fishes' group, *Ompok platyrhynchus* (10), was discovered in the Sungai (River) Esu in Brunei Darassalam<sup>(14)</sup>.

# Mammals

Whilst Borneo's small mammals have yielded disappointing results, new discoveries concerning two of its largest mammals have proven simply astounding. The Bornean Orang Utan (*Pongo pygmaeus*) is now known to be a distinct and separate species from its Sumatran counterpart (*Pongo abelli*). Recent genetic studies<sup>(25)</sup> have demonstrated that geographical separation of the two types occurred at least 1.1 million years ago, and since then they have both followed separate evolutionary paths. This discovery makes the Bornean Orang Utan the largest endemic land animal on the island.

Equally astounding is the recent classification of the Borneo Pygmy Elephant as a separate sub-species<sup>(26)</sup>. DNA sampling carried out by the Sabah Wildlife Department and WWF Malaysia was subsequently evaluated by scientists at Columbia University and demonstrated that Borneo's pygmy elephants were isolated from their mainland cousins over 300,000 years ago. This discovery has turned existing theories on their heads, as it was generally believed that Indian elephants were introduced to Sabah by the British East India Company as gifts to the Sultan of Sulu as recently as the 17<sup>th</sup> century. However their relatively larger ears, longer tails, straighter tusks and placid disposition could not easily be explained by 300 years of adaptation. Their genetic distinctiveness proves that elephants really are indigenous to Borneo and makes them one of the highest priorities for conservation.



# Reptiles:

*Hydrophis sibauensis* (11), a highly venomous species of water snake, was described from the Sibau River (West Kalimantan) in 2001<sup>(38)</sup>. The *Hydrophis* group is thought to be mainly marine, however this specimen was found about 1,000km upriver.



12 *Enhydris* sp.

Another addition to the Bornean list, *Enhydris* sp. (a rainbow water snake) (12) was recorded in 1996, but remains undescribed.

Two new species of the snake-like blind lizard belonging to the family Dibamidae have recently been described from Sabah - *Dibamus ingeri* and *Dibamus vorisi*<sup>(39)</sup>. *Dibamus ingeri*, which measures about 10cm in length, was discovered inside a rotting log at an altitude of 1,180m above sea level (Mendolong Camp, Sipitang District, Sabah). *Dibamus vorisi*, on the other hand was found 5cm below the soil surface at an elevation of just under 300m in the Danum Valley Conservation Area (Lahad Datu District, Sabah).

Three species of lizard from the *Sphenomorphus* group, the most diverse lizard group in Borneo, were described in 2001. All of the known species live occur in lowland forest and are terrestrial, though they will climb several meters up trees to avoid predators.

However the three new species were collected - at an elevation of over 1,000m above sea level - along the mountainous western spine of Sabah, from Mt. Kinabalu in the north to Mt. Lumaku in the south<sup>(6)</sup>.



11 *Hydrophis sibauensis*

In 1998, a lizard collected at Labang Camp in the Bintulu District of Sarawak over 30 years earlier was finally recognized as a new species, *Cnemaspis dringi*. Previously, the known range of this group of lizards (3 species) was restricted to the north-western tip (?) of Sarawak



# Invertebrates:

The 260 species of insects recently described include beetles (Coleoptera), jumping spiders (Aracnida), flies (Diptera) and 'waterbears' (Heteroptera). One entomologist alone - Roberto Pace - has contributed an amazing 168 new species in the last five years. About 30% of all new insect species were found on Mt Kinabalu, the highest mountain in Borneo (4,101m).

During a five week expedition led by The Nature Conservancy in 2004, a team of national and international scientists explored four "karst" systems of limestone caves, cliffs and sinkholes in the Sangkulirang Peninsula, East Kalimantan. Here, a number of new insect and fish species were discovered including a giant cockroach (13a), a brightly-coloured insect (13b) and a tiny crab (13c) (*Microeca*). At 10cm, the newly-discovered cockroach is believed to be the largest in the world. Given that cockroaches are one of the oldest existing insect species, the discovery of such a 'giant' is the entomologist's equivalent of finding a live Tyrannosaurus Rex!



13a Cockroach



13b Insect



13c Crab *Microeca* sp.

## Newly-discovered species in the karst systems of the Sangkulirang Peninsula, East Kalimantan

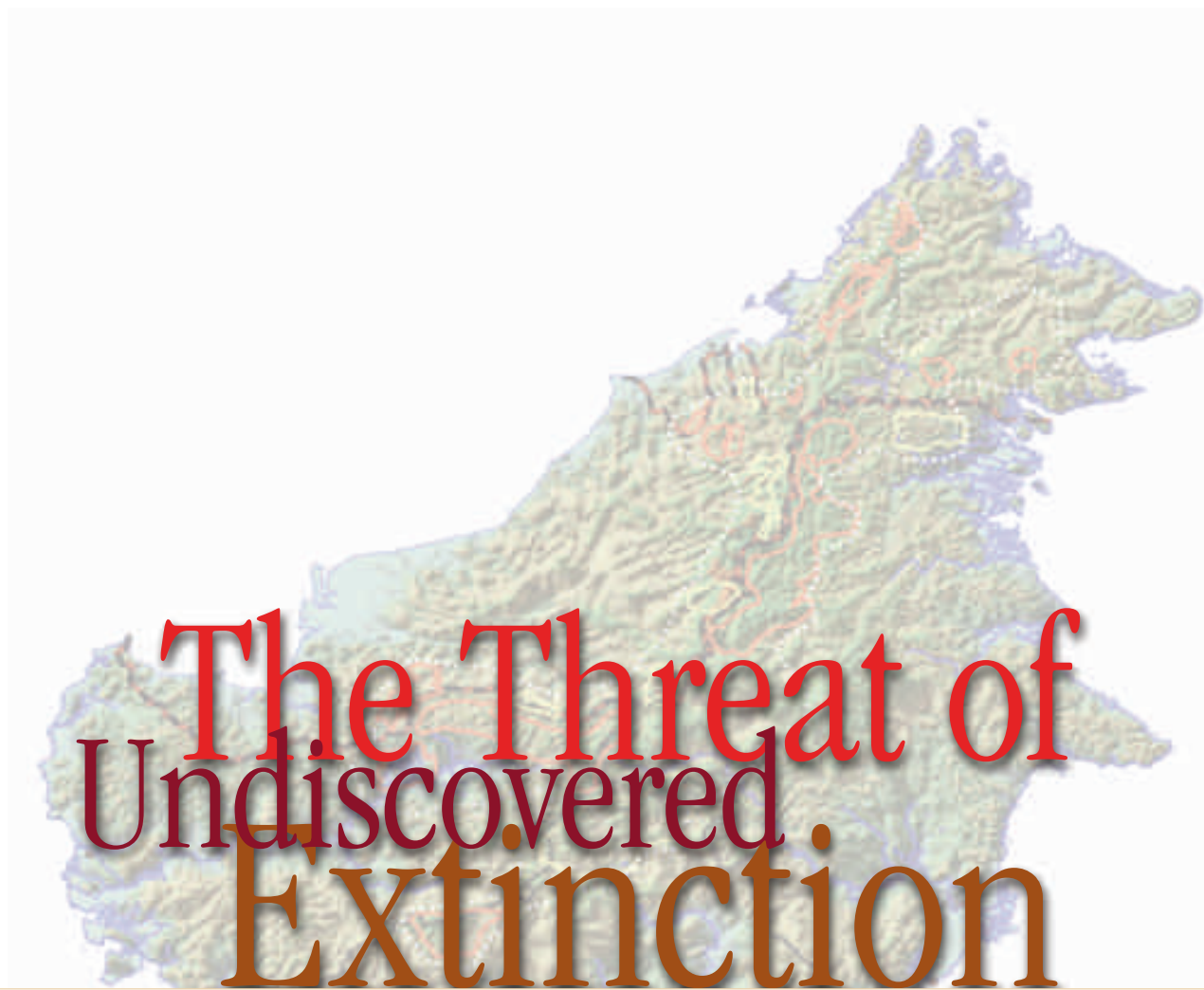
Of particular interest is also an entirely new species of bamboo-inhabiting, semi-aquatic bug (Heteroptera), which exploits a unique ecological niche in the water-filled internode cavities of various bamboo species. The bugs enter bamboo cavities through small holes bored by insects or woodpeckers and mainly feed on other insects trapped on the water surface<sup>(7)</sup>.

Three new crab species from the *Parathelphusa* group were described from three different sites in Borneo between September 1995 and June 1996<sup>(22)</sup>. This group comprises 35 species, which are all found mainly in Sumatra, Borneo and peninsular Malaysia *P.tera* was discovered in Belungan basin (East Kalimantan), *P.torta* from the Barito Basin (South Kalimantan) and *P.undulata* from the Kayan Basin (East Kalimantan).

### Photo Credit

3a Cahyo Rachmadi - The Nature Conservancy  
3b Harry Wiradinata - The Nature Conservancy  
3c Cahyo Rachmadi - The Nature Conservancy





Borneo is one of the biologically richest hotspots on Earth, possessing staggeringly high endemism levels across all groups of plants and animals. Unfortunately, a high percentage of Bornean species are also severely threatened. Like many tropical areas around the world, the natural forests of Kalimantan, Sarawak and Sabah are being cleared for commercial uses, including rubber, oil palm, and pulp production. The increase in these activities is matched by an increase in the illegal trade of wildlife<sup>(36)</sup>, as logging trails and cleared forest mean easy access to more remote and diverse areas. This begs the question; will many species become extinct before we even find them?

Between 1950 and 2000, forest cover in the whole of Indonesia fell from 162 million ha to 98 million ha. Since 1996, deforestation appears to have increased to an average of 2 million ha per year (an area about half the size of the Netherlands), and this alarming figure threatens to rise due to a growing population and the needs of international markets<sup>(18)</sup>. Furthermore, satellite studies show that some 56% (more than 29,000 sq km) of the protected lowland forests in Kalimantan were cut down between 1985 and 2001. Protection laws are in effect throughout Borneo, but are often inadequate or are flagrantly violated, usually without any consequences.

Conservation biology has provided us with powerful evidence that most groups of animals and plants are adversely affected by forest degradation and fragmentation, which may be caused by logging activities, slash and burn agriculture and the construction of roads within forested areas. Large mammals are particularly affected by these activities as they have large home ranges. Big cats and Orang Utans, for example, are suffering the effects of these activities by reporting alarming declines, whilst the Borneo Pygmy Elephant is being poached for its ivory, and is coming into conflict with human agricultural activities. Other, smaller species, especially small mammals, may not be able to recolonise isolated patches of suitable habitat and thus will become locally extinct. Road construction through protected areas leads to further separation of habitat ranges and provides easy access for poachers to some of the most remote and diverse tracts of remaining virgin forest.



# Conclusion and Recommendations

The forest of Southeast Asia are rapidly disappearing under human pressure. The full diversity of the forests of Borneo cannot be maintained if they are reduced to a patchwork. Reducing the habitat ranges of individual species leads to local extinction, and also causes inbreeding amongst smaller, isolated populations, thus reducing genetic vigour and increasing susceptibility to diseases. Successful rainforest conservation requires the maintenance of very large blocks of inter-connected forest, without which hundreds, or even thousands, of species become extinct.

There is only one place remaining in Southeast Asia where forests can still be conserved on a very large scale. It straddles the transboundary highlands of Indonesia and Malaysia, and reaches out through the foothills into adjacent lowlands and to parts of Brunei. We call this area the 'Heart of Borneo'. The future of this transboundary area depends on the collaboration of all three governments as no one country can save these unique uplands alone.

Recent species discoveries have only highlighted the urgency of the situation. If new species are being discovered on an almost daily basis, how many are dying out before we can get to them? If the Bornean Orang Utan and the Bornean Pygmy Elephant are unique to the island, and have adapted perfectly to the conditions here, how can they possibly be conserved or replaced by distant Sumatran or mainland cousins?

Another important consideration is the scientific, economic and social value of species loss. Does one of the thousands of undiscovered plant species offer a treatment for some life-threatening human disease, such as cancer? Could the powerful toxins secreted by Borneo's sticky frogs and banjo catfish offer new advances in pest control, or anesthesia, or the treatment of neurological diseases? Does a living fossil like the giant cockroach offer important undiscovered clues to insect evolution? Unless we can conserve the 'Heart of Borneo' we may never know the answers to these questions and we may forego a phenomenal wealth of bio-medical and scientific resources.

The 'Heart of Borneo' still holds huge tracts of continuous pristine forest, home to some of the most diverse fauna and flora of the world. The protection of Charles Darwin's amazing 'luxuriant hothouse' - keeping it as one uninterrupted forested area - is crucial to the very survival of its many rare, endemic and yet to be discovered species. The 'Heart of Borneo' is the home to forest-dependent rural people who rely on the goods and services the forests provide. The involvement of these people in the management of the forest is essential to the future of the 'Heart of Borneo'.

WWF aims to assist Borneo's three nations (Brunei, Indonesia and Malaysia) to conserve the area known as the 'Heart of Borneo' – a total of 220,000 sq km of equatorial rainforest - through a network of protected areas and sustainably-managed forest, and through international co-operation led by the Bornean governments and supported by a global effort. The 'Heart of Borneo' initiative presents a unique opportunity to conserve pristine tropical rainforest on a huge scale, i.e. almost 30% of the world's third largest island. But if it is going to happen, it has to be now or never.

## References

- (1) **A guide to the lizards of Borneo** [online]
- (2) **Burley, J.** 1991. A floral inventory of West Kalimantan. Project proposal.
- (3) **Conservation International (Biodiversity hotspots)** [online]
- (4) **Das, I.** & 2003: A new species of Kalophrynus (Anura: Microhylidae) from the Highlands of north-central Borneo, 51(1):109-113.
- (5) **Inger, L.** & Ambun. 2001: New species of toad of the genus Ansonia (Anura: Bufonidae) from Borneo, Raffles Bulletin of Zoology 49(1): 35-37.
- (6) **Jacobs, M.** 1988: The tropical rainforest. A first encounter. Berlin Heidelberg: Springer-Verlag.
- (7) **Kovac, D.** & Yang, C.M. 2000: Revision of the oriental bamboo-inhabiting semi-aquatic bug genus Lathriovelina Andersen, 1989 (Heteroptera: Veliidae) with description of *L.rickmersi*, new species, and notes on the genus *Baptista* distant, 1903, Raffles Bulletin of Zoology, 48(1): 153-168.
- (8) **Ng, H.H.** & Kottelat, M. 2000: *Parakysis notialis*, a new species of akysid catfish from Borneo (Siluriformes: Akysidae), Ichthyological Research 50: 48-51.
- (9) **Ng, H.H.** & P.K.L. Ng. 2001: A revision of the Akysid catfish genus *Acrochordonichthys* Bleeker, Journal of Fish Biology 58:386-418.
- (10) **Ng, H.H.** 2001: *Clarias microstomus*, a new species of clariid catfish (Teleostei: Siluriformes) from Eastern Borneo, Zoological Studies 40(2):158-162.
- (11) **Ng, H.H.** 2003: *Mystus impluviatus*: A new species of bagrid catfish (Teleostei: Bagridae) from Eastern Borneo, Copeia 2: 373-378.
- (12) **Ng, H.H.** 2003: *Clarias nigricans*, a new species of clariid catfish (Teleostei: Siluriformes) from Eastern Borneo, The Raffles Bulletin of Zoology 51(2): 393-398
- (13) **Ng, H.H.** 2003: *Clarias insolitus*, a new species of clariid catfish (Teleostei: Siluriformes) from Southern Borneo, Zootaxa 284:1-8.
- (14) **Ng, H.H.** & H.H. Tan. 2004: *Ompok platyrhynchus*, a new silurid catfish (Teleostei: Siluridae) from Borneo, Zootaxa 580: 1-11.
- (15) **Planet catfish** [online]
- (16) **Stuebing, R.B.** & Wong, A. 2000: A new species of frog, *Philautus erythrophthalmus* (Rhacophoridae) from Southwestern Sabah, Malaysia, Raffles Bulletin of Zoology 48(2): 293-296.
- (17) & 2001: Three new species of *Mitrephora* (Annonaceae) from Sabah, Malaysia, Botanical Journal of the Linnean Society 135(3): 305-313.
- (18) **Indonesia's Forests in Brief** [online]
- (19) **WWF Ecoregions, Borneo Montane rain forests (IMO103)** [online]
- (20) **WWF unpublished report: 'Borneo rich and unique'**.
- (21) **Wells, K.,** Lakim M.B., Bernard H. & Pfeiffer M. 2004: Small mammals in the rainforest canopy: a neglected group of conservation concern? [online]
- (22) **Chia, O.K.S.** & Ng, P.K.L. 1998: On three new species of *Parathelphusa* (Crustacea: Decapoda: Brachyura: Parathelphusidae) from Borneo, Hydrobiologia 377: 123-131.
- (23) **Avibase Bird checklists of the world** [online] <http://www.bsc-eoc.org/avibase/avibase.jsp?pg=checklist&region=BOR>
- (24) **IUCN/SSC Shark Specialist Group** [online]
- (25) **Muir, C.C.,** B.M. Galdikas & A.T. Beckenbach. 2000: mtDNA sequence diversity of orangutans from the islands of Borneo and Sumatra. Journal of Molecular Evolution 51(5): 471-480.
- (26) **WWF-UK** [online]
- (27) **Malaysia: Culture & Information** [online]
- (28) **WHLI Bioregions** [online]
- (29) **Brunei Direct** [online]
- (30) **Island characteristics and vulnerability: some perspectives** [online]
- (31) **Malkmus, R.,** U. Manthey, G. Vogel, P. Hoffmann & J. Kosuch (2002): Amphibians and reptiles of Mount Kinabalu. – A.R.G. Gantner Verlag K. G., Ruggell, 424 pp.
- (32) **Centre for Tropical Forest Science. Site summary information** [online]
- (33) **Tomistoma schlegelii** [online]
- (34) **Birdlife International.** 1998: *Endemic Bird Areas of the World – Priorities for Biodiversity Conservation.* Birdlife Conservation Series No. 7. Cambridge, UK.
- (35) **Sebastian, A.C.** 1994: The *Tomistoma schlegelii* in Southeast Asia: A Status Review and Priorities for its Conservation. In: *Proceedings of the 12th Working Meeting of the IUCN-SSC Crocodile Specialist Group.* April 1994, Pattaya, Thailand.
- (36) **WWF TRAFFIC SEA**, paper presented by James Compton at HoB Yogyakarta meeting.
- (37) **Schuiteman A.** 1998: New species of *Podochilus* and *Trichoglottis* (Orchidaceae) from Borneo, *Blumea* 43 (2): 489-494.
- (38) **Rasmussen, A. R.,** M. Auliya & W. Böhme. 2001: A new species of the sea snake genus *Hydrophis* (SERPENTES: ELAPIDAE) from a river in West Kalimantan (Indonesia, Borneo). *Herpetologica* 57(1): 23-32.
- (39) **Das, I.** & Lim. 2003: Two new species of *Dibamus* (Squamata: Dibamidae) from Borneo. *Raffles Bull. Zool.* 51(1): 137-141.