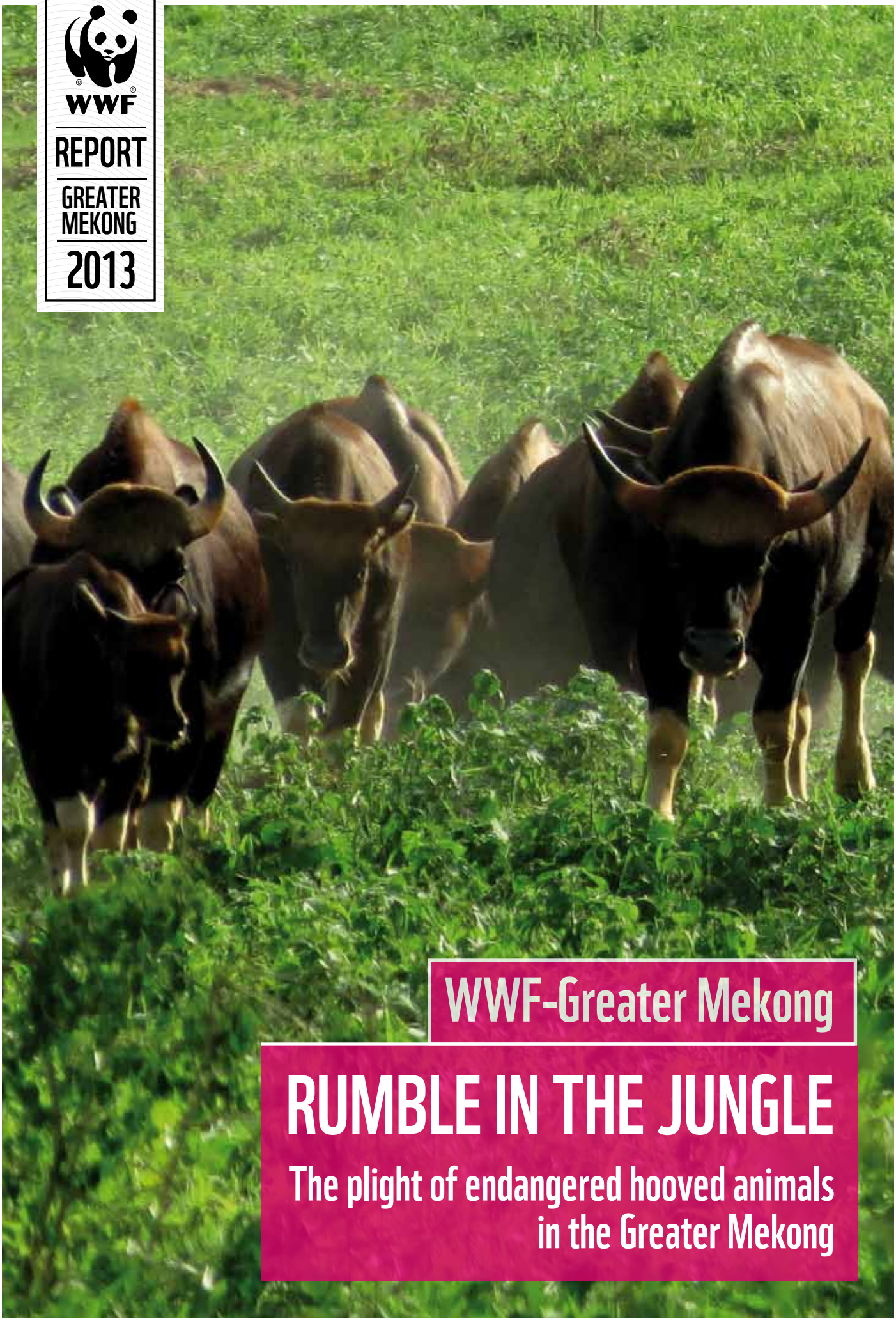
WWF

REPORT

GREATER MEKONG

2013



WWF-Greater Mekong

RUMBLE IN THE JUNGLE

The plight of endangered hooved animals in the Greater Mekong

Acknowledgements

The author wishes to thank the following for their kind assistance:

Stuart Chapman, WWF-Greater Mekong
Thomas Gray, WWF-Greater Mekong
Sarah Bladen, WWF-Greater Mekong
Nick Cox, WWF-Greater Mekong
Ana Denman, Global Wildlife Conservation
Will Duckworth, IUCN
Martha Hurley, Global Wildlife Conservation
Bill McShea, Smithsonian Institute
Bill Robichaud, Coordinator, IUCN Saola Working Group
Wes Sechrest, Global Wildlife Conservation
Rob Steinmetz, WWF-Greater Mekong
Rob Timmins, IUCN Saola Working Group

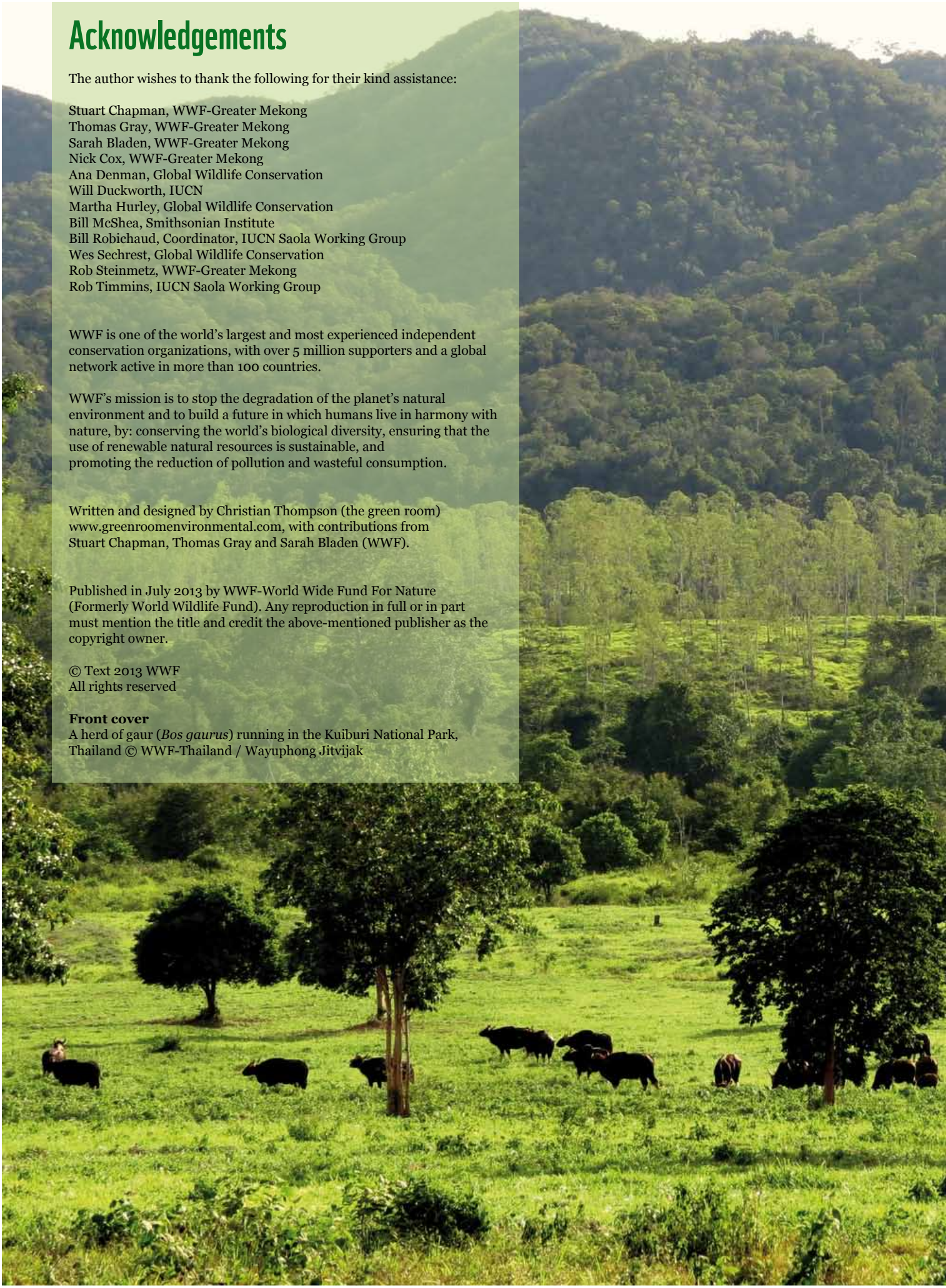
WWF is one of the world's largest and most experienced independent conservation organizations, with over 5 million supporters and a global network active in more than 100 countries.

WWF's mission is to stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature, by: conserving the world's biological diversity, ensuring that the use of renewable natural resources is sustainable, and promoting the reduction of pollution and wasteful consumption.

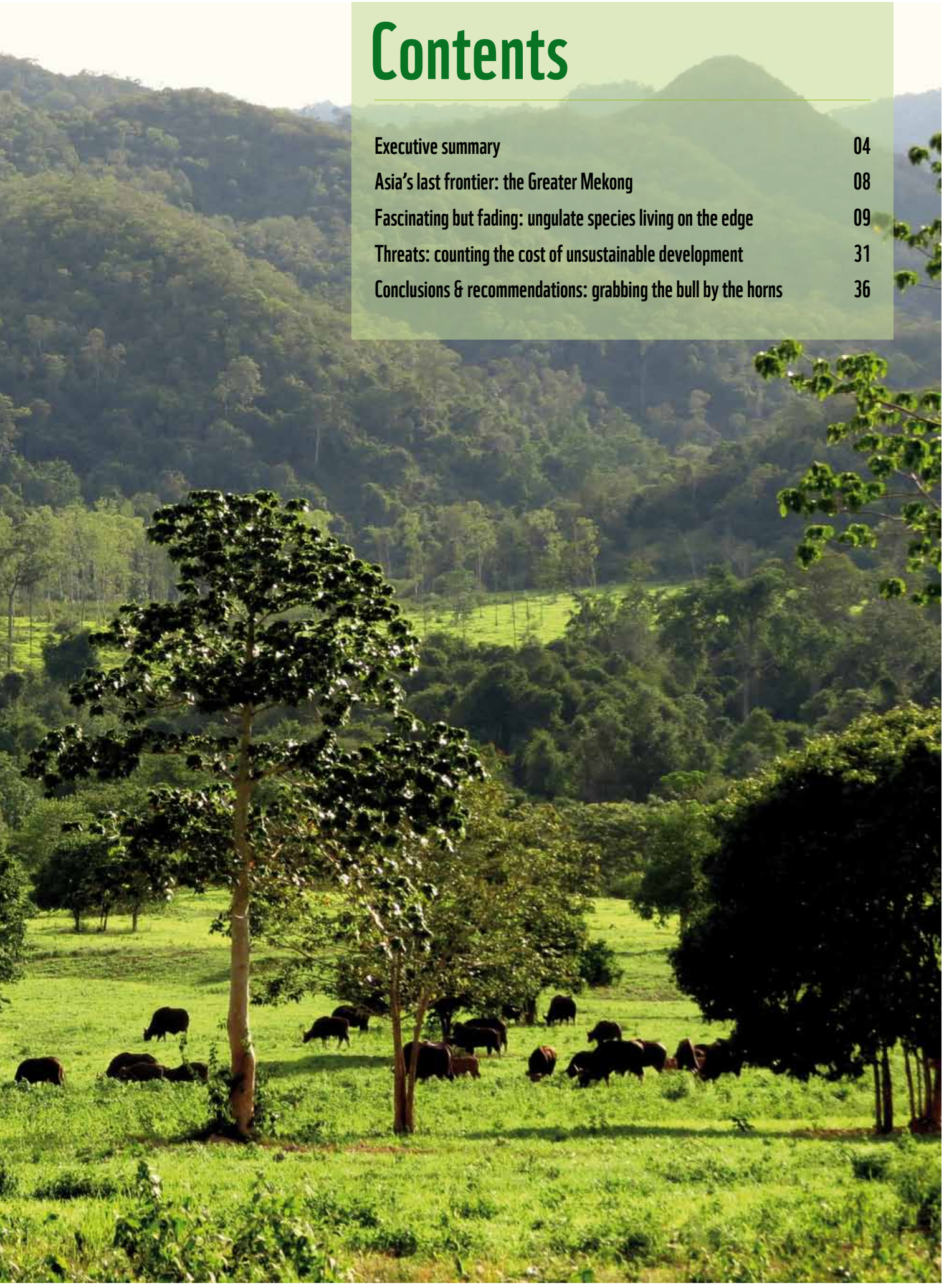
Written and designed by Christian Thompson (the green room) www.greenroomenvironmental.com, with contributions from Stuart Chapman, Thomas Gray and Sarah Bladen (WWF).

Published in July 2013 by WWF-World Wide Fund For Nature (Formerly World Wildlife Fund). Any reproduction in full or in part must mention the title and credit the above-mentioned publisher as the copyright owner.

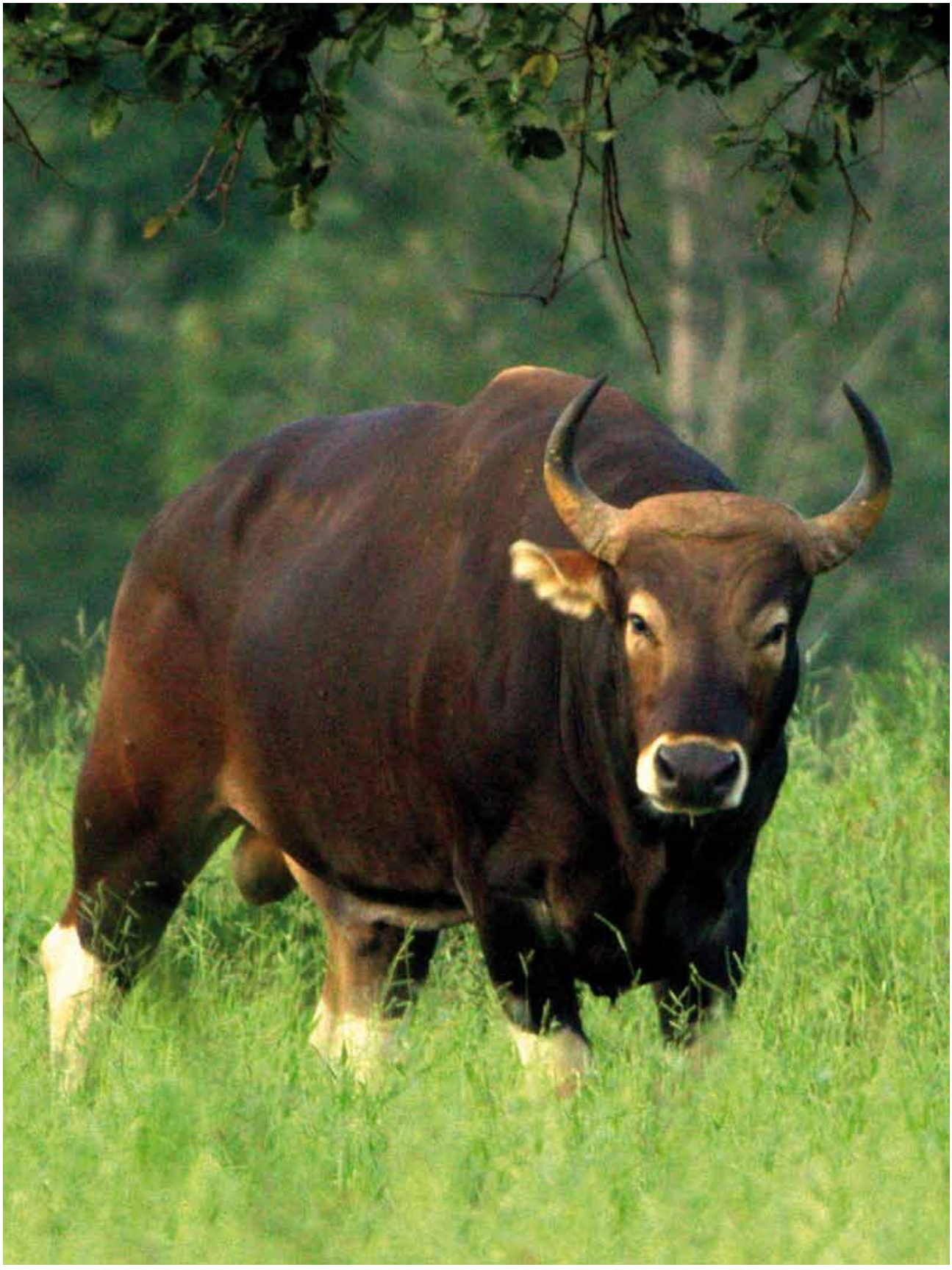
Front cover
A herd of gaur (*Bos gaurus*) running in the Kuiburi National Park, Thailand © WWF-Thailand / Wayuphong Jitvijak



Contents



Herd of gaur in restored grassland in Kuiburi National Park, Thailand



Banteng *(Bos javanicus)*

EXECUTIVE SUMMARY

Two ungulate species endemic[I] to the Greater Mekong, the kouprey *(Bos sauveli)* and Schomburgk's deer *(Rucervus schomburgki)*, became globally extinct in the 20th Century[1,2]. The hog deer *(Hyelaphus porcinus)* and saola *(Pseudoryx nghetinhensis)* are on the edge of disappearing from the region[3,4], while a number of species are extinct or about to go extinct in many of the countries they once inhabited, including Eld's deer *(Rucervus eldii)*[5] and banteng *(Bos javanicus)*[6].

TWO UNIQUE SPECIES ENDEMIC TO THE GREATER MEKONG BECAME GLOBALLY EXTINCT IN THE 20TH CENTURY

The world's most extraordinary ungulate ("being hoofed" or "hoofed animal") species can be found in the Greater Mekong region of Southeast Asia, spanning Cambodia, Laos, Myanmar, Thailand, Vietnam and Yunnan province and Guangxi Zhuang Autonomous Region in southern China. More unique ungulate species inhabit this unique part of the world, symbolised by the mighty Mekong River, than anywhere else on Earth.

Little is known about many of the region's hooved mammals; the saola for example was only discovered in the early 1990s and has been hailed by scientists as one of the most significant new mammal finds of the last 70 years. The ungulates of concern vary in species and status: from 'dog-sized' deer to culturally significant cattle; from large antlered species to others so seldom seen that they have taken on mythical status. What is known, is that their futures are uncertain.

Many of the ungulate species are endangered. Living amongst the new emerging economic powers of Asia, a combination of human pressures: hunting and international wildlife trade, habitat destruction, particularly deforestation and degradation, and infrastructure development, is quickly eroding populations of these extraordinary species.

The clock is ticking. Between 1973 and 2009, the Greater Mekong region lost 42.4 million ha of forest cover – more than 30 percent[7].

Statue of the now extinct kouprey, Phnom Penh, Cambodia

Apart from losing the biological, economic and cultural benefits derived from these species, their further decline would also deal a serious blow to the remaining population of endangered tigers *(Panthera tigris)* that rely on the ungulates as prey species. Because of the same threats, the number of tigers in the Greater Mekong has fallen from 1,200 to 350 since 1998[8].

In addition, ungulates are an important food source and play a vital role in the conservation of three critically endangered vultures in the region.

As ambassadors of the Greater Mekong region, vulnerable to pressure and changes in the environment, the status of the ungulate species is one indicator of the health and ecological integrity of the entire Greater Mekong region. The well-being of these species is therefore closely linked to the sustainable management of the region and to limiting the environmental impacts of increased regional economic activity and integration. Any impact on the ecological balance of the environment also threatens the sustainability of the resources that support millions of people.

[I] Endemic refers to a species that is exclusively native to a specific place and found nowhere else. For example, the kiwi is a bird endemic to New Zealand.

WWF encourages others to join in supporting the Mekong countries to commit to an overarching green economy. Key steps that need to be taken to create these enabling conditions include:

- Prioritizing government investment and spending in areas that stimulate the greening of economic sectors as opposed to depleting our natural capital; and
- Investing in capacity building and training; and
- Establishing sound regulatory frameworks.

In addition, underpinning these regional efforts to encourage and maintain a healthy and sustainable population of the species and those that depend on the ungulates, WWF aims to work closely with governments and key partners to:

- RESTORE focal species populations to forests where they were once abundant;
- RECOVER focal species populations where populations still exist; and
- RECONNECT forest habitat to ensure focal species populations increase. This can be achieved through countries fostering greater sustainable forestry, alternative forest uses and sustainable livelihoods. This will alleviate further pressure on remaining populations of the region's unique ungulates.

Gaur (*Bos gaurus*) photographed in the Mondulkiri Protected Forest, Cambodia

A tributary of the Mekong River flowing through flooded forest, Kratie, Cambodia

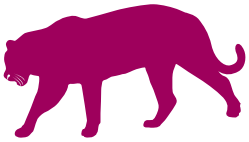
Endangered Asian elephant *(Elephas maximus)* grazing in restored grasslands in Kuiburi National Park, Prachuap Khiri Khan Province, Thailand

Asia's last frontier: the Greater Mekong

The Greater Mekong region of Southeast Asia, through which the Mekong river flows, comprises the countries of Cambodia, Laos, Myanmar, Thailand, Vietnam and Yunnan province and Guangxi Zhuang Autonomous Region in southern China spans 2.6 million square kilometres and is home to more than 300 million people[9].

Together with the region's rich mosaic of cultures, are some of the planet's most endangered and charismatic wild species including tiger *(Panthera tigris)*, Asian elephant *(Elephas maximus)*, saola *(Pseudoryx nghetinhensis)*, freshwater Irrawaddy dolphin *(Orcaella brevirostris)* and Mekong giant catfish *(Pangasianodon gigas)*. In addition, scientists discover hundreds of new species every year - more than 1,710 species since 1997 alone[10,11,12,13,14].

350 ENDANGERED TIGERS



The Greater Mekong is a globally significant tiger land containing the largest combined tiger habitat in the world. Forests of the region (minus Yunnan and Guangxi in southern China) cover 98 million ha, or 43 percent of the total land area[15], and provide a range of important services such as the regulation of fresh water and the capture of globally significant carbon stocks[16]. Of this 540,000km^2 of forest, an area roughly the size of France, are priority landscapes for current tiger conservation efforts[17]. Around 350 wild tigers roam the region today[18]. While this is about a 70 percent decline in tiger numbers in a little over a decade[19], with strong and immediate conservation efforts there is still time to save this iconic species.

2,000+ WILD ELEPHANTS

At the heart of the region, is the Mekong River, the longest river in Southeast Asia, winding its way from the Tibetan Plateau to the Mekong Delta, for 4,800 km through the region's six countries. It is second only to the Amazon River in terms of fish biodiversity. It is estimated 850 species of fish swim the waters of this mighty river[20], including some of the world's largest freshwater species like the Giant freshwater stingray *(Himantura chaophraya)* weighing up to 600kg - the world's largest freshwater fish[21] – and the Mekong giant catfish weighing up to 350kg - the third largest freshwater fish on the planet[22].

Among the region's most extraordinary diversity is the Greater Mekong's diverse range of ungulates, many of which are important, rare and endemic species - found only within this particular region of Southeast Asia.

850+ FISH SPECIES

This marks this land as one of the last frontiers for exceptional diversity on our planet and furthers the urgency to place the Greater Mekong region on the map of global conservation priorities. The region is an integral part of one of the top five most threatened biodiversity hotspots in the world today[23].

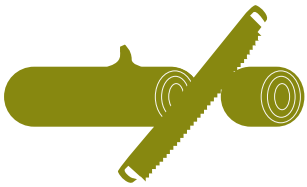
Fascinating but fading: ungulate species living on the edge

The majestic and charismatic ungulates of the Greater Mekong epitomise everything that is unique about this region of Southeast Asia.

The subsistence, culture, history and beliefs of the many millions of people across the Greater Mekong are intrinsically entwined with these species.

Little is known about many of the magnificent ungulate species here; the saola has been described as the most remarkable large mammal discovery of the 20th Century[24]. The ungulates of concern vary in species and status: from 'dog-sized' deer to culturally significant cattle; from large-antlered species to others so seldom seen that they have taken on mythical status. What is known, is that their futures' are uncertain.

BETWEEN 1973 AND 2009, THE GREATER MEKONG REGION LOST 42.4 MILLION HA OF FOREST COVER - MORE THAN 30 PERCENT



Many of the species are endangered. Living among the new emerging economic powers of Asia, a combination of human pressures: habitat destruction, particularly deforestation and degradation, infrastructure development, hunting and international wildlife trade, is quickly eroding populations of these extraordinary species.

© WWF-Cambodia

Eld's deer (*Rucervus eldii*) photographed in the Mondulkiri Protected Forest, Cambodia

The decreasing species

The Greater Mekong region contains an extraordinary high diversity of muntjacs, with four endemic species to the region including at least two in the highly biodiverse Annamite Mountain Range.

Two ungulate species endemic to the Greater Mekong became extinct in the 20th Century; kouprey and Schomburgk's deer - two species (endemic to the region) globally gone[25,26]. In addition, there is one more (hog deer) very possibly about to disappear from the region[27], with the saola on the brink[28], and a number of species extinct in many of the countries (e.g. Eld's deer in Thailand and Vietnam)[29] or about to go extinct (banteng in Vietnam)[30,II]. Most species are threatened by indiscriminate snaring to supply regional markets for wild meat.

[ii] There is currently a debate within the scientific community that are heavily involved in the conservation of ungulates in the Greater Mekong regarding the correct taxonomy and identification of species (i.e. taxonomic statuses of ungulates are either incorrect or in need of review and revision), and so this section attempts to summarise the best available information at the current time regarding the various species. The IUCN Red List accounts for the relevant species provide the best information.

Countdown to extinction*

Threatened and declining...

1. Leaf muntjac (*Muntiacus putaoensis*)
2. Gaur (*Bos gaurus*)
3. Sambar (*Rusa unicolor*)
4. Annamite muntjac (*Muntiacus truongsonensis*)
5. Large-antlered muntjac (*Muntiacus vuquangensis*)
6. Fea's muntjac (*Muntiacus feae*)

On the very brink...

7. Banteng (*Bos javanicus*)
8. Saola (*Pseudoryx nghetinhensis*)
9. Hog deer (*Hyelaphus porcinus*)
10. Wild water buffalo (*Bubalus arnee*)
11. Eld's deer (*Rucervus eldii*)

Too late to save...

12. Kouprey (*Bos sauveli*)
13. Schomburgk's deer (*Rucervus schomburgki*)

* Note: This list has been generated by WWF based on their conservation priorities and may vary from those of other organisations.

Wild water buffalo (*Bubalus arnee*), an Asian icon

THREATENED AND DECLINING

© Alan Rabinowitz / Panthera

Leaf muntjac

1. Leaf muntjac

(*Muntiacus putaoensis* – Myanmar, China and Northeast India)

A deer that can be wrapped in a single leaf...

The largest mountain range on Earth, the Himalayas - the birthplace of the mighty Mekong and its many tributaries, was the location for a surprisingly small species discovery in 1999[31].

The world's second smallest deer species[32], a miniature muntjac, was first seen by a team of scientists undertaking field surveys in the Himalayan region of northern Myanmar. Hunters call the species a leaf deer because a single large tree leaf can wrap its body.

This species is named after the town of Putao in northern Myanmar, where it was first discovered. Leaf muntjac remains elusive, with sightings of the animal so rare that scientists have not been able to assess its full distribution and status. Locating such a small deer in such a large landscape exemplifies the ongoing difficulties of better understanding it[33].

Since its discovery, the species has also been encountered in the north-east Indian state of Arunachal Pradesh[34].

Name: Leaf muntjac
Scientific name: *Muntiacus putaoensis*
Distribution within Greater Mekong: Western parts of Yunnan, China; Huwkawng Valley, Myanmar
IUCN status: Data Deficient (DD)
Key threats: Hunting

2. Gaur

(*Bos gaurus* - South and Southeast Asia)

A species that has declined 70 percent in number over three decades...

Gaur historically occurred throughout mainland south and Southeast Asia, but is now seriously fragmented within its range. The population decline in parts of the species' range is likely to be well over 70 percent over the last three generations because of key threats especially wild meat hunting and hunting for the trade in horns in Southeast Asia[35].

The species has been known to mass in groups of 20, 40, or even 100 animals, but a typical herd size appears to be in the range of 5–12 animals and herds are rarely larger than 20.

Gaur occur in many forest types in Cambodia, Laos, Thailand and Vietnam. The species is something of a mountain climber occurring in habitats from sea level up to at least 2,800 m above sea level, where they graze on mostly young green grasses but also leaves, fruit, twigs, and bark of various woody species, as well as coarse dry grasses, and bamboo.

Name: Gaur
Scientific name: *Bos gaurus*
Distribution within Greater Mekong: Widespread but now very patchy and restricted to protected areas in Cambodia, Laos, Myanmar, Thailand and, in very small numbers, Vietnam
IUCN status: Vulnerable
Key threats: Habitat loss, hunting and wildlife trade

© WWF Cambodia

Vanishing vultures – The importance of ungulates in the Greater Mekong's food-chain

Ungulates of the region are crucial in the lifecycle as food for the conservation of three critically endangered vultures in the region.

Red-headed *(Sarcogyps calvus)*, slender-billed *(Gyps tenuirostris)* and white-rumped vulture *(Gyps bengalensis)* have declined spectacularly in the Indian subcontinent due to poisoning from the veterinary drug diclofencac. The remnant populations in Myanmar and Cambodia's Eastern Plains Landscape represent the best hopes of the survival of these iconic species.

Globally significant populations of all three species persist in northern and north-eastern Cambodia. These species have undergone dramatic declines of 95-99 percent on the Indian subcontinent due to the poisoning by the livestock-drug diclofenac ingested from animal carcasses. Though this drug appears not in use in Southeast Asia, populations have decreased there as well, almost certainly because of a decrease in food availability due to shrinking wild ungulate populations.

The remaining populations are very small, numbering a few hundred individuals at most. Nesting populations in Cambodia are supported by regular supplemental feedings of domestic cattle carcasses through a joint monitoring effort of WWF, WCS and BirdLife International. Because of the absence of diclofenac, Southeast Asian vulture populations are of critical importance to the global survival of these three species.

Critically Endangered red-headed vulture *(Sarcogyps calvus)*

Working across Asia's 'Cattle Countries' at all levels to achieve lasting conservation results

WWF believes that the survival of the region's threatened ungulates will be ensured by protecting their essential habitat. Our work concentrates on enlarging the geographic scale of ungulate conservation from site-specific intervention to the protection, restoration and sustainable use of the larger habitat in which the species lives, breeds and disperses.

Ecoregions, critical landscapes of global biological and cultural importance, help WWF to define and focus its conservation efforts. We are concentrating on four key landscapes in the Greater Mekong (the Eastern Plains Landscape of Cambodia and Vietnam, the Dawna-Tennaserim Landscape of Thailand and Myanmar, the Central Annamite Landscape of Laos and Vietnam, and the Mekong Flooded Forest Landscape of Laos and Cambodia). These expansive areas overlap with the major corridors of economic acitivity in the region. It is therefore of paramount importance that these crucial environmental, economic and cultural arteries, are developed and maintained in a sustainable way.

By working simultaneously in six countries as one team across these ecosystems, good lasting results are being achieved through a "local to global" approach, where field work undertaken at community-grassroots level, is complemented with policy initiatives at regional and at global levels. It is the goal of WWF to promote the conservation of biodiversity and sustainable management of the Greater Mekong ecoregions for the benefit of local communities and the region as a whole.

Find out more:
www.panda.org/greatermekong

WWF-Laos team using Global Positioning System (GPS) to monitor wildlife and human practices in Xesap National Protected Area

Wild water buffalo

3. Wild water buffalo

(*Bubalus arnee* - South and Southeast Asia)

A once-abundant and well-recognisable Asian icon is now on the brink...

Wild water buffalo are restricted to two populations (Mondulkiri Protected Forest in Cambodia and Huay Kha Khaeng in Thailand).

Think of rural Asia and perhaps images of wild water buffalo aiding farmers with their crops might spring to mind, but now wild version of this magnificently strong beast is, like many other ungulates, facing the abyss of extinction.

This is not an overstatement – fewer than 4,000 exist in the wild today[36]. Unfortunately, wild buffaloes are tied to the availability of water, like small pools and marshes, in addition to permanently flowing rivers like the Mekong and its many tributaries, all of which are equally under threat in the region.

Although the species does enjoy some protection, most of the species' former lowland habitat has been lost to agriculture, and what remains is highly fragmented. However, especially in countries such as Cambodia and Laos, vast tracts of suitable lowland forest (prime buffalo habitat) remain from which the species has long since been hunted out[37].

Name: Wild water buffalo
Scientific name: *Bubalus arnee*
Distribution within Greater Mekong: Small populations in remote areas of Cambodia, Myanmar and Thailand
IUCN status: Endangered
Key threats: Interbreeding with feral and domestic buffalo, hunting, habitat loss and degradation

4. Sambar

(*Rusa unicolor* - South and Southeast Asia)

The favourite prey of tigers and Asiatic lions (and the occasional crocodile), comprising nearly 60 percent of the prey selected by tigers in some parts of Asia Pacific[38] - and, a giant in its class...

Among all living deer species, only the moose and the elk can attain larger sizes than this species. This is what probably what makes them the favourite prey item for tigers and Asiatic lions. In some parts of Asia, the sambar can comprise up to nearly 60 percent of the prey selected by the tiger. Anecdotally, the tiger is said to even mimic the call of the sambar to deceive it while hunting. Crocodiles, mostly the mugger crocodiles *(Crocodylus palustris*; literally "crocodile of the marsh") also can take them.

This species prefers dense forest cover and feed on a wide variety of vegetation, including grasses, foliage, and browse, fruit, and water plants.

Unfortunately, sambar numbers throughout the Mekong region have been severely depressed through hunting for both wild meat and horns. Evidence also suggests populations are very slow to recover and this is severely limiting tiger population recovery across the region.

Name: Sambar
Scientific name: *Rusa unicolor*
Distribution within Greater Mekong: Widespread but numbers severely depressed and very rare in Laos, Cambodia, and Vietnam
IUCN status: Vulnerable
Key threats: Hunting, wildlife trade

Sambar

5. Annamite muntjac

(*Muntiacus truongsonensis* – Laos and Vietnam. Endemic to Mekong region)

"The deer that lives in the deep, thick forest"....

The Annamite muntjac is locally called "sam coi cacoong," which means "The deer that lives in the deep, thick forest". Scientists first recorded this species during a survey of forests in the Annamite range of mountains in Vietnam in April 1997. It is found mostly in wet evergreen forest, with ferns and leaf litter in the dense undergrowth, on higher ridges.

The Annamite muntjac is one of several new species found in the Annamite Mountains and described by scientists only recently. These species had not been identified previously because years of armed conflict, steep and rugged terrain and remoteness, had precluded scientific exploration of this region until recently.

Name: Annamite muntjac
Scientific name: *Muntiacus truongsonensis*
Distribution within Greater Mekong: Vietnam
IUCN status: Data Deficient
Key threats: Hunting from snares. Although hunting is illegal in Vietnam, many people hunt, either for commercial or subsistence purposes

Large-antlered muntjac

6. Large-antlered muntjac

(*Muntiacus vuquangensis* – Laos and Vietnam. Endemic to Mekong region)

Big antlers are no match for the expansion of large dams in the region...

The large-antlered muntjac *(Muntiacus vuquangensis)* or giant muntjac is the largest muntjac species. It was discovered in 1994 in Vu Quang, Ha Tinh province of Vietnam and in central Laos. The species may also live in parts of northeastern Cambodia.

The giant muntjac is found in evergreen forests and weighs about 25-41kg. Due to habitat loss (e.g. from infrastructure projects like large dam development) and hunting, the giant muntjac is considered endangered.

Together with the saola and Annamite muntjac this species is indiscriminately caught in snares set to catch wild pig to satisfy the growing demands for wild meat amongst the burgeoning Vietnamese middle class. Targeted removal of snares, plus demand reduction campaigns, are necessary to prevent these species' global extinctions.

Name: Large-antlered muntjac
Scientific name: *Muntiacus vuquangensis*
Distribution within Greater Mekong: Annamite Mountains of Laos, Vietnam and extreme northern Cambodia
IUCN status: Endangered
Key threats: Hunting, forest loss, infrastructure projects

7. Fea's muntjac

(*Muntiacus feae* - Myanmar and Thailand. Endemic to Mekong region)

A species found in one of the highest priority conservation areas for tigers globally...

The Fea's muntjac or Tenasserim muntjac *(Muntiacus feae)* is a rare species of muntjac native to Myanmar and Thailand. It is diurnal and solitary, inhabiting upland evergreen, mixed or shrub forest (at an altitude of 2500m) with a diet of grasses, low-growing leaves, and tender shoots.

It is named after zoologist Leonardo Fea. Its other name comes from the Tenasserim Hills, between Myanmar and Thailand.

Name: Feas's muntjac
Scientific name: *Muntiacus feae*
Distribution within Greater Mekong: Myanmar and Thailand
IUCN status: Data Deficient
Key threats: Hunting and habitat loss particularly the ongoing and projected conversion of forests to oil palm plantation in southern Myanmar

No ungulates, no food for tigers and other large carnivores

Low densities of sambar, Eld's deer and hog deer throughout Greater Mekong area a major hindrance to tiger conservation and recovery as key prey species.

Conservation of the region's ungulate species is inexplicably linked to the plight of the Greater Mekong's tigers. Tigers prey mainly on medium and large-sized wild ungulates. Sambar (the region's largest deer species), wild pigs, and wild cattle such as banteng and gaur comprise the majority of tiger's diet in the region.

According to recent estimates, which for most of the range are imprecise and potentially inaccurate, there are possibly as few as 350 tigers left in the wild across the Greater Mekong. They have disappeared entirely from some protected areas in the last 10 years and are currently listed as endangered on the IUCN Red List. Tiger are now, tragically, effectively extinct in four of the six Greater Mekong countries (Vietnam, Laos, Cambodia and Southern China). Direct, targeted poaching of tigers is the immediate danger for the species today. However, a serious contributing factor to the plight of the tiger is the widespread decline of its forest larder – the deer, wild pigs and wild cattle.

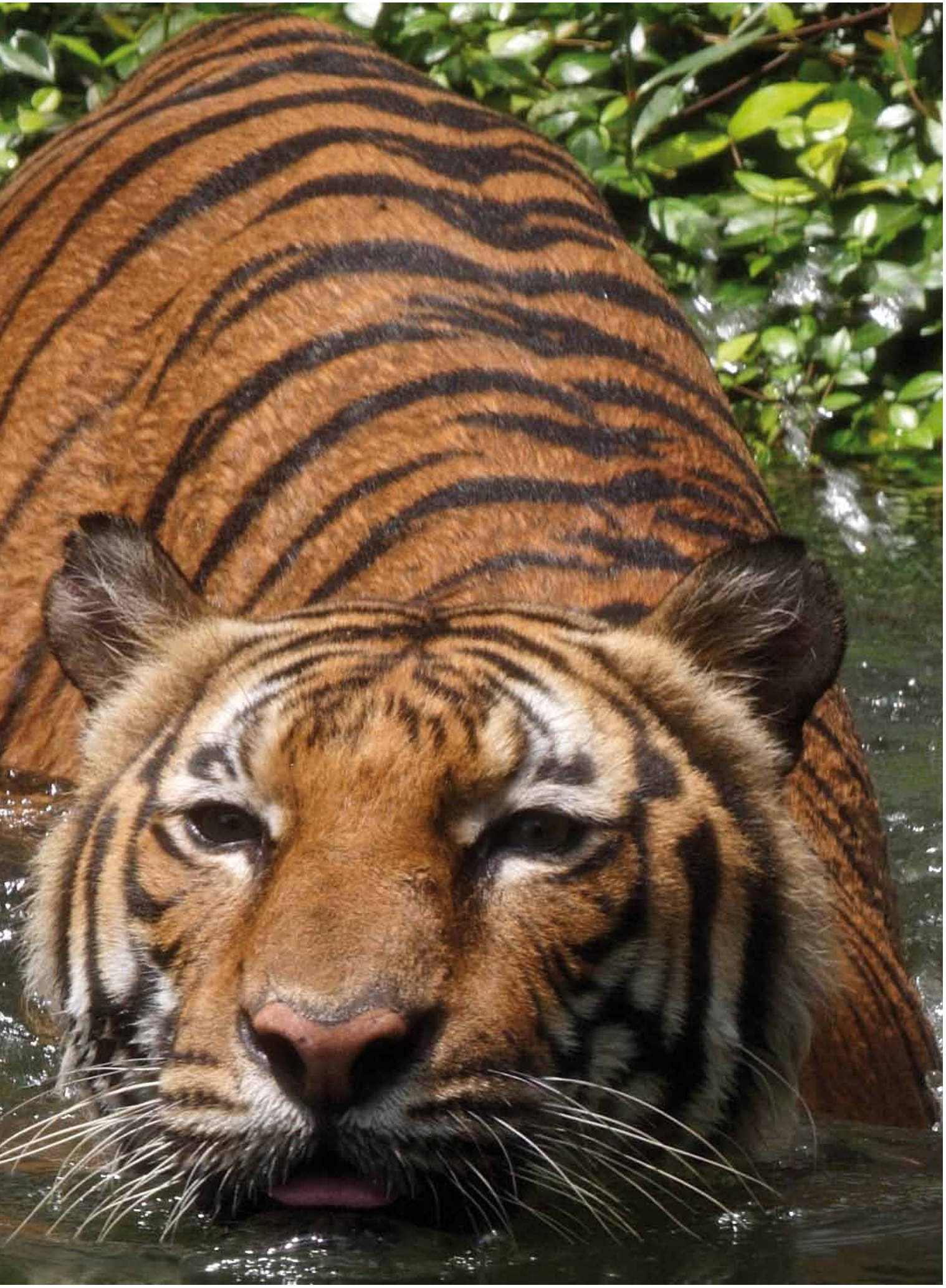
One tiger needs to eat the equivalent of a medium size deer every week to survive and without adequate food, the tiger population declines very fast. Too many forests of Asia are classed as "empty forests" – the trees are there but the animals are gone. Anti-poaching efforts therefore must be targeted at protecting both the tiger and its prey.

Poachers very often focus on tiger prey rather than tigers themselves. Prey animals are sought by local poachers to supply the local food market. Many of these prey species are also highly endangered and often neglected by conservation efforts. Yet, they can also benefit from the extra protection given to the tiger.

WWF is urging governments to raise efforts to work towards Zero Poaching of tiger prey as well as tigers as part of an ambitious campaign to double the number of tigers in the wild across its 13 state range by 2022, the next Chinese Year of the Tiger.

Without protecting the tiger's prey from poaching and forest degradation, achieving the target of doubling wild tiger numbers by 2022 is impossible. The survival of the prey is key to the survival of the tiger.

Find out more: www.panda.org/greatermekong/tigers



The Eastern Plains Landscape: Saving Cambodia's Dry Forests

Just 50 years ago, large herbivores like banteng, Asian elephant, and Eld's deer as well as predators like tiger and leopard were so abundant in the Dry Forests of North and Northeast Cambodia that scientists compared this ecoregion to the savannas of East Africa. In the troubled decades that followed, however, habitat destruction and hunting greatly reduced animal numbers and diversity. Today, the largest intact dry forests in Indochina remain in north-eastern Cambodia in an area known as the Eastern Plains Landscape (EPL).

WWF-Cambodia works in two key protected areas in this landscape, Mondulkiri Protected Forest and Phnom Prich Wildlife Sanctuary. Even in these areas, animal numbers are critically low, especially of large herbivores and their predators. With its largely intact dry forest habitat, the area forms part of the landscape with the highest potential for tiger recovery in Asia. With increased protection effort, there are already many signs of improvement, particularly of leopard, and prey species such as banteng, deer, and wild pig. This leaves hope that, at some point in the future, wildlife in the EPL can be restored to its former glory

WWF has been working in this landscape since 2000 supporting the Royal Cambodian government with protected area management, law enforcement, scientific research, and community outreach activities. Because of these initiatives the population of banteng, and other threatened species including leopard, Eld's deer, and large waterbirds, are recovering from the extensive and unchecked hunting, which occurred throughout the Khmer Rouge period of civil unrest and warfare.

ON THE VERY BRINK

Banteng

8. Banteng

(*Banteng javanicus* - North-east India to Indonesia)

A crisis does not cover it: this species has declined 80 percent in the last 24 years...

Banteng is a globally threatened species of wild cattle restricted to Southeast Asia. The largest global population can be found in the Eastern Plains Landscape as demonstrated by recent WWF research[39].

This species has declined by 80 percent in just three generations, particularly in the Greater Mekong, because of the unrestrained hunting for the bush meat trade in Southeast Asia and international wildlife trade for their horns, as well as habitat loss and degradation.

A once fairly wide distributed species, it is now largely reduced to small isolated populations, most of which are still in decline. Although originally inhabiting a large expanse of Asia from northeast India to Indonesia the species is now extinct in Bangladesh, Brunei Darussalam and India. The Greater Mekong represents one of the last bastions for this species. However, populations in Vietnam and Laos are tiny and likely to be lost within the next 10 years.

Recent research has revealed that the Eastern Plains support the largest global population of banteng with estimates of between 2,000 and 5,000 individuals[40]; likely more than two-thirds of the remaining world population of the species.

Stronger protection, both in the form of increased anti-hunting and poaching patrols and integrated land-use planning to prevent habitat loss within protected areas, is essential for securing wild cattle populations in the Eastern Plains Landscape.

Species: Banteng
Scientific name: *Banteng javanicus*
Distribution within the Greater Mekong: Thailand and Cambodia. Tiny populations remain in Vietnam and Laos
IUCN status: Endangered
Key threats: High levels of illegal trade in Banteng parts (mainly horns), bush meat trade, hunting for the horns, habitat loss and degradation

"A few years ago, the Saola Working Group brainstormed with our partner WWF-Greater Mekong on a concept of privately funded, trained and supervised forest guards, hired from local communities, to patrol the new Hue Saola Nature Reserve in central Vietnam. In 2011, WWF began implementing this innovative model in collaboration with Thua Thien-Hue Province.

The results were remarkable.

In less than two years, forest guards collected and destroyed a total of 26,651 snares from saola habitat - that's 26,651 fewer chances of a saola dying. Not only are the forest guards successful at removing snares, but also at keeping them out of the forest, This is the most concrete, on-the-ground result for saola conservation since the species' scientific discovery 20 years ago."

- William Robichaud
Coordinator,
IUCN Saola Working Group

9. Saola

(*Pseudoryx nghetinhensis* – Vietnam and Laos. Endemic to Mekong region)

This species has taken on mythical status. So elusive in fact that it has been named the "Asian unicorn"...

This species occurs only in the Annamite Mountains of Vietnam and the Laos and has never been seen in the wild by scientists. What little is known of the species, status, ecology and threats comes from ethnic villagers across the species' range and rare camera-trap photographs. The species' discovery in the early 1990s has been hailed as one of the most significant new mammal finds in the last 70 years.

However, the saola has been severely under-represented in conservation funding, planning, and action.

Few mammals in the world share saola's combination of three attributes:
1.Phylogenetic distinctiveness: it is the only species in its genus and it is likely to merit its own subfamily within the wild cattle;
2.Degree of endangerment: not only is saola critically endangered but there are none in captivity anywhere in the world, and;
3.Paucity of conservation attention: saola is far more threatened than many other large mammals in Asia which receive substantially greater attention and funding.

The main threat to saola, as for large-antlered and Annamite muntjac, is illegal hunting. Saola are caught in wire snares set by hunters to catch other animals, such as sambar, muntjac and civets, which are largely destined for the lucrative wildlife trade, driven by traditional medicine demand in China and restaurant and food markets in Vietnam and Laos. Whilst present in a number of protected areas at no sites are saola populations secure from hunting.

Threats from hunting are exacerbated by other factors including loss of habitat. The new Ho Chi Minh Road through the Annamite Mountains in Vietnam, (with additional roads branching to Laos) is a major threat.

The species has never been seen in the wild.

Name: Saola
Scientific name: *Pseudoryx nghetinhensis*
Distribution within Greater Mekong: Annamite Mountains of Vietnam and Laos.
IUCN status: Critically Endangered
Key threats: Hunting and habitat loss

© Ban Vangban village / WCS / W. Robichaud

One of the only photos of a saola in the wild. Photo taken by cameratrap in 1999

CarBi: WWF's largest and most ambitious project in the Greater Mekong region

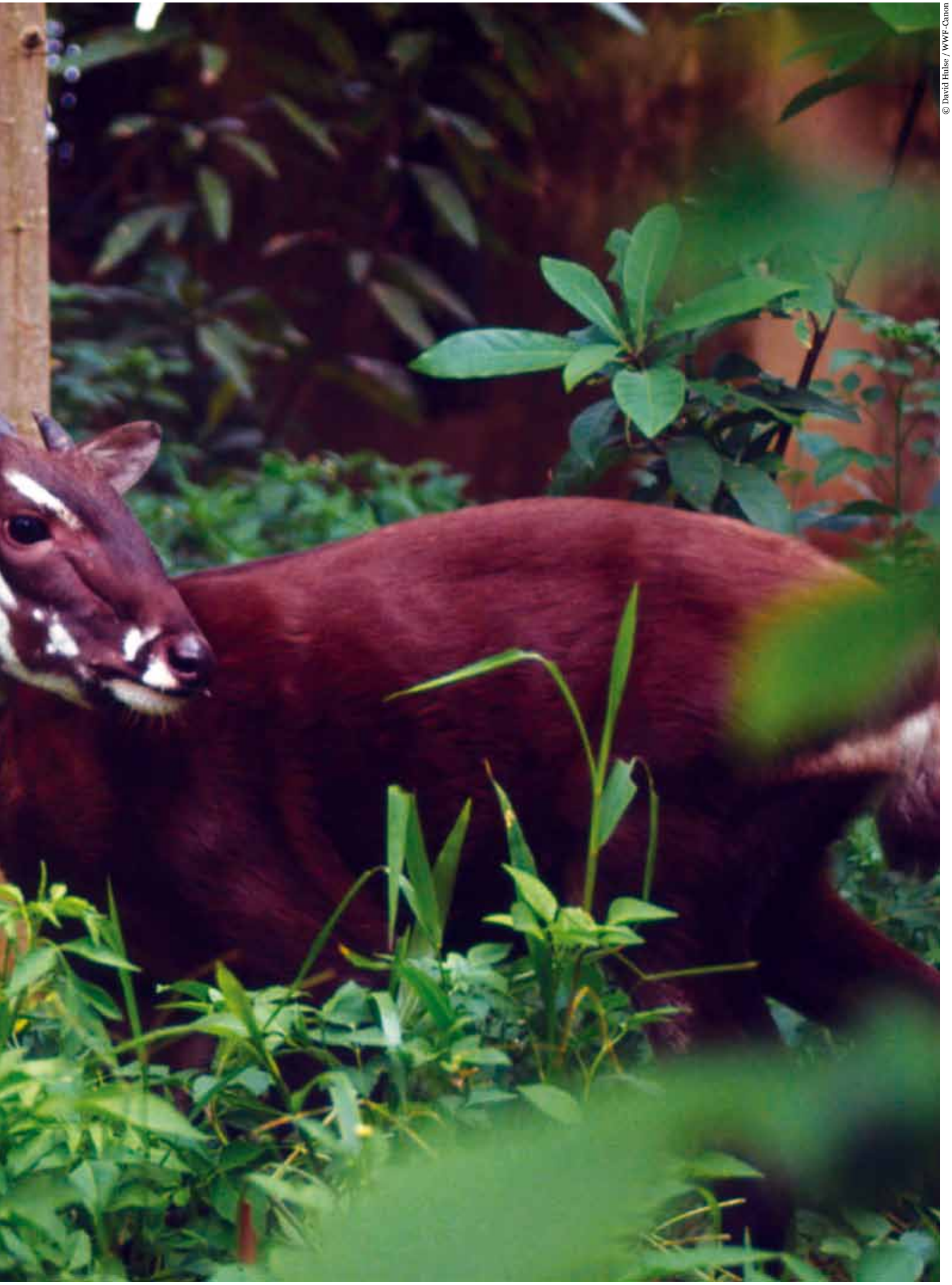
The Greater Annamites are dominated by a mountain range lying to the east of the Mekong River and which stretches along the border of Vietnam and Laos, with its most south-western outliners extending into the northeast of Cambodia. The region is a globally unique place; since 1992 alone, four new large mammals have been discovered which are found nowhere else in the world: saola, large-antlered muntjac, Annamite striped rabbit, and grey-shanked douc.

The 'Carbon and Biodiversity' (CarBi) project of WWF is currently undertaking protection activities in some of the priority sites for Annamite endemic species in the Central Vietnam and Southern Laos. Aimed at halting deforestation, through forest protection and sustainable use of forest resources, and preserving the unique species diversity, the new project covers an area of more than 200,000 ha of forest that links Laos and Vietnam.

A key aspect of the project focuses on the removal of snares, recognising that indiscriminate snaring is driving the unique, and threatened, ungulates of the region to extinction. At three sites in Thua Thien Hue and Quang Nam Provinces (Bach Ma National Park, Hue Saola Reserve and Quang Nam Saola Reserve), WWF is training and funding National Park and Forest Protection Department rangers and local community members to conduct more targeted enforcement and over 14,000 snares are being removed annually. It is believed that this is just the tip of the iceberg .

While the new CarBi project is important for species and forest conservation, it will also enhance the income of the area's culturally diverse people who also depend on forests for their livelihoods.
The project area, equivalent to the size of more than 280,000 football pitches, is important in the fight against global climate change as the forests remove carbon dioxide (CO_2) from the atmosphere – also known as a carbon sink – and our aim is for this project to reduce global emissions by an estimated 1.8million tonnes of CO_2.
WWF will work with partners, including local communities in the region to help rehabilitate, restore and protect the forest, including four protected areas, with two connecting corridors that will allow species to move between the areas. These protected areas provide unique habitat for some of Asia's most charismatic and rare species, including many only recently discovered by scientists, such as saola.

Find out more: www.panda.org/greatermekong/carbi



The discovery of the saola in 1993 has been hailed as one of the most significant new mammal finds in the last 70 years

10. Hog Deer

(*Hyelaphus porcinus* – South and Southeast Asia)

An endangered deer that thinks it is a pig...

The hog deer gets its name from the hog-like manner in which it runs through the forests with its head hung low so that it can duck under obstacles instead of leaping over them like most other deer. Although still relatively abundant in a few well-protected tiger reserves in India and Nepal hog deer is one of the most threatened and poorly known ungulates in Southeast Asia. Known populations of wild hog deer are restricted to tiny fragments of heavily disturbed lowland alluvial grasslands in Cambodia and Myanmar. The species is extinct in Vietnam, Laos, Thailand and probably Pakistan and Bhutan.

The species' preferred habitat is one of the first areas to be cleared for agriculture and alluvial grasslands are the most threatened habitat type across Asia. Mortality from domestic dogs is also a major issue particularly given the tiny, and highly fragmented, populations.

Name: Hog deer
Scientific name: *Hyelaphus porcinus*
Distribution within Greater Mekong: Tiny wild populations in Myanmar and Cambodia
IUCN status: Endangered
Key threats: Habitat loss and hunting

Hog deer

Hog deer

11. Eld'd Deer

(*Rucervus eldii* – North-east India, mainland Southeast Asia and Hainan)

A hunter's favourite...

In Cambodia, Laos and Vietnam, Eld's deer was hunted for the traditional medicinal trade and to meet demand for captive animals. In addition, the species' preferred lowland deciduous dipterocarp forest has been degraded (deforested) to meet agriculture and infrastructural developments.

They are hunters' favourite game – because of their impressive antlers and hides that are in demand in the local markets. They are widely hunted for food and were believed to have been hunted to feed armies during many Asian wars. Their population has declined due to intense development activities necessitating reclamation of land for grazing, cultivation and fish farming, in all countries. In Myanmar, deforestation of the dipterocarp forests is cited as a reason for the threat faced by the species.

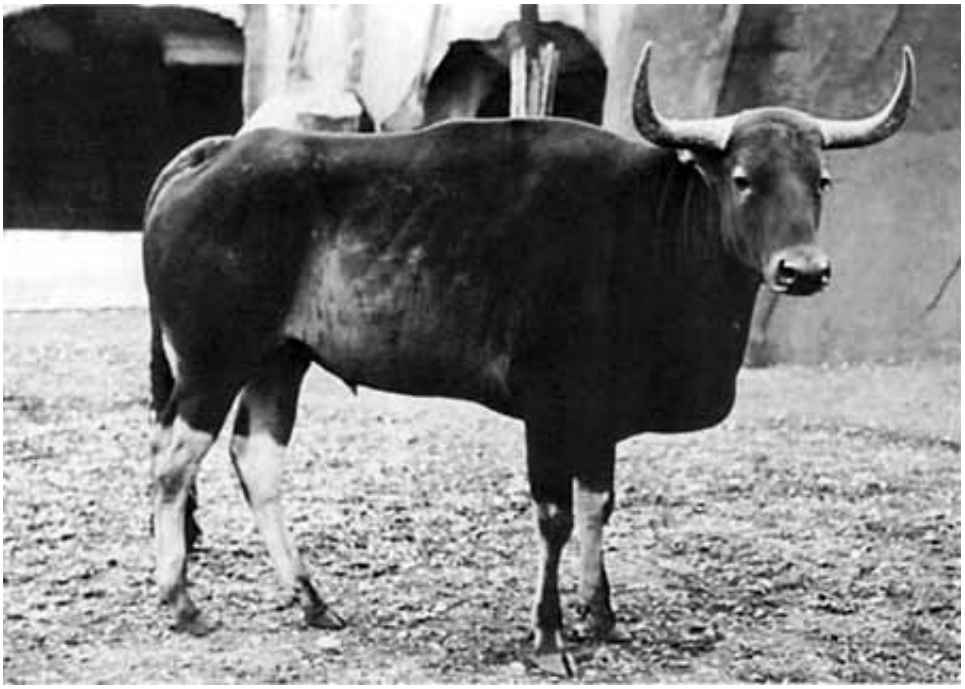
Together with banteng the Eld's deer is a characteristic species of the lowland deciduous dipterocarp forests of Cambodia's Eastern Plains Landscape. WWF support to government protected area management activities within two protected areas, Mondulkiri Protected Forest and Phnom Prich Wildlife Sanctuary (which together support a significant population of at least 50 individuals) has been instrumental in securing the future of this species.

Name: Eld's deer
Scientific name: *Rucervus eldii*
Distribution within Greater Mekong: Small and fragmented populations in lowland Myanmar, Cambodia and one site in Laos
IUCN status: Endangered
Key threats: Hunting

© WWF-Cambodia

Eld's deer

TOO LATE TO SAVE



© Georges Broihanne

Kouprey

"Populations of many large mammal species are declining throughout the Mekong region. For example, in 2011, WWF and the International Rhino Foundation confirmed the extinction of the Javan rhinoceros (Rhinoceros sondaicus annamiticus) after the last remaining individual was shot and its horn removed. This extinction is a sad example of the broader extinction crisis facing the Greater Mekong region."

– Dr Thomas Gray, Wildlife Biologist and Head of Species Programme, WWF-Greater Mekong

12. Kouprey

(*Bos sauveli* - Cambodia and adjacent areas of lowland Vietnam, Laos, and Thailand. Endemic to Mekong region)

An omen of things to come...?

Hunting for both subsistence and for trade (horns and skulls), has been the major contribution to the downfall of this species. Sadly, the only confirmed sightings of a kouprey in recent years has been old skulls and horns offered for sale in local markets - at very high prices. The wars in Indochina contributed to the decimation of the kouprey population and the species' global extinction is a conservation tragedy.

The kouprey was a wild forest-dwelling ox with a tall narrow body, either grey, dark brown, or black in colour restricted to open deciduous dipterocarp forest in Cambodia, Thailand, Laos and Vietnam. The species' preference for open forest, together with the overlap of its restricted range with one of the most turbulent areas in the world during the mid 20th century, facilitated hunting. The only significant scientific observation of the kouprey was made in 1957 when zoologist Charles Wharton studied and filmed the animal in the wild. No such studies can ever be made again and the IUCN[III] and leading NGOs like Global Wildlife Conservation[IV] and WWF believe it likely that the kouprey is now extinct[41,42,43].

Name: Kouprey
Scientific name: *Bos sauveli*
Status: Critically endangered likely extinct
Distribution within Greater Mekong: Nowhere

[III] International Union for Conservation of Nature (IUCN). www.iucn.org
[IV] Global Wildlife Conservation (GWC). www.globalwildlife.org

13. Schomburgk's deer

(*Rucervus schomburgki* – Thailand. Endemic to Mekong region)

The first, and hopefully the last, deer extinction in the region...

The wild population of Schomburgk's deer died out around 1932, with the last captive individual killed in 1938. The species is considered a single-country endemic, to Thailand, where it is certainly extinct.

The species inhabited seasonally inundated swampy plains with long grass, cane, and shrubs; it apparently avoided forest[44]. These habitat preferences strongly match those of hog deer and the fate of Schomburgk's deer is a poignant remainder of the perilous conservation state of the former species.

Commercial production of rice for export began in the late 19th Century in Thailand's central plains, leading to the loss of nearly all the grassland and swamp areas that this deer depended on, and greatly fragmented what remained. Intensive hunting pressure at the turn of the 19th–20th Century restricted the species further and it disappeared in the 1930s. During the wet season, animals marooned on higher ground were hunted readily with spears from boats[45], no doubt hastening the species' decline.

The extinction of two large mammals from a continental region is unprecedented in the 20th Century. This highlights the need for conservation action now to prevent the remainder of unique and globally significant ungulate species, from disappearing from both the Greater Mekong, and the planet, forever.

Name: Schomburgk's deer
Scientific name: *Rucervus schomburgki*
Status: Extinct
Distribution within Greater Mekong: Nowhere

Schomburgk's deer

The Dawna Tenasserim Landscape: A priority conservation area for tigers globally

Located on the Thai-Myanmar border the mountainous Dawna Tenasserim landscape spans more than 58,000km², and is one of the highest priority conservation areas for tigers globally, on a par with sites in India and Siberia and one of the most significant biodiversity areas in Southeast Asia. This vast wilderness landscape comprises a continuous block of forest straddling Western Thailand and eastern Myanmar. Huay Kha Khaeng Wildlife Sanctuary, in the heart of the complex, contains very large tracts of grassland, bush land, deciduous dipterocarp forest and semi-evergreen forest patches: fine tiger habitat.

Within the vast wilderness of the Dawna Tenasserim Landscape lies Thailand's world-class Western Forest Complex (WEFCOM), comprising an integrated group of more than 18 national parks and wildlife sanctuaries, several of which form a World Heritage Site. The Western Forest Complex has the largest population of tigers in Thailand, and probably in all Southeast Asia. It is believed to be one of the Greater Mekong's best chances to recover tiger numbers. Recent WWF led camera trapping from the Mae Wong-Khlong Lan National Park complex has demonstrated tiger breeding and dispersal from the adjacent source breeding population in Huay Kha Khaeng.

Based on an extrapolation from one area surveyed, the Western Forest Complex could support as many as 2,000 tigers if its remaining habitats are maintained, and anti-poaching efforts are increased!

WWF has supported conservation efforts in the Western Forest Complex for over 25 years and is a member of the Western Forest Complex Conservation Committee. This multi-stakeholder planning body is the first of its kind in Southeast Asia. It is designed to coordinate conservation planning across a large landscape with inputs from government and civil society bodies. WWF efforts within this region focus on the direct involvement of local people and institutions in conservation related activities, and include participatory approaches to tiger and elephant conservation, biological monitoring, habitat restoration, law enforcement, awareness-raising; and maintaining landscape connectivity.

The region is also globally important for Asian Elephant conservation, and shelters one of the few remaining breeding populations of the endangered Siamese crocodile. Among the many other notable species occurring here are: Asian tapir, Asiatic black bear, sun bear, gaur, rufous-necked hornbill and wild water buffalo.

Threats: counting the cost of unsustainable development

© WWF-Cambodia

Signs of life, but for how long?

As the economies of the Greater Mekong have grown, ungulate populations have declined. Throughout their range ungulates are threatened either directly by poaching from hunters, an international trade in wildlife, or from habitat destruction and fragmentation. This has resulted in a region-wide collapse in ungulate species numbers. Many range countries lack the capacity and resources to assess ungulate populations and monitor their distribution over time and space; neither are they able to effectively enforce laws prohibiting poaching and trade. Policies to ensure the long-term survival of ungulates are often lacking- and where they do exist, implementation is often weak.

A region-wide problem

Booming economic development and per-capita consumption across the Asia-Pacific region is burning up more natural resources than are available, placing enormous pressure on the region's already heavily taxed forests, rivers and oceans.

A new report used the Living Planet Index (LPI) to measure changes in the health of ecosystems across the Asia-Pacific region. The global index fell by 28 percent from 1970 and 2008, while the Indo-Pacific region saw a shocking 64 percent decline in key populations of species over the same period[46].

In the Greater Mekong Subregion, economic development will jeopardise the connectivity between the biodiversity hotspots in the region. The region's diverse species and habitats are hanging in a fragile balance. The plight of the wild tiger who's numbers have dropped by a dramatic 70 percent in a little over a decade[47], and the local extinction of the Javan rhino in Vietnam during 2010[48] are urgent reminders that biodiversity is still being lost at an alarming rate from man-made pressures. The global extinction in the 20th Century of two large ungulates endemic to the region also highlights the fragility of the Mekong's endemic species and, without action, predicts the future trajectories of such unique and fascinating species as saola and banteng.

Rapid unsustainable development and climate change impacts are profoundly affecting biodiversity and ecosystem services and consequently the millions of people who depend on them. The Greater Mekong is warming and experiencing more extreme floods, droughts and storms because of shifting rainfall patterns. These changes are exacerbating non-climate pressures such as agricultural expansion and unsustainable infrastructure on natural ecosystems and the services they provide.

Today the Greater Mekong regions ranks as one of the top five most threatened biodiversity hotspots in the world[49].

The central importance of the region's shared natural resources cannot be overstated. The economic and social development of the Greater Mekong depends on the continued productivity of its inter-connected ecological systems. This ecological productivity, and hence the prosperity of the Greater Mekong, depend upon intact, healthy and diverse natural ecosystems, which provide resilience to the increasingly evident impacts of climate change, while ensuring continued access to water, energy, food, export commodities, and livelihoods for over 300 million people[50].

All roads lead to China's unsustainable development

China has the largest footprint of all the countries of Asia and the Pacific. China and India are likely to experience the greatest increase in overall Ecological Footprint by 2015, representing 37 percent of the projected global footprint[51].

The country is having a profound effect on the forests of the Asia Pacific, not least those in the Greater Mekong region. Virtually all of the region's timber is exported to China, with volumes increasing rapidly from Myanmar, Cambodia, Laos and Vietnam year-on-year.

According to the latest WWF report *Ecosystems in the Greater Mekong: past trends, current status, possible futures*, the Greater Mekong countries have lost 42.4 million hectares of forest, 30 percent of forest cover, between 1973-2009[52]. On a global scale, the ever-dwindling forests of the region are among the highly-biodiverse tropical rainforests that remain on earth.

Like 'a bull in a China shop', with no significant responsible green procurement taking place by either central or local government departments or industry in China, the country's insatiable and damaging appetite for wood threatens the long –term future of the Greater Mekong's forests, already vastly reduced from 1970s levels.

For forest-dwelling species like ungulates, the loss of habitat further exacerbates the other key threats to the species like poaching. Successful WWF-supported initiatives like the Forest Stewardship Scheme (FSC), Global Forest & Trade Network (GFTN), Roundtable on Sustainable Palm Oil (RSPO) and others, provide a sound basis in areas of forestry and agriculture for countries moving towards green economic development.

Logging operation in Laos. China imports most of the timber produced in the Greater Mekong region

"Across the Asia-Pacific region, the gap between human demand for natural resources and the environment's ability to replenish those resources is widening. In 2008, the natural resources available per person, in places as diverse as the Mekong river basin, shrunk by about two thirds compared to 1970. The rate of species loss was about twice the global average over this period."

- Jim Leape, WWF's Director General

Poaching

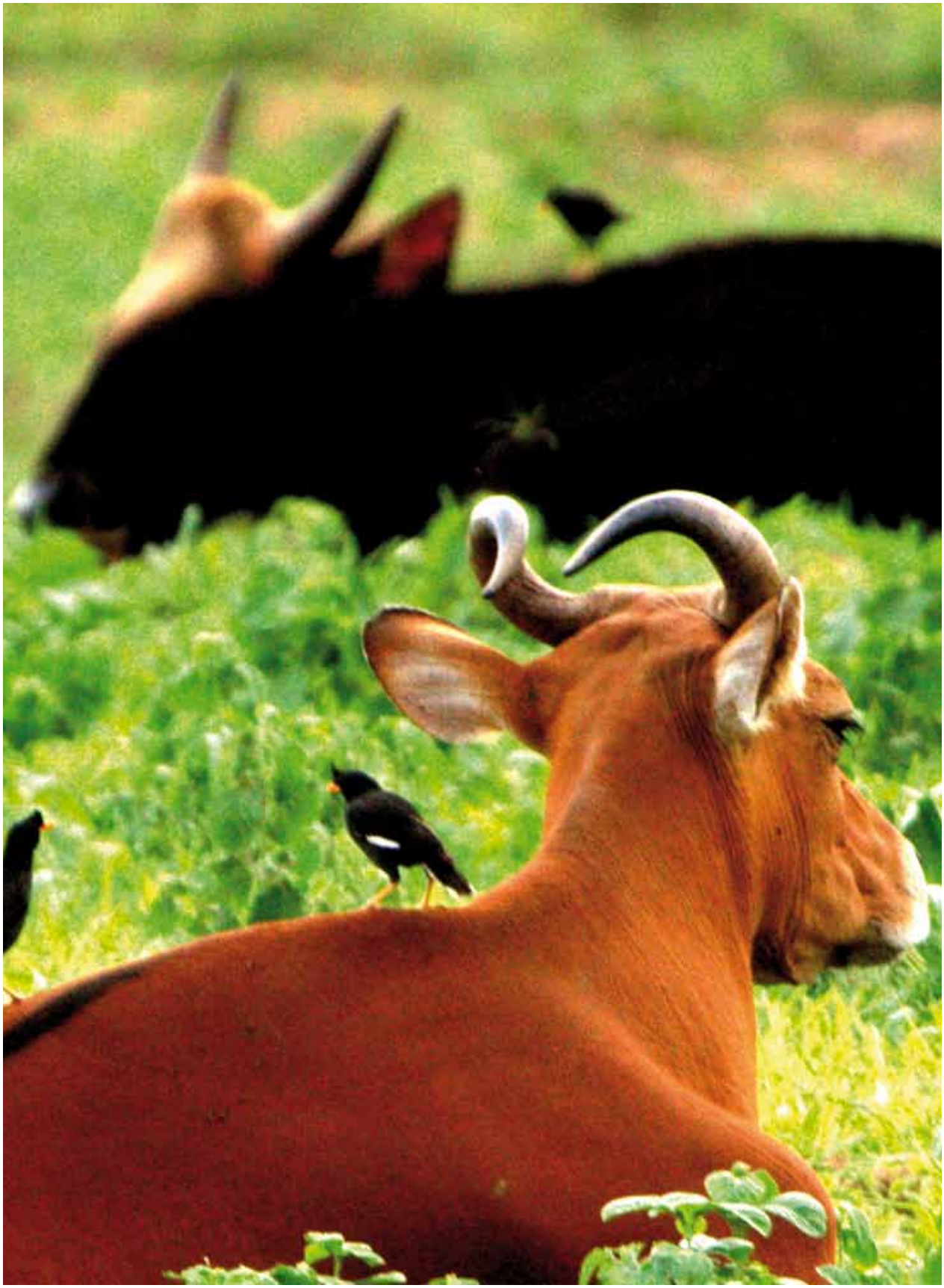
Habitat destruction has increased accessibility for Asia's rural poor and illegal wildlife traders to penetrate further into forests to harvest key ungulate species such as deer and wild pigs[53,54], and optimal ungulate habitat is generally easier to access and so bears the brunt of the recent increase in trade-driven wild meat hunting. Poaching is a serious threat in all ungulate range countries within the Greater Mekong. Two of the most threatened species in the region, saola and large-antlered muntjac, are unwitting casualties of indiscriminate snaring for more widespread species such as wild pig. The tragedy is that these unique Mekong endemics are not the target for snaring and are caught as by-catch.

In much of Southeast Asia large animal populations have been seriously depleted because of illegal hunting, resulting in so-called "empty forest syndrome" – i.e. a habitat that looks botanically and structurally intact, but where most of the wildlife has been eliminated. Muntjac-leather jackets are an almost ubiquitous status apparel in Myitkyina and other Kachin state towns in Myanmar[55].

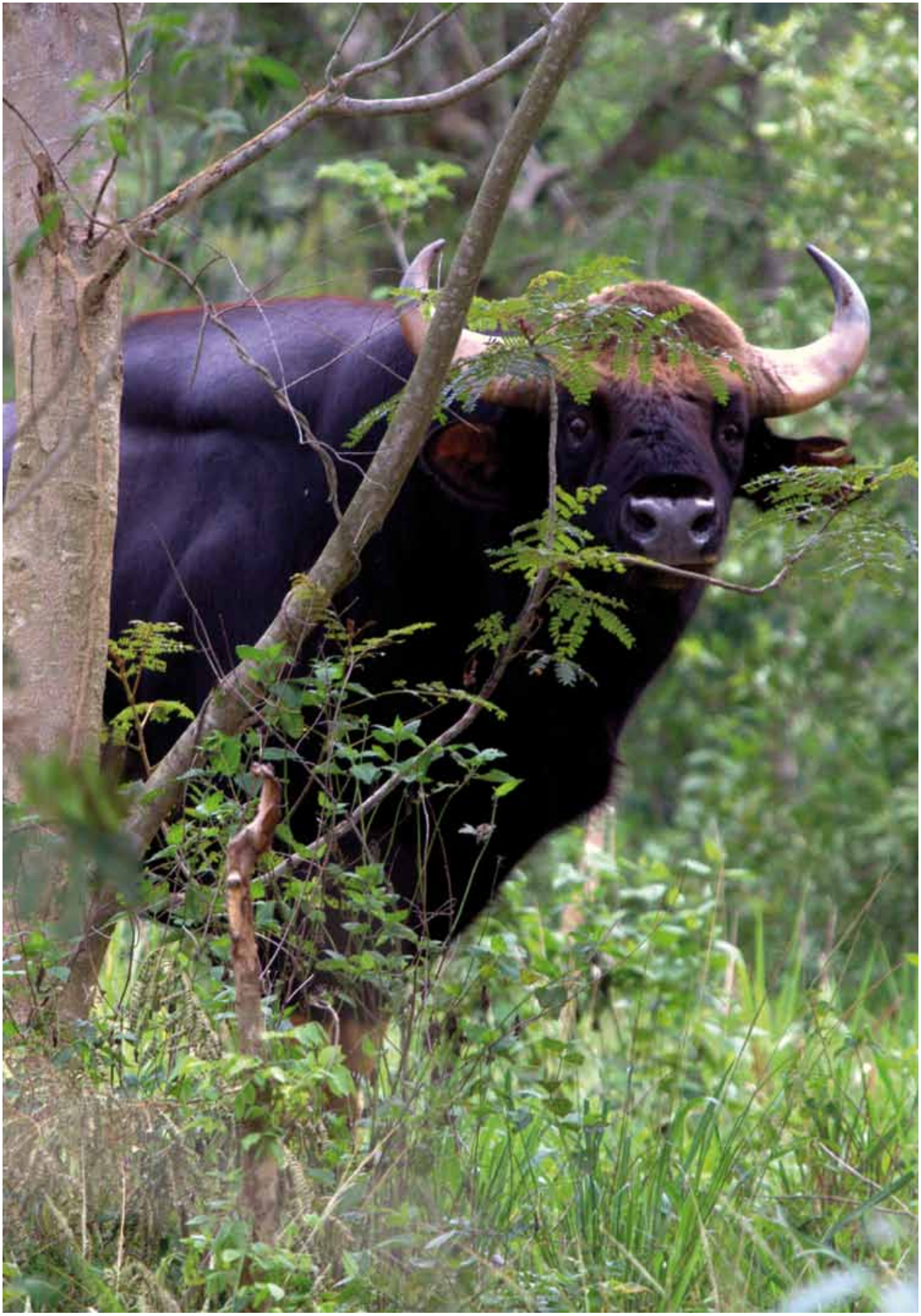
Some Southeast Asian mammal species, such as the kouprey and Schomburgk's deer, are now extinct, and Eld's deer, hog deer, banteng and wild water buffalo are present only in a few relict populations. As a result large carnivores like tigers are forced to subsist on smaller prey, such as muntjacs, porcupines, macaques and hog badgers. Small prey by itself is insufficient to meet the energy requirements of tigers and is generally insufficient to support successful reproduction. To survive, a tiger must feed on a deer-sized mammal approximately once a week, consuming about 50 such animals per year. Assuming that in general the available prey populations can sustain an annual off-take of 10 percent, a prey population of about 500 deer-sized animals is therefore needed to support a single tiger.

Lack of habitat and competition for food has resulted in an increase in human-wildlife conflict with some tigers being killed in retaliation for livestock depredation. Such is the concern that prey for Asia's tigers may disappear altogether that ungulate prey species are being introduced into the wild to help the plight of the species.

Over-hunting is leaving forests in the Greater Mekong region empty of wildlife



Banteng (foreground) and gaur (background) face a multitude of threats such as high levels of illegal trade in body parts (mainly horns), bush meat trade, hunting for the horns, habitat loss and degradation



Gaur in Kuiburi National Park, Thailand

Conclusions & recommendations: grabbing the bull by the horns

The Mekong is at a crossroads. Governments can decide whether to follow the current path towards a brown economy or take an alternative path towards sustainable green economy.

The Greater Mekong Subregion (GMS) is one of the most biologically diverse places on the planet and is home to numerous endangered species. The Mekong River Basin is also the richest river basin in the world in terms of fish stocks, and its productivity is directly linked to the livelihoods of people in the region.

Recognising the enormous importance of the region's natural capital, the six countries of the GMS – Cambodia, the People's Republic of China (PRC), Lao PDR, Myanmar, Thailand and Vietnam agreed to enter into a regional collaboration on the environment and established the Core Environment Program–Biodiversity Conservation Corridors Initiative (CEP-BCI). With the goal of a poverty-free and ecologically rich GMS, the countries are undertaking a range of activities to improve natural resource management, biodiversity conservation and climate resilience. Numerous other programs are also being implemented with support from various partners, contributing to a comprehensive approach to sustaining natural capital in the region.

The central importance of the regions shared natural resources cannot be overstated. The economic and social development of the GMS depends on the continued productivity of its inter-connected ecological systems. This ecological productivity, and hence the prosperity of the GMS, depend upon intact, healthy and diverse natural ecosystems, which provide resilience to the increasingly evident impacts of climate change, while ensuring continued access to water, energy, food, export commodities, and livelihoods for over 70 million people.

According to the recent UNEP report "Towards a Green Economy", several enabling conditions can help the transition to a green economy. Key steps that need to be taken to create these enabling conditions include:

- Prioritizing government investment and spending in areas that stimulate the greening of economic sectors as opposed to depleting our natural capital; and
- Investing in capacity building and training; and
- Establishing sound regulatory frameworks.

Sound regulatory frameworks implemented via harmonized policies across the GMS will help GMS countries adequately address complex, challenging, and regional-scale issues like habitat loss and fragmentation, unsustainable natural resource use, and climate change. Addressing all of these challenges requires stronger regional collaboration because countries cannot easily solve these problems individually. Regional collaboration needs high levels of political support. It also needs to be formalised into a regional agreement, which is supported through an effective institutional framework and mechanism.

In addition, underpinning these regional efforts to encourage and maintain a healthy and sustainable population of the species and those that depend on the ungulates, WWF aims to work closely with governments and key partners to:

- RESTORE focal species populations to forests where they were once abundant;
- RECOVER focal species populations where populations still exist; and
- RECONNECT forest habitat to ensure focal species populations increase. This can be achieved through countries fostering greater sustainable forestry, alternative forest uses and sustainable livelihoods. This will alleviate further pressure on remaining populations of the region's unique ungulates.

References

[1] Timmins, R.J., Hedges, S. & Duckworth., J.W. 2008. *Bos sauveli*. In: IUCN 2012. IUCN Red List of Threatened Species. Version 2012.2. <www.iucnredlist.org>. Downloaded on 27 February 2013.
[2] Duckworth, J.W., Robichaud, W.G. & Timmins, R.J. 2008. *Rucervus schomburgki*. In: IUCN 2012. IUCN Red List of Threatened Species. Version 2012.2. <www.iucnredlist.org>. Downloaded on 27 February 2013.
[3] Timmins, R., Duckworth , J.W., Samba Kumar, N., Anwarul Islam, M., Sagar Baral, H., Long, B. & Maxwell, A. 2012. *Axis porcinus*. In: IUCN 2012. IUCN Red List of Threatened Species. Version 2012.2. <www.iucnredlist.org>. Downloaded on 27 February 2013.
[4] Timmins, R.J., Robichaud, W.G., Long, B., Hedges, S., Steinmetz, R., Abramov, A., Do Tuoc & Mallon, D.P. 2008. *Pseudoryx nghetinhensis*. In: IUCN 2012. IUCN Red List of Threatened Species. Version 2012.2. <www.iucnredlist.org>. Downloaded on 27 February 2013.
[5] Timmins, R.J. & Duckworth, J.W. 2008. *Rucervus eldii*. In: IUCN 2012. IUCN Red List of Threatened Species. Version 2012.2. <www.iucnredlist.org>. Downloaded on 27 February 2013.
[6] Timmins, R.J., Duckworth, J.W., Hedges, S., Steinmetz, R. & Pattanavibool, A. 2008. *Bos javanicus*. In: IUCN 2012. IUCN Red List of Threatened Species. Version 2012.2. <www.iucnredlist.org>. Downloaded on 27 February 2013.
[7] WWF, 2013. *Ecosystems in the Greater Mekong: past trends, current status, possible futures*. WWF Greater Mekong Programme, Lao PDR.
[8] WWF. 2010. *Tigers on the brink*. WWF Greater Mekong Programme, Lao PDR.
[9] *Greater Mekong Subregion*. Asian Development Bank [Online]. Accessed 12 May 2013.
[10] WWF. 2008. *First Contact in the Greater Mekong*. WWF Greater Mekong Programme, Lao PDR.
[11] WWF. 2009. *Close Encounters: Greater Mekong New Species Discoveries*. WWF Greater Mekong Programme, Lao PDR.
[12] WWF. 2010. *New Blood: Greater Mekong New Species Discoveries 2009*. WWF Greater Mekong Programme, Lao PDR.
[13] WWF. 2011. *Wild Mekong New species in 2010 from the forests, wetlands and waters of the Greater Mekong, Asia's land of rivers*. WWF Greater Mekong Programme, Lao PDR.
[14] WWF. 2012. *Extra Terrestrial: Extraordinary new species discoveries in 2011 from the Greater Mekong*. WWF Greater Mekong Programme, Lao PDR.
[15] WWF, 2013. *Ecosystems in the Greater Mekong: past trends, current status, possible futures*. WWF Greater Mekong Programme, Lao PDR.
[16] Forest Investment Program Expert Group 2010.
[17] Dinerstein et al. 2006. *Setting priorities for the conservation and recovery of wild tigers: 2005-2015. A user's guide*. WWF, WCS, Smithsonian and NFWF-STF, Washington, D.C. – New York.
[18] WWF. 2010. *Tigers on the brink*. WWF Greater Mekong Programme, Lao PDR.
[19] WWF. 2010. *Tigers on the brink*. WWF Greater Mekong Programme, Lao PDR.
[20] Fishes of the Mekong – How Many Species Are There? *Catch and Culture*. Volume 15, No.2, August 2009.
[21] Stone, R. The Last of the Leviathans. *Science* 22 June 2007: Vol. 316 no. 5832 pp. 1684-1688.
[22] Stone, R. The Last of the Leviathans. *Science* 22 June 2007: Vol. 316 no. 5832 pp. 1684-1688.
[23] Tordoff et al. 2007. *Ecosystem Profile: Indo-Burma Biodiversity Hotspot Indochina Region*. Final Version May 2007. USA: Critical Ecosystem Partnership Fund, Conservation International.
[24] *The saola: rushing to save the most 'spectacular zoological discovery' of the 20th Century*. mongabay.com, 4 April 2011. Accessed 27 February 2013. http://news.mongabay.com/2011/0404-hance_robichaud.html#7qBrmj4I0FPeppHq.99
[25] Timmins, R.J., Hedges, S. & Duckworth., J.W. 2008. *Bos sauveli*. In: IUCN 2012. IUCN Red List of Threatened Species. Version 2012.2. <www.iucnredlist.org>. Downloaded on 27 February 2013.
[26] Duckworth, J.W., Robichaud, W.G. & Timmins, R.J. 2008. *Rucervus schomburgki*. In: IUCN 2012. IUCN Red List of Threatened Species. Version 2012.2. <www.iucnredlist.org>. Downloaded on 27 February 2013.
[27] Timmins, R., Duckworth , J.W., Samba Kumar, N., Anwarul Islam, M., Sagar Baral, H., Long, B. & Maxwell, A. 2012. *Axis porcinus*. In: IUCN 2012. IUCN Red List of Threatened Species. Version 2012.2. <www.iucnredlist.org>. Downloaded on 27 February 2013.
[28] Timmins, R.J., Robichaud, W.G., Long, B., Hedges, S., Steinmetz, R., Abramov, A., Do Tuoc & Mallon, D.P. 2008. *Pseudoryx nghetinhensis*. In: IUCN 2012. IUCN Red List of Threatened Species. Version 2012.2. <www.iucnredlist.org>. Downloaded on 27 February 2013.
[29] Timmins, R.J. & Duckworth, J.W. 2008. *Rucervus eldii*. In: IUCN 2012. IUCN Red List of Threatened Species. Version 2012.2. <www.iucnredlist.org>. Downloaded on 27 February 2013.

[30] Timmins, R.J., Duckworth, J.W., Hedges, S., Steinmetz, R. & Pattanavibool, A. 2008. *Bos javanicus*. In: IUCN 2012. IUCN Red List of Threatened Species. Version 2012.2. <www.iucnredlist.org>. Downloaded on 27 February 2013.
[31] Rabinowitz, AR; T. Myint; ST Khaing & S Rabinowitz (1999) Description of the Leaf Deer (*Muntiacus putaoensis*), a new species of muntjac from northern Myanmar. *J. Zool.* 249:427-435.
[32] Rabinowitz, AR. Panthera.org, pers. comm, 2008.
[33] Datta, A;J Pansa; MD Madhusudan & C Mishra (2003) Discovery of the Leaf Deer (*Muntiacus putaoensis*) in Arunachal Pradesh: an addition to the large mammals of India. *Current Science* 84:454-458.
[34] Datta, A;J Pansa; MD Madhusudan & C Mishra (2003) Discovery of the Leaf Deer (*Muntiacus putaoensis*) in Arunachal Pradesh: an addition to the large mammals of India. *Current Science* 84:454-458.
[35] Duckworth, J.W., Steinmetz, R., Timmins, R.J., Pattanavibool, A., Than Zaw, Do Tuoc, Hedges, S. (2008). "*Bos gaurus*". IUCN Red List of Threatened Species. Version 2012.2. International Union for Conservation of Nature.
[36] Choudhury, A. (2010). *The vanishing herds : the wild water buffalo*. Gibbon Books, Rhino Foundation, CEPF & COA, Taiwan, Guwahati, India.
[37] Tordoff et al. 2005; R. J. Timmins pers. comm. 2008.
[38] T. Ramesh, V. Snehalatha, K. Sankar and Qamar Qureshi (2009). "Food habits and prey selection of tiger and leopard in Mudumalai Tiger Reserve, Tamil Nadu, India". *J. Sci. Trans. Environ. Technov.* 2 (3): 170–181.
[39] Gray et al. 2012. Distance sampling reveals Cambodia's Eastern Plains Landscape supports largest global population of the endangered Banteng *Bos javanicus*. *Oryx*.
[40] Gray et al. 2012. Distance sampling reveals Cambodia's Eastern Plains Landscape supports largest global population of the endangered Banteng *Bos javanicus*. *Oryx*.
[41] Timmins, R.J., Hedges, S. & Duckworth., J.W. 2008. *Bos sauveli*. In: IUCN 2012. IUCN Red List of Threatened Species. Version 2012.2. <www.iucnredlist.org>. Downloaded on 28 February 2013.
[42] *Searching for the Last Kouprey. Final Project Report to the Critical Ecosystem Partnership Fund* for Grant Number GA 10/0.8 to Global Wildlife Conservation, P.O. Box 129, Austin, TX 78767-0129, USA. April 25, 2011.
[43] *Kouprey*. WWF International. Accessed 28 February 2013. http://wwf.panda.org/about_our_earth/species/profiles/mammals/kouprey/
[44] Giles, F. H. 1937. The riddle of *Cervus schomburgki*. *Journal of the Siam Society, Natural History Supplement*: 1–34.
[45] Harper, F. 1945. *Extinct and Vanishing Mammals of the Old World*. American Committee for International Wild Life Preservation, New York, USA.
[46] WWF and Asian Development Bank (ADB). 2012. *The Ecological Footprint and Investment in Natural Capital in Asia and the Pacific*.
[47] WWF. 2010. *Tigers on the brink*. WWF Greater Mekong Programme, Lao PDR.
[48] *Inadequate protection causes Javan rhino extinction in Vietnam*. WWF International press release, 25 October 2011.
[49] Tordoff et al. 2007. *Ecosystem Profile: Indo-Burma Biodiversity Hotspot Indochina Region*. Final Version May 2007. USA: Critical Ecosystem Partnership Fund, Conservation International.
[50] *Greater Mekong Subregion*. Asian Development Bank [Online]. Accessed 12 May 2013.
[51] WWF and Asian Development Bank (ADB). 2012. *The Ecological Footprint and Investment in Natural Capital in Asia and the Pacific*.
[52] WWF, 2013. *Ecosystems in the Greater Mekong: past trends, current status, possible futures*. WWF Greater Mekong Programme, Lao PDR.
[53] Sodhi et al. 2004. Southeast Asian biodiversity: an impending disaster. *TRENDS in Ecology and Evolution*; 19:655.
[54] Karanth et al. 2004.Tigers and their prey: Predicting carnivore densities from prey abundance. *Proceedings of the National Academy of Science*. 2004; 101:4854-4858.
[55] J.W. Duckworth pers. comm. 2008.

Greater Mekong in numbers

100% RECYCLED

1,700+

Since 1997, an incredible 1,710 new species were newly described by science in the Greater Mekong

2

ungulate species endemic to the Greater Mekong became globally extinct in the 20th Century

350

endangered tigers in the region directly depend on the recovery of key ungulate prey species

42.4 million

hectares of forest cover (more than 30 percent) was lost in the Greater Mekong region between 1973 and 2009

WWF

Why we are here

To stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature.

www.panda.org/greatermekong

WWF-Greater Mekong, D13 Thang Long International Village, Cau Giay District, PO Box 151, Hanoi, Vietnam
Tel: +84 4 3719 3049 Fax: +84 4 3719 3102