Briefing document on road network through the Leuser Ecosystem

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1. The Leuser Ecosystem

The Leuser Ecosystem Region is one of the most important conservation areas on earth. It contains over twenty-five thousand of the known species on earth in a biodiversity hot spot in northern Sumatra. It contains 4.2% of all the known bird species on the planet. It also contains 3.2% of all the known species of mammals on earth. This includes the last remaining viable populations of the Sumatran orang-utan (*Pongo abelii*), Sumatran tiger (*Panthera tigris sumatrae*) and Sumatran elephant (*Elephas maximus sumatranus*), as well as the largest population of the most critically endangered large mammal on earth, the Sumatran rhino (*Dicerorhinus sumatrensis*).

Every new taxonomy survey has found more new species. When compared with estimates of the total predicted number of undescribed species on earth, the Leuser Ecosystem Region is estimated to contain over 100,000 species in total (including, adjacent to the mainland rain-forests of the Leuser Ecosystem, a 12 km stretch off the east-coast mangrove forests and the west-coast swamps, that harbour many species of sea fish, corals, whales, and dolphins). The calculation for this is given in the Appendix.

Efforts are being made to propose the Leuser Ecosystem for nomination as a natural World Heritage Site. It is recognised as one of the top twenty-five critical ecosystems in the world. It is the only place on earth where representatives of the major characters of Rudyard Kipling's *The Jungle Book* can be found in the one area: orang-utans, bears, tigers, elephants, melanic form of tree-climbing (clouded) leopard, pythons, monkeys (Thomas langur, silver langur, long-tailed macaque, pig-tailed macaque), pack living canines (Asian wild dogs), large birds of prey (black eagle, crested serpent eagle, white-bellied sea-eagle), strangling fig trees, together in their rain-forest habitat with thousands of species of plants (more than 4,500 of the plants of the West Indo-Malayan Realm), and no forest-dwelling tribal people living inside the forests. Some of the extra species not in the Walt Disney classic include: siamang and lar gibbons (the latter being considered to have one of the most beautifully melancholic songs in the world), hairy rhinoceros, flying squirrels, flying lemurs, bats (at least 37 species, including flying foxes, *Pteropus vampyrus*), porcupines, civets, small and large deer, slow loris (nocturnal prosimian primates), scaly pangolins, crocodiles, monitor lizards, nine species of hornbills, the Great Argus, luminescent toadstool fungi, pitcher plants, several species of the world's largest flower (*Rafflesia spp*), and the world's tallest flower (*Amorphophallus*).

The Leuser Ecosystem is globally important for bird conservation, containing more than 80% of Sumatra's resident breeding species, with one of the world's longest area-bird lists, and all the IUCN "Red Data Book" bird species listed for Sumatra.

This rich diversity of bird species includes: bee-eaters, flycatchers, flowerpeckers, honeyguides, kingfishers, spiderhunters, woodpeckers, barbets, bablers, broadbills, bulbuls, drongos, hornbills, magpies, minvets, mynas, orioles, robins, shamas, shrikes, swallows, swifts, thrushes, treepies, trogons, warblers, weavers, whistlers, white-eyes, leafbirds, sunbirds, tailorbirds, fantails, forktails, needletails, wagtails, doves, pigeons, quails, partridges, pheasants, cuckoos, parakeets, parrots, bitterns, herons, finfoots, ducks, snipes, sandpipers, waders, falcons, hawks, nightjars, owls, serpent eagles, hawk eagles, fish eagles, sea eagles, and many more.

Although the Leuser Ecosystem was only created in 1995, its spectacular fauna and flora has been the subject of many international films that have been shown to over a hundred million viewers throughout the world. The *BBC* celebrated the new millenium with a special documentary on the community of orang-utans in their rain-forest habitat at Ketambe in the Leuser Ecosystem, South-east Aceh. Other programmes shown throughout the world have included Leuser's orang-utans that inhabit the Singkil-Trumon and Kluet swamp forests on the west coast of Aceh. These are the only known orang-utans in the world that have developed a sophisticated tool-using culture.

The Leuser Ecosystem covers some 26,000 sq. km, or 2.6 million hectares, of tropical rain-forest in northern Sumatra, Indonesia - an area almost as large as Belgium. It is the most complete and representative conservation area in the West Indo-Malayan Realm (Malesia), thereby making it of unparalleled conservation importance on a global scale. It is fringed by two major volcanic calderas, and contains a volcanic plateau, a rift valley, four spectacular volcanoes, two lakes, 13 major river systems, as well as numerous hot springs and fumaroles, and many 3,000m+ mountain peaks, including Mount Leuser that rises to 3,455m. The main vegetation types comprise coastal beach forest, swamp forests, lowland dry forest, riparian forest, hill dipterocarp forest, sub-montane forest, and alpine meadows.

About 80% of the Ecosystem is located in the province of Aceh, the remaining 20% occurring in the province of North Sumatra. The boundaries in Aceh were gazetted in 2001, whilst those in North Sumatra were gazetted in 2002. Excluding the west-coast swamp forests, and the lowland Sikundur Wildlife Reserve, most of the Leuser Ecosystem is situated on slopes of 40% or more, that should by law become protection forest. The designated Mount Leuser National Park is situated inside the Leuser Ecosystem, and comrises about one third of the total size of the Ecosystem. Except Sikundur, most of the National Park is high mountains, and is not large enough to contain viable populations of three of the endangered large mammals – the Sumatran tiger, Sumatran elephant, and Sumatran orang-utan.

Further information on Leuser can be found in:

(i) Rijksen, H.D, (1978), *A Field Study on Sumatran Orangutans (Pongo pygmaeus abelii, LESSON 1827): Ecology, Behaviour and Conservation*. H.Veenman and B.V. Zonen, Wageningen.
(ii) Rijksen, H.D. & Griffiths, M (1995), *Leuser Development Programme Master Plan*, IBN-DLD (Institute for Forestry & Nature Research), Wageningen;
(iii) Van Schaik, C.P. & Jatna Supriatna (1996), eds., *Leuser: A Sumatran Sanctury*, Yayasan Bina Sains Hayati Indonesia, Depok (yabshi@rad.net.id); and
(iv) The LDP web-site: http://www.eu-ldp.co.id

2. Benefits of the Leuser Ecosystem to local communities

The Leuser Ecosystem acts as a life-support system for more than two million indigenous people that rely on the ecological services provided by an intact ecosystem. The primary service is fresh water required to sustain the livelihoods of local people that live around the ecosystem. There are thirteen major river systems arising in the ecosystem. The water-catchment area of just one of these rivers, the left branch of the *Simpang Kiri* /Alas River, has a rainfall catchment of 20 billion cubic meters of water per year (N.Jewell, 2002). The forests of the Leuser Ecosystem act like a sponge to soak up this water and spread out its release downstream more evenly across the months. When undisturbed, they dampen out the peaks and troughs, thereby preventing flash floods and regulating the water supply to prevent prolonged droughts. They sustain the local rice-growing cultures by ensuring a reliable source of fresh water for drinking, bathing, transportation, and supplying the fisheries and agricultural sector. The Ecosystem also provides non-timber forest products such as rattan and bamboo, which are harvested by local communities.

Due to the prolonged conflict in Aceh, revenues for local communities from the nature tourism industry have been almost completely wiped out. It will take many years and substantial investment for the sector to develop to its full potential.

3. The conflict in Aceh

Aceh is the most north-westerly province in the Republic of Indonesia. Since 1976, the Free Aceh Movement (GAM, *Gerakan Aceh Merdeka*) has been fighting for complete independence from Indonesia. To put down the separatists, the Indonesian military declared Aceh a special Military Operation Area (DOM, *Daerah Operasi Militar*) for ten years from 1989 until 1998, when former President Soeharto stepped down. Since then the conflict between GAM and the Indonesian army has escalated, with up to 1,000 people being killed per year in recent years. Killings go on almost every day in the province. Most of the victims have been innocent civilians killed by unknown armed assassins (OTK, *orang tak kanal*) who assassinate targets from motor-bikes and regularly go into the homes of villagers to shoot the father in front of his family. Reports estimate that over 10,000 people have been killed as a result of the conflict.

Since 2000, the Swiss-based Henry Dunant Centre has been involved as a neutral third party helping the warring sides to come to the negotiating table to broker a peace deal. All cease-fire agreements prior to December 2002 have failed. A new comprehensive peace deal was expected to be signed on December 9th 2002. The basis for this agreement was to be the adoption of a special autonomy package for Aceh that gave the province a far greater proportion of its oil, gas, mineral, and forest resources. Under the special autonomy law of 2001, the province changed its name to *Nanggroe Aceh Darussalam* ('House of Peace' Aceh Country) and was allowed to introduce islamic sy*ariah* law.

4. Proposed road network 'Ladia Galaska'

The provincial and local governments in Aceh have proposed a road system to open up the forests of Leuser from the west coast by the Indian Ocean (*Lautan Hindia=Ladia*) through the main centres of two indigenous peoples' groups, the *Gayo* and *Alas* (=*Galas*), to the east coast by the Malacca Straits (*Selat Malaka=ka*), known locally by the abbreviation *Ladia Galaska.*

The main Ladia Galaska road network proposal, together with related road projects, cuts through the Leuser Ecosystem in at least nine places. It ignores all legal environmental impact assessments (EIA's), and cuts through 'protection forests' (*Hutan Lindung* – generally, non-conservation forests that have an average slope of 40% or more), as well as conservation forests (including the designated Mount Leuser National Park).

The Leuser Management Unit (the technical management body of the Leuser Development Programme, which is a joint EC-GoI initiative to conserve the Leuser Ecosystem) has been lobbying for over a year on technical grounds against the roads, using sophisticated GIS analyses. In particular, only three of the nine proposed roads have had environmental impact assessments (EIA's) carried out, and even these three EIA's violated the laws.

Proponents of the road projects argue they are just upgrading existing roads, most of which originated as logging roads. Nevertheless, legally, all these roads require EIA's.

5. Destruction of Leuser Ecosystem by Ladia Galaska

The road network cutting through forest areas will lead to a massive wave of illegal logging, encroachment and settlements inside the Leuser Ecosystem. Once the first waves of local people move in along the main roads, this will then lead to dozens of finger roads off each main road, each with the same effect of eventual forest conversion for the 'benefit and development of the people'. This will lead to the destruction of all the areas of highest biodiversity in the lowland and hill forests, leading to the local extinction of all the endangered large mammals, followed eventually by hundreds of other species, including species of lowland plants of unknown benefit for human welfare.

The effect of Ladia Galaska can be predicted exactly because of precedents in Leuser. In 1982, US*AID* helped fund a road upgrading project that split the Mt Leuser National Park in two. Aerial photographs taken before and after clearly show that US*AID* helped facilitate uncontrolled illegal settlements along the road inside the National Park around Gumpang and Marpunga (districts of Gayo Lues and South-east Aceh). These local indigenous settlers were responsible for large-scale illegal encroachment, illegal logging, and poaching of endangered species.

There are many examples from Leuser of people being killed as a result of floods caused by destructive logging practices. The most recent occurred in western Aceh in November 2002. This caused several tens of thousands of people from four regencies in western Aceh to evacuate their homes due to devastating flood damage. Roads and main-highway bridges downstream were destroyed, cutting the area off from the rest of Aceh. The damage was estimated at US $11.74 million (Jakarta Post, 28.11.2002). These floods in West Aceh, Nagan Raya,West Aceh Daya, and South Aceh, were all the result of destruction of the adjacent forests in the Leuser Ecosystem, the scale of which had been exacerbated by road networks that had opened up the area for logging operations on mountain slopes.

The effect of logging on the wildlife in Leuser has been well documented through an indicator species (van Schaik *et al*., 2001, Dramatic decline in orang-utan numbers in the Leuser Ecosytem, northern Sumatra, *Oryx* 35: 14-25). The mechanisms causing flash floods in Leuser have also been documented (Robertson & Soetrisno, 1982, Logging on slopes kills, *Oryx* 16: 229-230).

All the proposed roads lead to habitat fragmentation that is one of the primary threats to the viability of endangered species in Leuser. None of the EIA's prepared for three of the nine roads took Population Viability and Habitat Analysis (PVHA) of endangered species of flora and fauna into account. These would give an indication of whether populations of key indicator endangered species will go extinct as a result of the proposed project.

6. Political support for Ladia Galaska

The main supporters of the Ladia Galaska road network through the Leuser Ecosystem are the current Governor of Aceh, and several regents (*Bupati's*) and heads of District Peoples' House of Representives (*DPRD*), especially those for South-east Aceh, Gayo Lues, Central Aceh, and Nagan Raya – all indigenous people. These officials argue that Ladia Galaska is a road project to help solve the Aceh problem by decreasing road transportation distances and freeing remote villages from isolation, thereby allowing poor rural areas quicker access to markets and encouraging development. In addition, they have obtained support from the current Minister for Infrastructure Development, Minister of Forestry, Minister for Environment, and Deputy Co-ordinating Minister for Economy who also holds the position of Head of the Team for Ending the Conflict in Aceh.

7. NGO opposition to Ladia Galaska

Many local NGO's are against the road network on the grounds that the road network will contribute no net benefit to solving the Aceh problem, but through massive corruption in Aceh, the wasted investment would result in lost opportunity costs for alternative developments that might have contributed positively to helping the majority of poor people. Instead, these NGO's argue the Ladia Galaska road network mainly benefits contractors and logging tycoons, and will open up Leuser's forests for massive illegal logging operations, that will eventually lead to encroachment, illegal settlements, and finally destruction of the greatest part of Leuser facilitated by the roads.

An economic valuation of the Leuser Ecosystem by Caesar & van Beukering (2001) showed that over a thirty-year period, the total economic benefit from conserving the Leuser Ecosystem was far greater than an alternative policy of logging followed by converting as much as possible to plantations. In addition, the conversion policy only gave short-term benefits to the elite logging groups, whereas local communities gain far more economic benefits if the Ecosystem is conserved in both the short-term and long-term.

The recent approval of the road proposals, however, show that it is no longer a technical issue, but purely a political issue.

Declarations by religious leaders and informal traditional customary leaders, as well as community groups, have been made in many districts around the Leuser Ecosystem in both Aceh and North Sumatra. These formal declarations have called for the Leuser Ecosystem to be conserved for the welfare of local communities and the benefit of mankind. They reconfirm the original calls of the traditional leaders of Aceh who lobbied the colonial government for their sacred forests to be protected at a customary meeting (*musyawarah*) in Tapaktuan, South Aceh, in 1928. *Leuser* in the ancient Gayo myth means 'veiled in clouds', and represents the link between heaven and earth.

An alliance of local NGO's has been campaigning against Ladia Galaska. In the forefront had been SKEPHI (the Indonesian NGO's Network for Forest Conservation), AMAN (the Alliance of Traditional Peoples of the Archipelago), and FORPAT. They have been joined by an alliance comprising PBHI (the Indonesian Legal Aid & Human Rights Association), Walhi Eknas (the Indonesian Forum for the Environment, National Executive), Walhi Aceh, Walhi Sumut, Forest Watch Indonesia, Sawit Watch, Forum Komunikasi Pengacara 61 (FKP61 – an Association of Lawyers), KPHKEL Aceh Sumut, Lembaga Advokasi Petani Sumut (LAP), and Forum Komunikasi Petani Karo.

They have been supported by many Indonesian offices of international NGO's like Birdlife International, Conservation International, Fauna & Flora International, Marinelife International, The Nature Conservancy, the Tiger Foundation, Wetlands International, Wildlife Conservation Society and WWF, together with the Sumatran Orangutan Conservation Programme, the Sumatran Orangutan Society, the Orangutan Foundation, and the International Primate Protection League.

8. International donors' group for reconstruction of Aceh

Japan, the United States of America, the World Bank and the European Union initiated a meeting to support the peace agreement in Aceh. The meeting was held in Tokyo on 3rd December 2002, before the scheduled signing of the peace deal on 9th December between the government and GAM. The purpose is to help produce a lasting settlement by agreeing a post-war financial assistance package for the reconstruction of Aceh. During the conflict, hundreds of public buildings were destroyed, including many schools. Over 21 other countries attended the meeting, including Australia, Britain, Canada, Denmark, Germany, Greece, France, Indonesia, Malaysia, the Netherlands, Norway, Philippines, Sweden, and Thailand.

9. What is required to help save the Leuser Ecosystem from destruction

The Ladia Galaska road network will lead to the destruction of the Leuser Ecosystem, but it will not help solve Aceh's problems, most of which relate to corruption, the separatist movement which is based in northern Aceh, north of the Ecosystem, and decades of lack of investment in Aceh. Historically, the Leuser Ecosystem has never been part of the 'Aceh problem', so constructing roads through it will only waste investments by not paying attention to the real needs of the majority of the people of Aceh.

To prevent destruction of the Ecosystem that will result from opening it up with road networks, and to prevent illegal logging in the Ecosystem, requires:

(a) strong pressure to be put on all the donor agencies to make a commitment that they will not contribute to the destruction of Leuser by supporting infrastructure projects that are likely to lead to deforestation or other degradation of the Leuser Ecosystem;
(b) to ensure that the donor group on the rehabilitation of Aceh receives a prior commitment from the provincial government of Aceh and all related local regency governments, that they will not substitute any of their provincial or regency budget resources for projects that are likely to lead to degradation of the Leuser Ecosystem;
(c) that any donor commitment to Aceh is conditional on a prior commitment of the provincial government and all related local governments to strive to conserve the Leuser Ecosystem, including a commitment to eliminate all illegal logging.

Without clause (b) above, the local governments can just **substitute** their own funds. Without clause (c), they might not go ahead with the formal asphalt road proposals, but can still destroy Leuser through logging roads that have the same effect. For instance, despite commitments to the CGI by the national government over the last three years, 14 new logging roads were opened up inside the Mount Leuser National Park in South-east Aceh during 2002.

It is crucial that despite these problems, the donors do not take the easy option and use any pressure on them not to support the reconstruction of Aceh. To prevent this, NGO's should:

(d) encourage the donors to support the rehabilitation of Aceh to help the people of Aceh who have been repressed and traumatised by civil conflict for decades; and

(e) encourage donors to ensure that local governments in Aceh that support sound environmental conservation, and have revised their spatial plans to help support the conservation of the environment, including the Leuser Ecosystem, are not penalised for doing so, but instead are given special support targeted to their needs for sustainable development.

Local governments frequently stress the need to find solutions to help districts that have (theoretically) most of their administrative area under formal protected forest cover (e.g., South-east Aceh, Gayo Lues, and South Aceh each have about 80-85% of their land area under protection forests). Their leaders use this reason to call for the opening up of protected forests for the 'development of their people'. Donors need to consider how to support suitable developments for districts that have revised their spatial plans to support conservation of their forests, including incorporation of the Leuser Ecosystem boundaries in their spatial plans, through incentives for them to follow the laws on forest protection.

10. What you can do to help save the Leuser Ecosystem from destruction

To help stop this destruction of Leuser, you need to:

(a) write letters to any of the sponsors of the Tokyo meeting – Japan, USA, or the World Bank – or any of the other European donor country participants, either via their prime ministers / presidents or Ambassadors; and

(b) send this e-mail on to any other people or NGO's you know who are concerned that their government might be implicitly involved in the destruction of Leuser demanding a declaration from the donor group for Aceh similar to those given in the previous section.

In addition to the donors, letters can be sent to the President of Indonesia, copied to other Indonesian government officials. These are more effective if they stress that destruction of the life-support function of the Leuser Ecosystem resulting from road networks through forest areas leads to floods and droughts, loss of lives, destruction of infrastructure (houses, roads and bridges), and degradation of agricultural productivity, as has recently happened. Biodiversity arguments are countered by local government officials as evidence that the west only cares about monkeys and doesn't care about the welfare of the people. Biodiversity arguments are important for western donor countries, but it is stronger to say they are wasting their investments building roads and bridges downstream in the mainstream development zones if deforestation upstream subsequently results in destruction of their investments.

Letters are more effective if they are short and polite. Any letters copied to Indonesian government officials should take account of the sensitivity of the humanitarian tragedy in Aceh, as well as the government's limited means available due to its prolonged economic crisis and debt burden to creditors. Indonesian foreign debt amounts to over US $70 billion (Jakarta Post, 11th June 2002), while its domestic debt is about US $73 billion (Jakarta Post, 25th June 2002). Indonesia's foreign debt repayments for 2002 amounted to US $8.3 billion ((Jakarta Post, 12th June 2002), which is far more than the country is able to allocate for development spending, including poverty alleviation programmes.

11. List of addresses

a) American Embassy – use your local embassy address, or
United States Embassy Jakarta, Jalan Medan Merdeka No. 5, Jakarta 10110, Indonesia (Fax No. +62-21-34359911), Attn. Ralph L Boyce, Ambassador

b) US*AID*, Indonesia: US Agency for International Development, Jalan Medan Merdeka Selatan No 3, Jakarta 10110, Indonesia (Fax No. +62-21-34359926)

c) Japanese Embassy – use your local embassy address

d) World Bank: Office of the President, World Bank, 1818 H Street NW, Washington, DC 20433, USA (Fax No. +202-522-3031), Attn. James D Wolfson, President

e) World Bank, Indonesia: World Bank Office, Jakarta Stock Exchange Building, Tower 2, 12th Floor, Jalan Jenderal Sudirman Kav. 52-53, Jakarta 12190, Indonesia (Fax No. +62-21-52993111), Attn. Andrew Steer, Country Director

f) World Bank, Washington: The World Bank, Natural Resource Management, Environment Department, 1818 H Street NW, Washington, DC 20433, USA
(Fax No. +202-522-1142), Attn. Kristalina Georgieva, Director

(i) Her Excellency Megawati Soekarnoputri
President of the Republic of Indonesia
Istana Negara, Jl. Medan Merdeka Utara, Jakarta, Indonesia

(ii) Mr. Amien Rais
Chairman
Council of Peoples' Assembly (MPR-RI)
Jl. Jendral Gatot Soebroto No.6, Senayan, Jakarta 10270, Indonesia

(iii) Mr. Akbar Tanjung
Chairman
House of Representatives (DPR-RI)
Jl. Jend. Gatot Subroto No. 6, Senayan Jakarta
Fax: +62-21-5706057

(iv) Mr. Soenarno
Minister of Settlements and Infrastructure
Jl. Pattimura 20, Kebayoran Baru, Jakarta, Indonesia
Fax: +62-21-7260769

(v) Mr. Nabiel Makarim
State Minister for the Environment
Gedung B. Kav. 24, Jl. D.I. Panjaitan, Jakarta, Indonesia
Fax: +62-21-8580087

(vi) Mr. M. Prakosa
Minister of Forestry
Department of Forestry
Gedung Manggala Wanabakti Blok I, Lt. 4
Jl. Jend. Gatot Subroto, Senayan, Jakarta 10270, Indonesia
Fax: +62-21-5700226

(vii) Mr. Kwik Kian Gie
Minister for National Planning and Development
Jl. Taman Suropati No. 2, Jakarta 10310, Indonesia
Fax: +62-21 -314 5374

(viii) Mr. Abdullah Puteh
Governor
Province of Nanggroe Aceh Darussalam
Jl. Nyak Arief, Banda Aceh, Indonesia
Fax: + 62-651-51091

APPENDIX

Estimate of the total number of species in the Leuser Ecosystem Region

TDS = Total Described Species on Earth = 1,392,485
LER = Species Recorded in Leuser Ecosystem Region
Est. = estimate

No. Species of Birds:	380 LER / 9040 TDS	= 4.2%
No. Species Mammals:	129 LER / 4000 TDS	= 3.2%
No. Species Reptiles And Amphibians:	95 LER / (6300+4184) TDS	= 0.9%
No. Species Plants:	est. 4500 LER / 248428 TDS	= 1.8%

Conservative estimate of Number Described Species in LER = 1.8% TDS

= 1,392,485 TDS x 1.8% = **25,065**

Estimated Total Species on Earth (Described + Undescribed): 3 – 70 Million

Conservative estimate of Total Species existing in LER:

= 2 x 2 x 25,065 = **> 100,000**

Assumptions:

1. LER includes an anticipated 100 km stretch of marine environment up to 12 km off the west coast adjacent to the Singkil-Trumon Swamp and Kluet Swamp, from Singkil to Kluet, and the Kuala Tripa-Kuala Batee Swamp, as well as a small stretch of marine environment off the east-coast mangrove forests, also anticipated to be included as an annex to the LE. Such areas to be promoted as conservation reserves, allowing sustainable harvesting by local communities, but preventing species extinctions. Whether included in formal conservation areas or not, these species exist now.

2. Number of recorded species of reptiles, amphibians and plants in Leuser is grossly underestimated compared to birds and mammals due to very low relative field identification effort. Thus, using the overall average figure of 1.8% for plants is a conservatively low figure.

3. Figures for recorded species in Leuser given in: Rijksen, H.D. & Griffiths, M (1995), *Leuser Development Programme Master Plan*, IBN-DLD (Institute for Forestry & Nature Research), Wageningen; Nico J. van Strien for mammals, and Jan Wind for birds, in: van Schaik, C.P. & Jatna Supriatna (1996), eds., *Leuser: A Sumatran Sanctury*, Yayasan Bina Sains Hayati Indonesia, Depok; and LMU records.

4. Figures for described species on earth given in: E.O. Wilson (1988), ed., *Biodiversity*, Washington, DC, National Academy Press. Figures for total described and undescribed species on earth are given in: Kormondy, E.J. (1996), *Concepts of Ecology*, Prentice Hall, NJ.

5. LER covers an extremely wide range of habitats, including marine, coastal, rivers, lakes, mangroves, swamps, lowland forest, hill forest, sub-montane forests, montane forests, volcanic plateaus, volcanic scree and alpine meadows up 3,450 m altitude between 2°-5° N latitude. Any phylogenetic taxa under-represented are assumed to be compensated by other taxa that are over-represented.

6. The lowest estimate for the total number of described and undescribed species on earth, 3 million, gives a minimum multiplier factor of 'x 2' (being 3,000,000 / 1,392,485 = 2.15).

7. The tropical rain-forest areas are known to harbour more than half the species of the entire biota of the world (Kormondy, E.J. (1996), *Concepts of Ecology*, Prentice Hall, NJ). Thus, an additional multiplier factor of 'x 2' represents a conservatively low absolute minimum adjustment required. This is in keeping with field evidence whereby new taxonomic field surveys in Leuser usually always discover new species, and Leuser's status as a biodiversity hotspot.

8. The real number of species in the Leuser Ecosystem Region could still be far higher.