WWF

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The Eastern Himalayas

Where Worlds Collide

New Species Discoveries

Living Himalayas Initiative

MINISTER

ROYAL GOVERNMENT OF BHUTAN
Ministry of Agriculture
Thimphu:Bhutan

Message from Lyonpo Pema Gyamtsho
Minister for Agriculture, Bhutan

For centuries, the Himalayas have determined climate, history, economy , and biodiversity providing livelihoods to millions of people both directly and indirectly. It is without doubt the bastion of livelihood sources putting smiles on the faces of millions of people who are lucky to be dwelling either within or beyond the Himalayas. It is therefore befitting that a large number of new species are being discovered in the Himalayas. The discovery of two new mammals among over 350 new species is indeed a pointer towards the Himalayas being one of the planets ' rich reservoir of biodiversity.

The Himalayas provide forest cover, feed our perennial rivers – that are the source of drinking water, irrigation, and hydropower- conserves biodiversity, provides a rich base for high value agriculture, and spectacular landscapes for sustainable tourism. Clearly, the Himalayan ecosystem is vital to the ecological security of not only Bhutan, but also South Asia.

It is sad to note that climate change is adversely impacting the Himalayan ecosystem through increased temperature, altered precipitation patterns, receding glaciers, threat from GLOFs and episodes of drought and we must expedite interventions to contain these adverse impacts and prevent our populace falling victims to the wrath of nature.

Continued and enhanced monitoring of the Himalayan ecosystem, particularly its glaciers and glacial lakes is necessary to equip ourselves with tools to adapt to the impacts of Climate Change. Since several other countries in the South Asian region share the Himalayan ecosystem, appropriate forms of scientific collaboration and exchange of information is needed. We need to come together to conserve this shared natural heritage - the Himalayas.

I express support for WWF and its efforts for conservation of biodiversity and natural resources and helping the planet to continue enjoying the bounties of the Living Himalayas.

Pema Gyamtsho
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NEW DELHI - 110 003

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Foreword

The Himalayas are an unparalleled treasure trove of biodiversity. It is fascinating to observe that a large number of new species of flora and fauna are being discovered in the Himalayas even today. The recent discovery of two new mammal species among over 350 new species, speaks volumes of the range of treasures that the Himalayas possess.

In addition to their pristine beauty, the Himalayas make several vital economic and ecological contributions to our lives – they provide forest cover, feed our perennial rivers that are the source of our drinking water, irrigation and hydropower, provide a rich base for high value agriculture, and provide spectacular landscapes for sustainable tourism. Clearly, preserving the Himalayan ecosystem is critical not only for the sake of their beauty, but also for ensuring the ecological security of India and the rest of South Asia.

Continued and enhanced monitoring of the Himalayan ecosystem, particularly of its glaciers and glacial lakes, is necessary to equip ourselves with the scientific evidence required to respond to challenges like Climate Change. Since several other countries in the South Asian region share the Himalayan ecosystem, appropriate forms of scientific collaboration and exchange of information is needed. We need to come together to conserve this great shared natural heritage.

I congratulate the WWF on its efforts to conserve the biodiversity and natural resources of the Eastern Himalayas and extend to them my complete support.

Jairam Ramesh
(Jairam Ramesh)

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FOREWORD

Discoveries of over 350 new species in the Himalayas in the last decade illustrate the vast natural treasure that the Himalayas hold.

Few places on Earth can match the breathtaking splendor of the Himalayas. It's towering peaks and secluded valleys have inspired naturalists, adventure seekers and spiritualists for centuries. The Himalayan ecosystem is vital to the ecological security of not only Nepal but also South Asia. It provides forest cover; feeds perennial rivers that are the sources of drinking water, irrigation, and hydropower; conserves biodiversity; provides a rich base for high value agriculture, and is a source of spectacular landscapes for sustainable ecotourism.

However, climate change is adversely impacting the Himalayan ecosystem through increased temperature, altered precipitation patterns, receding glaciers, threat from GLOF and episodes of drought. It is accordingly, necessary to continue and enhance monitoring of the Himalayan ecosystem, in particular the state of its glaciers, and the impacts of change in glacial mass on river flows.

The Himalayan ecosystem is shared by several countries in South Asia, therefore in order to preserve this natural heritage there is a need for countries in the region to come together with appropriate forms of systematic collaboration and exchange of information leading towards conservation of a shared natural heritage – the Himalayas.

The Ministry of Forests and Soil Conservation express support for WWF and their sincere efforts towards conserving biodiversity and natural resources of the Eastern Himalayas.

Deepak Bohara

executive summary

At least 353 new species have been discovered in the Eastern Himalayas between 1998 and 2008, equating to an average of 35 new species finds every year for the last 10 years. The discoveries include 242 plants, 16 amphibians, 16 reptiles, 14 fish, 2 birds and 2 mammals, and at least 61 new invertebrates.

Above: The Arunachal macaque, a new primate species, one of the extraordinary new finds from the Eastern Himalayas. New mammals, particularly primates, are very rare among global scientific discoveries.
Main photo: The awe-inspiring Eastern Himalayas.

The Eastern Himalayas is at the crossroads of two continental plates represented by two biogeographical realms: the lowland Indo-Malayan Realm and to the north, the elevated Palearctic Realm. The meeting of these worlds has created one of the biologically richest areas on Earth.

Spanning Bhutan, the north-eastern Indian states of Arunachal Pradesh, Assam, North Bengal and Sikkim, the far north of Myanmar (Burma), Nepal and southern parts of Tibet, the region includes four Global 200 ecoregions with their critical landscapes of international biological importance. The Himalayas are home to an estimated 10,000 plant species, 300 mammal species, 977 bird species, 176 reptiles, 105 amphibians and 269 freshwater fish. The region supports high density of the Bengal tiger and is the last bastion for the charismatic greater one-horned rhinoceros.

Even today the rugged, and largely inaccessible landscape of the Eastern Himalayas, hides the real extent of the region's biodiversity, with extraordinary new species continuing to be discovered year-on-year. Between 1998 and 2008, at least 353 new species have been discovered in the Eastern Himalayas, 35 new species finds on average every year for the last 10 years **(see Appendix)**.

The extent of the new species finds place the Eastern Himalayas on a par with more well-known biological hotspots such as Borneo.

This report celebrates these unique and fascinating species discoveries. It also highlights growing pressures on the ecosystems and species as a consequence of unsustainable development in the region. Despite protection efforts, in the last half-century, this area of South Asia has faced a wave of pressures as a result of population growth and the increasing demand for commodities by global and regional markets. The host of threats include forest destruction as a result of unsustainable and illegal logging, agriculture, unsustainable fuel wood collection, overgrazing by domestic livestock, illegal poaching and wildlife trade, mining, pollution, hydropower development, and poorly planned infrastructure. The region is also among the most vulnerable to global climate change, which will amplify the impacts of these threats.

Only 25% of the original habitats in the region remain intact and 163 species that live in the Eastern Himalayas are considered globally threatened.

Many of WWF's established priority conservation landscapes are being impacted by the current unsustainable development in the Eastern Himalayas, and so we consider that a new layer of strategic action is needed to augment our longstanding field projects. This includes asking the governments of Bhutan, India and Nepal to commit to a shared tripartite vision that recognises the global significance of the region and supports the implementation of a unified conservation and sustainable development plan that ensures the landscapes within the Eastern Himalayas are connected.

By promoting a shared sustainable development vision, WWF believes that real progress can be made in tackling huge poverty-impacting issues in the Eastern Himalayas such as climate change, deforestation, the illegal wildlife and timber trade, poor infrastructure development, and thereby secure the livelihoods, subsistence and fresh water essential to millions of people throughout the region.

Only a concerted focus and a shared vision can maintain a living Himalayas, for people and nature, whether discovered or yet to be discovered.

Above: Where worlds collide. The Eastern Himalayas is at the crossroads of two continental plates, creating one of the biologically richest areas on Earth.

Asia's Land of Contrast, Life and Wonder

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Above: Asian elephant **(top)** and greater one-horned rhino **(bottom)**. **Main photo:** The Eastern Himalayas comprise 17 critical tiger landscapes and the densest population of Bengal tigers in the world.

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No mountain range on Earth can match the awe-inspiring Himalayas. Home to all of the world's highest peaks, many standing above 8,000m, they include the tallest, the formidable Sagarmatha (Mount Everest) at 8,848m. Their story is one of fascination and intrigue, which continues to captivate the world.

The 3,000km-long Himalayan mountain range, "abode of snow" in Sanskrit, was born from a massive tectonic collision 40-50 million years ago. The energy dissipated by the monumental meeting of India and Eurasia was far-reaching and shaped many of Asia's most distinctive geographical features, including the formation of the Tibetan Plateau; the highest on Earth. Even today, the relentless movement of the plates continues to push the Himalayas further skyward.

The Eastern Himalayas spanning Bhutan, the north-eastern Indian states of Arunachal Pradesh, Assam, North Bengal and Sikkim, the far north of Myanmar (Burma), Nepal and southern reaches of Tibet forms a wall that separates the lowlands of the Indian subcontinent from the high, dry Tibetan Plateau. Climatic variability and altitudinal gradation have forged the region into Asia's land of contrasts, encompassing some of nature's most magnificent spaces, from the world's highest mountains and several of the world's deepest gorges, to sub-tropical jungles, temperate forests, tall grasslands, savannas and rich alpine meadows.

A myriad of cultures and faiths including Buddhists, Hindus, Christians and animists, have lived closely with the natural environments of the Eastern Himalayas for millennia. Many of these communities live in isolation; their customs, lifestyles and livelihoods have been shaped by their environment, and they remain deeply dependent on the resources nature provides.

[1] Endemic refers to a species that is exclusively native to a specific place and found nowhere else.

Right: The beautifully-marked snow leopard is also found in the Eastern Himalayas.


© Bhutan Times

Where worlds collide

A global biodiversity hotspot[1], the Eastern Himalayas is one of the biologically richest areas on Earth. Because the region sits at the biogeographical crossroads of two continental plates, it contains an incredible wealth of biodiversity from both worlds. The Indo-Malayan Realm in the lowlands of the Eastern Himalayas is home to Asian elephants, clouded leopards, wild water buffalo, gaur, hornbills, cobras and geckos. The elevated Palearctic Realm to the north includes the snow leopard, red pandas, black bears, wolves, and a diverse assemblage of alpine ungulates, like takins, tahrs and blue sheep.

The Eastern Himalayas hotspot[2] includes four Global 200 ecoregions[3], critical landscapes of international biological importance, four World Heritage sites, two Endemic Bird Areas[4], and several global centres for plant diversity[5]. The Himalayas harbour a staggering 10,000 plant species, from tropical to temperate, 300 mammal species, 977 bird species, 176 reptiles, 105 amphibians and 269 types of freshwater fish[6]. A third of all plants and reptiles are endemic[1], as are 40% of all amphibians[7].

The world's northernmost tropical rainforests can be found in the Eastern Himalayas[8] and nearly half of the flowering plants[9] and bird species known from India[10]. The plant life of Arunachal Pradesh is considered among the most diverse in the world, ranking second only to Sumatra in Indonesia and greater than Borneo, Brazil and Papua New Guinea[11].

Importantly, the region comprises several priority landscapes for the Bengal tiger[12], Asia's largest carnivore, with the densest population of Bengal tigers in the world. The forests and grasslands along the base of the Eastern Himalayas are also the last bastion for the charismatic greater one-horned rhino, which once enjoyed a range spanning the entire length of the Himalaya foothills, from Pakistan to Myanmar[13] but are now restricted to a few corners of India, Bhutan and Nepal.

People and wildlife form a rich mosaic of life stretching across a remarkable and unparalleled landscape.

a decade of new life revealed...

New life in colour, clockwise: Male Gumprecht's green pitviper *(Trimeresurus gumprechti)*; Smith's litter frog *(Leptobrachium smithi)*; Orange-spotted snakehead *(Channa aurantimaculata)*; blue diamond impatiens *(Impatiens namchabarwensis)*.

Historically, the rugged and largely inaccessible landscape of the Eastern Himalayas has made biological surveys in the region extremely difficult. As a result, wildlife has remained poorly surveyed and there are large areas that are still biologically unexplored.

The topographic complexity, including steep mountains and valleys, has also forged isolated islands of habitat. According to scientists, large areas of intact forests, rivers and thousands of isolated streams, separated by mountain massifs, high ridges and valleys, could support populations of species cut off from one another, giving rise to genetic differences among populations, a step toward the evolution of endemic species. Scientists believe that these pockets could harbour many undiscovered species, including mammals, reptiles and amphibians, some of which could qualify for globally threatened status but have been missed in surveys to date[14].

Many species groups have been inadequately studied and the real extent of the biodiversity of the Eastern Himalayas is undoubtedly underestimated. This is reflected in the remarkable level of new life discovered in the region over the past 10 years by dedicated scientists. Some of these species have evolved and survived for centuries, and their full glory is only just being unearthed.

Renewed effort in the last decade on wildlife research and exploration gathered momentum in the Eastern Himalayas, led by researchers of non-governmental and governmental research institutions. Recent surveys have yielded extraordinary results, and the discovery of large mammals such as the leaf deer *(Muntiacus putaoensis)*, the primate Arunachal macaque *(Macaca munzala)*, and new birds such as the Bugun Liocichla *(Liocichla bugunorum)*, has drawn renewed attention to this globally important region for biodiversity.

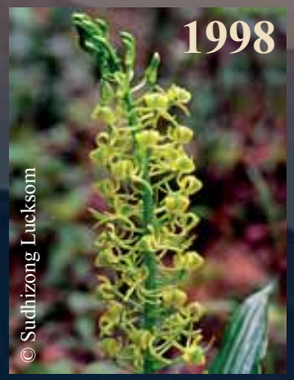
Remarkably, at least 353 new species have been discovered in the Eastern Himalayas between 1998 and 2008, equating to an average of 35 new species finds every year for the last 10 years. The discoveries include 242 plants, 16 amphibians, 16 reptiles, 14 fish, two birds and two mammals, and at least 61 new invertebrate discoveries **(see Appendix)**.

The extent of the new species finds place the Eastern Himalayas on a par with Borneo[II].

Today, further species continue to be unearthed, and many more species of amphibians, reptiles and fish are currently in the process of being officially named by scientists. The Eastern Himalayas is certainly one of the last biological frontiers of Asia and, without doubt, there are still many new discoveries waiting to be made.

[II] The WWF report, *Borneo's Lost World (2005)*, showed that between 1994 and 2004, 361 new species were identified on Borneo.

The rugged and largely inaccessible landscape of the Eastern Himalayas has made biological surveys in the region extremely difficult. As a result, wildlife has remained poorly surveyed and there are large areas that are still biologically unexplored.



Above: The orchids *Calanthe yuksomnensis* **(top)** and *Liparis dongchenii* **(bottom)** are just two of more than 200 new species of plants discovered in the Eastern Himalayas in the last decade.

amphibians

1b *Amolops assamensis*

1c *Leptobrachium smithi*

1a *Rhacophorus suffry*

There have been 16 new amphibian discoveries in the Eastern Himalayas over the past 10 years. A caecilian and a diverse chorus of 14 frogs and a toad have revealed themselves for the first time in the last decade.

The eclectic mix of amphibians from Bhutan, India, Myanmar, Nepal and Tibet includes a number of high-altitude dwellers, with many found more than 1,000m above sea level. The toad, *Pseudepidalea zamdaensis*, belonging to the 'true toad' family Bufonidae, was discovered at the extraordinary altitude of 2,900m[15].

Lowland discoveries include *Hylarana chitwanensis* or Chitwan frog of Nepal[16]. Named after the Chitwan National Park, this frog inhabits the terai grasslands, bushes and tropical *Shorea* forest. Because of the closer proximity of the species to human populations than its cloud-dwelling cousins, populations of the Chitwan frog in the Eastern Himalayas are decreasing and are already considered at risk by the IUCN, as a result of habitat destruction. The status of the Chitwan frog is close to being elevated to 'Vulnerable' from 'Near Threatened' according to the IUCN Red List of Threatened Species, on account of the declining quality and extent of habitat in its only know range, which is limited to 20,000 sq km[17].

Most of the new amphibians are endemic to the Eastern Himalayas. Some of them found only in a specific area. The bright green, red-footed tree frog *Rhacophorus suffry* **[1a]**, a so-called 'flying frog' because long webbed feet allow the species to glide when falling, was described in 2007[18]. The species is mainly found in swampy areas and is known only from five specific sites, including the Suffry tea estate in Assam, where it was originally found[19], and in neighbouring areas. Other new species from Assam include *Amolops assamensis* **[1b]**, a green and brown species also called the Assamese cascade frog. Cascade frogs or torrent frogs as they are also known as, have adapted to life amongst the torrents, waterfalls and wet boulders that cascade out of Asia's rainforests.

The species *Philautus sahai* is perhaps the lead contender for the crown of 'most endemic frog' in the Eastern Himalayas. This frog was described in 2006 from specimens found in 1988 in a single tree hollow about 3m above ground, in a dense forest on the bank of the Noa Dihing River, in Arunachal Pradesh[20]. Very little is known about the species and there has been no more information about it since 1988[21], indicating this elusive frog may be extremely rare.

Also among the new amphibian species discovered was a caecilian, *Ichthyophis garoensis*[22]. These are interesting creatures; although classed as amphibians, they are completely limbless and look more like giant earthworms. As caecilians are subterranean, they are among the least studied of the amphibian species, making the latest species discovery from Assam particularly significant.

A golden-eyed frog

Smith's litter frog *(Leptobrachium smithi)* **[1c, 1d]** identified in 1999[24], one of five new frog discoveries in the Indian state of Assam, must certainly rank among the most extraordinary-looking frogs in the world. Measuring only a few centimetres, this small frog has a giant pair of piercing, bulging and vivid golden eyes. Smith's litter frog was reportedly discovered in the Mayeng Hill Reserve Forest and Garbhanga Reserve Forest, Kamru District, Assam[25], and today populations of the frog are declining due to pressures from forest clearance and other impacts such as stream pollution[26].

1d *Leptobrachium smithi*

2a *Liocichla bugunorum*

It seems fitting that a region closely associated with the sky should be blessed with so many bird species. In the Eastern Himalayas, 977 species have been recorded, which roughly equates to a staggering one tenth of all known bird species of the world. Among this number have been two recent new discoveries.

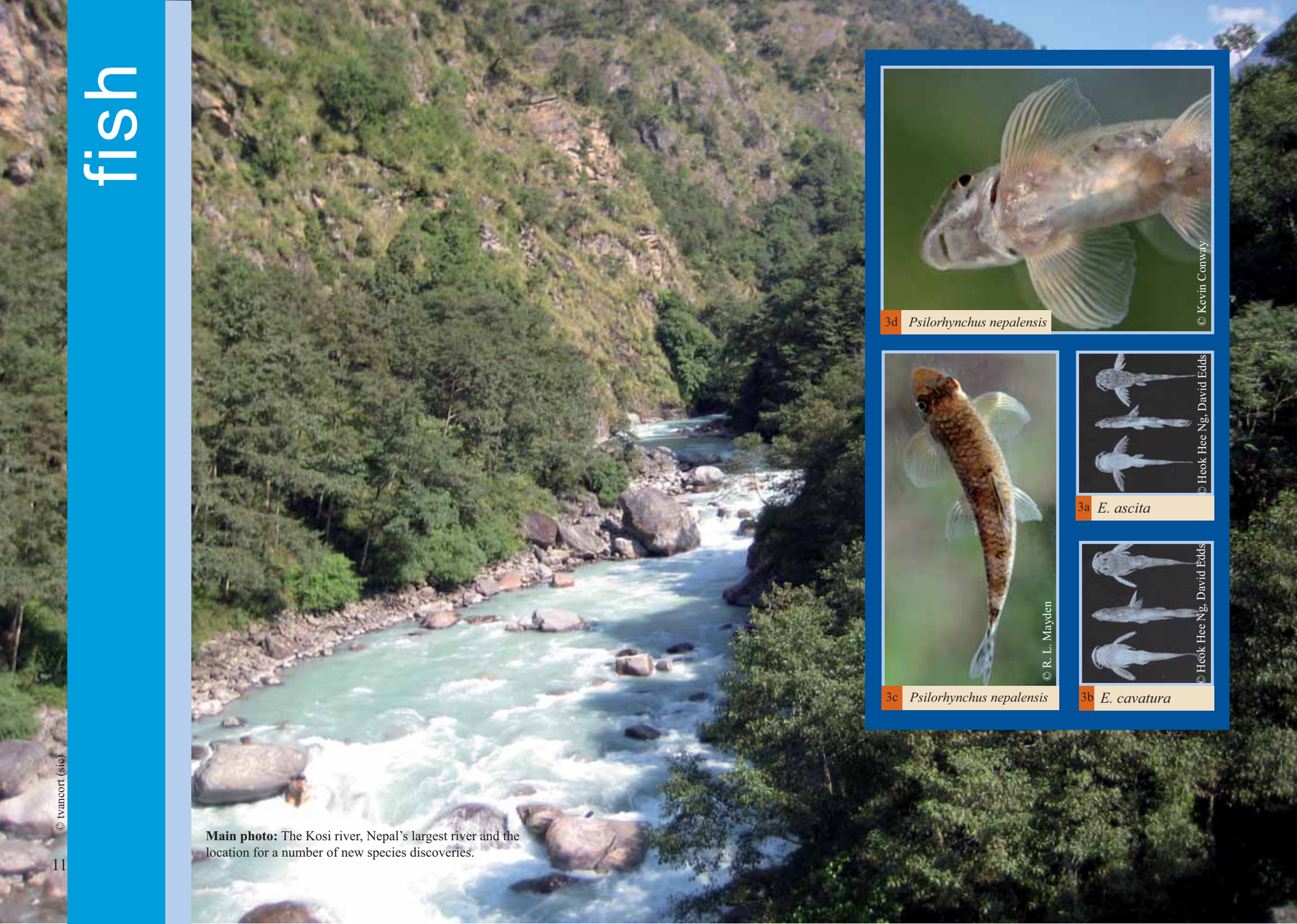
The discovery of Bugun Liocichla *(Liocichla bugunorum)*, a striking, colourful Asian babbler was unconventional in every sense and highly significant, given that prior to this the most recent new bird species reported from India was described more than half a century earlier, in 1948. Astrophysicist Ramana Athreya described the new species in 2006[27]. The species predominantly inhabits open-canopied hill forests with dense shrubs and small trees, and so far is known to be restricted to 2 sq km at an altitude of between 2,000m and 2,350m. Ramana had first glimpsed two of the birds in 1995 near Eagle's Nest Wildlife Sanctuary, Arunachal Pradesh, during a birdwatching trip. Ten years passed before he saw the birds again and was able to take a closer look.

It was initially believed to be a similar species, *Liocichla omeiensis* (the bird's closest relative), but the many differences in size, plumage and calls, especially its distinctive fluty song, indicated a new species. The bird is spectacularly colourful, with wings of yellow, red and white and tail of black with red tips **[2a]**. Since the species had been overlooked during several years of surveys at Eagle's Nest, the astrophysicist felt the population might be too small to withstand the loss of an adult bird. The International Code of Zoological Nomenclature does not allow for new species to be described without the collection of type specimens, but somewhat luckily for the bird, the Code does allow for "any part of an animal" and the species was eventually described as a new species based on feathers, photographs, sound recordings and field notes.

Given that it is unlikely that the species could have escaped detection for so long if it were relatively common and widespread, the known population of between 50 and 250 individuals[28] is today listed as 'Vulnerable' according to the IUCN Red List of Threatened Species[29].

A second new bird species was identified near the remote Naung Mung township of northern Kachin state, Myanmar, in a temperate rainforest or hill jungle at the base of the Himalayas, 540m above sea level. A team of scientists ventured into the area, 118km south of the Tibetan border, to inventory the poorly-known bird fauna, and subsequently discovered the Naung Mung scimitar-babbler *(Jabouilleia naungmungensis)*[30]. The medium-sized jungle bird reminiscent of a wren is dark brown, with a short tail, long legs, relatively large feet and a long curved bill **[2b]**. This long bill is used to forage and probe for food on the ground. The species was officially described as a new species in 2005.

2b *Jabouilleia naungmungensis*



Main photo: The Kosi river, Nepal's largest river and the location for a number of new species discoveries.

3d *Psilorhynchus nepalensis*

3c *Psilorhynchus nepalensis*

3a *E. ascita*

3b *E. cavatura*

In the past 10 years, 14 new fish species have surfaced in the Eastern Himalayas.

Half the new fish species are from the rivers and streams of Nepal. Until recently, the fish diversity of this country had been poorly studied or understood, relative to other fauna. A single scientist, Dr David Edds, undertook an ambitious exploration of Nepal's fish diversity in the late 1990s. The aim of the research was to better understand the biodiversity and conservation value of the protected areas. As a result of 35 different collections from seven protected areas, ranging from Himalayan mountains to subtropical lowlands and from east to west throughout the country, the scientist collected 91 different species of fish[31]. These were the first fish surveys in two of the reserves and the most comprehensive assessments to date in three others, adding to our knowledge of the distribution and ecology of fishes in Nepal and South Asia.

As a result of the increase in ichthyological activity in Nepal by scientists, new species to science have been reported. These include a small bagrid catfish, *Batasio macronotus*, discovered in the Kosi river, Nepal's largest river and part of the Ganges river drainage. The species has a dark yellow body and head, with two dark horizontal stripes, and was officially recorded as a new species in 2004[32].

Perhaps among the more bizarre new fish discoveries are the two light chocolate-brown catfish, *Erethistoides ascita* **[3a]** and *E. cavatura* **[3b]** described in 2005 from the Ganges river drainage in the terai of Nepal[33]. Both species display a battery of serrations along the length of their blade-like fins, in the case of *E. ascita*, as many as 24 sharp points. It is perhaps easy to see why the Latin name given to the fish means 'strange'.

Two further catfish species *Pseudecheneis crassicauda* and *P. serracula*, were discovered from tributaries of the Ganges river drainage in Nepal in 2005[34]. Both are catfish that live in fast-flowing streams, which have evolved unique adhesive undersides, made of a series of transverse ridges (12-15 on *P. crassicauda*, 13-18 on *P. serracula*) that allow the fish to stick to rocks. The chestnut brown species were collected from broad and shallow stretches of river with swift water over rocks. Local fishers report that *P. serracula*, or 'kabre' as the fish is known locally, is something of a mountain climber, ascending from the base of the Himalayas in the terai to 1000m above sea level during the monsoon, suggesting these fish may breed in the upper reaches of the river, then migrate downstream following the spawning season.

The fish *Psilorhynchus nepalensis* **[3c, 3d]**, named after its country of origin, was officially described in 2008 from the Budi Rapti river, just outside Chitwan National Park[35]. The body of this slender species is marked with dark pigment blotches, with highlights of silver and gold, and with a remarkable iridescent underbelly.

Field work in Nepal suggests that there are already several other new fish species awaiting formal description, not only in the species-rich lowlands but also rather surprisingly also in the high altitude rivers[36]. Although the high altitude rivers of the Himalayas have unique fauna, the level of species diversity is usually less compared to that of the terai lowlands.

Orange-spotted snakehead fish

The fairly large species, *Channa aurantimaculata* **[3e]**, is endemic to the forest streams, ponds, and swamps adjacent to the Brahmaputra river in the subtropical rainforest of northern Assam[37]. The species is remarkably striking, with a vibrant pattern of purple and orange adorning the length of its body. Discovered in 2000, and measuring up to 40cm in length, the fish is also known as the 'orange-spotted snakehead', as its head looks like that of a snake. It is carnivorous and predatory, enjoying a diet of smaller fish and invertebrates.

3e *Channa aurantimaculata*

There have been at least 61 new invertebrate discoveries from the Eastern Himalayas region in the last 10 years.

Invertebrate species can sometimes add an additional element of danger in already formidable territory. The Eastern Himalayas is no exception. The region is home to the world's largest hornet, *Vespa mandarinia*, or the Asian hornet known colloquially as the 'yak-killer' on account of its potent venom. Perhaps none of the new finds are as potentially nasty as this but some definitely deserve to be handled with care.

Asian huntsman spiders have been poorly investigated, with very little taxonomic research being published on these medium to large species of spider since the late 1800s[38]. In 2001, Dr Peter Jäger published a paper describing an extraordinary 42 new species of huntsman spider from the Eastern Himalayas, as a result of an expedition through East Nepal, Sikkim, Darjeeling and West Bhutan[39]. This plethora of spiders were formally organised into two new genera, Pseudopoda and Bhutaniella, both found in habitats more than 1,000m above sea level. *Bhutaniella hillyardi* was discovered at over 2,000m in the Arun Valley of East Nepal[40]. Although not poisonous, some species of huntsman spiders can deliver a nasty bite.

Further amazing invertebrates include at least nine beetles being reported. The discovery of *Agabus joachimschmidti* in Tibet shattered the world altitude record for the genus Dytiscidae (from 'to dive' in Latin)[41]. Found at the dizzying height of 5,100m above sea level, this small and predatory diving beetle is able to move underwater where it feeds on tadpoles and smaller water-dwelling creatures. Adding further to the beetle-mania in Tibet were two black robust-bodied beetles *Itagonia cordiformis* **[4a, 4b]** and *Itagonia zayica*[42] **[4c, 4d]** and three new stag beetles described in 2006[43], including *Prismognathus prossi* **[4e]**.

A recent shipment of freshwater prawns imported into Europe from Cooch Behar, Bengal, had among their number a surprise stowaway; a previously unknown species to science. Freshwater prawns do not only have economic importance in hydroponics and fisheries for food purposes, but are also increasingly in demand by the global aquarium trade. With its tinted reddish-brown colour, the medium sized new species *Macrobrachium agwi*, described in 2008[44], is now categorised as an 'ornamental shrimp' in the aquarium trade **[4f, 4g]**.

4c *I. zayica* (female)

4d *I. zayica* (male)

4a *I. cordiformis* (female)

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4b *I. cordiformis* (male)

© Luca Bartolozzi

4e *P. prossi*

Nepal's first scorpion

Among the new finds are three species of scorpion, one of which was described from the Chitwan National Park in Nepal in 2004. This discovery was particularly significant as it was the first species of scorpion ever to be discovered in the country, and was subsequently named *Heterometrus nepalensis*[45] to honour the occasion **[4h]**. The 8cm long, reddish-black, species has a smooth carapace, and a reddish-brown tail tip or telson that contains the venom. All scorpions should be considered dangerous, as the venom that they release is generally neurotoxic, and is of variable potency. The new discovery is a member of the Heterometrus genus of large black scorpions, which inhabit tropical rainforests and have a diet of large insects and the occasional mouse, but will generally eat any small animal it can subdue. The genus includes *Heterometrus swammerdami* that lives in India, one of the world's largest scorpions, capable of growing to more than 20cm in length.

© František Kovařík

4h *Heterometrus nepalensis*

© Werner Klotz

4f *Macrobrachium agwi*

© Werner Klotz

4g *Macrobrachium agwi*

5c *Muntiacus putaoensis*

5a *Macaca munzala*

5b *Macaca munzala*

The remote Eastern Himalayan state of Arunachal Pradesh, with its rugged mountains and extensive forest cover, is one of India's last truly wild places, and the location of two highly significant and exciting large mammals finds.

Biological expeditions in this biodiversity hotspot resulted in the discovery of the Arunachal macaque *Macaca munzala* **[5a, 5b]**, a primate new to science[46], in the high altitudes of western Arunachal Pradesh. Described as a new species in 2005, the relatively large brown primate with a short tail was a significant discovery as, at the time, it represented the first new monkey species identified anywhere in the world in over a century. The newly described macaque species is stocky in build and has a darker face than other closely related species. The new species is also the highest-dwelling macaque in the world, occurring between 1,600m and 3,500m about sea level.

The status of the monkey is not yet fully known. Subsequent field studies to learn more about the species have revealed a total of 569 individuals in the Tawang and West Kameng districts of the state[47]. Although new to science, locals have been familiar with the species for some time, which they blame for widespread crop damage[48]. As a result, the species, known locally as mun zala or 'deep-forest monkey' by the Dirang Monpa people, is vulnerable to extensive hunting in the only two places it is known to occur[49].

The world's largest mountain range was the location for a surprisingly small species discovery in 1999. The world's smallest deer species, a miniature muntjac **[5c]**, standing 60-80cm tall and weighing just about 11kg, was first seen by a team of scientists undertaking field surveys in the Himalayan region of northern Myanmar. Examining the small carcass of a deer initially believed to be the juvenile of another species, scientists were astounded to learn that the carcass was of an adult female of a mystery species[50]. After obtaining specimens of the accidental discovery from local hunters, scientists conducted further DNA analysis in a New York laboratory, with the results of the genetic work confirming the so-called 'leaf deer' *(Muntiacus putaoensis)* as a unique species[51].

The muntjac group, with its eleven known living species, is the oldest known deer group, first appearing in the fossil record 15-35 million years ago.

At the time of its official scientific recording, scientists believed *Muntiacus putaoensis* to be highly endemic to the nothern region in Myanmar; the species was named after the town of Putao in Myanmar, a recognisable reference point in the region where it was first discovered. Then in 2003, a team of Indian scientists sprang a surprise, reporting conclusive evidence that the leaf deer also inhabits the lush rainforests close to Namdapha Tiger Reserve in Arunachal Pradesh[52]. Before examining skulls of *Muntiacus putaoensis*, displayed as trophies by hunters in local villages, it was not known that the species existed in India. The new find was particularly significant as it represented the only addition to the ungulate fauna of the Indian subcontinent in the last century. While the existence of the species had eluded scientists, local villagers were well aware of the leaf deer.

The species *Muntiacus putaoensis* 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 plays a large role in the ongoing difficulties of better understanding it[53].

6e *Trachycarpus ukhrulensis*

6b *Impatiens namchabarwensis*

6a *Impatiens namchabarwensis*

6c *Meconopsis tibetica*

6d *Coelogyne pantlingii*

An astonishing 242 new plant species have been recorded in the Eastern Himalayas in the last 10 years.

A vast garden stretches across the Eastern Himalayas, a mysterious and alluring landscape that has yielded on average of 24 new plant discoveries every year for the last 10 years. These remarkable floral finds, in a place still much to be explored, include *Impatiens namchabarwensis*, or the blue diamond impatiens described in 2005 from Medog in Tibet, 930m above sea level[54]. The highly endemic ultramarine-blue flower was discovered as a result of an intrepid expedition undertaken by a dedicated pair of Chinese botanists, Yuan Yong-Ming and Ge Xue-Jun. The duo ventured 100km from the nearest road, then descended into the remote reaches of the Namcha Barwa canyon, a gorge measuring almost 250km long and, in places, twice as deep as the Grand Canyon.

Named after the canyon in which it was found, an area of Tibet which really only started to be explored as recently as the mid-1990s, the rare plant can grow as tall as 60cm and flowers all year round. The many flowers are dramatic in both colour and form and, extraordinarily, the colour seems to change with temperature and exposure. They sometimes appear truly blue when in a cool climate **[6a]** and change to purple when temperatures rise **[6b]**; a characteristic unique for this species among impatiens. The shape of the flower is also far different from the traditional flat-disk shape of most impatiens, with some saying that when viewed from the side, the flowers resemble an elegant crane in flight.

Also from Tibet, *Meconopsis tibetica* (described in 2006[55]) is one of 12 new poppy species discoveries joining the ranks of new flora in the region **[6c]**. The species has a yellow centre surrounded by petals of deep red colour.

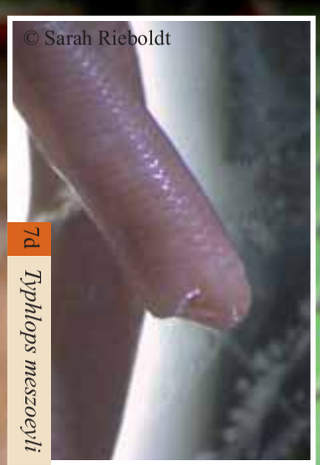
The orchid stands supreme in the plant kingdom for its beauty. In the Eastern Himalayas 21 new orchid species have been identified between 1998 and 2008. Roughly one quarter, including the pure white *Coelogyne pantlingii*[56] **[6d]**, were found in Sikkim, an ancient land also known as Indrakil - the garden of Indra, the king-god of heaven in Hindu religious texts.

Among the newly discovered species of plant is a palm tree, *Trachycarpus ukhrulensis*, or Saramati palm **[6e]**. The species is the most recent addition to the Trachycarpus genus, and the most interesting yet according to some scientists. The palm was discovered in Assam, on the border with Myanmar. Growing to a height of 15m, the tree has a hairless trunk, 30cm in diameter. The species produces between 24 and 28 palmate leaves, each about a metre long. The underside of the leaves are a stunning powdery white, and the top sides are dark green[57].

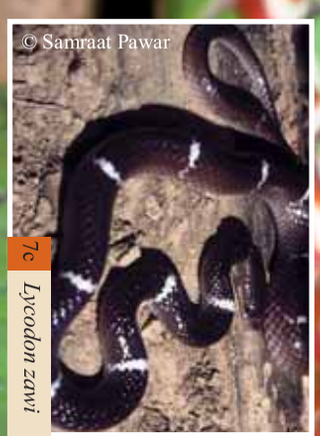
Other new finds include 15 new bamboo species and 46 species of fern.

reptiles

7a *T. gumprechti* (female)



7d *Typhlops meszoeyli*



7c *Lycodon zawi*

7b *T. gumprechti* (male)

The Eastern Himalayas have yielded 16 new reptile species over the past 10 years. These include 13 lizards and three snakes.

The most colourful snake discovery has been the emerald green pitviper, *Trimeresurus gumprechti*. Officially discovered in 2002[58], Gumprecht's green pitviper is venomous and capable of growing to 130cm in length. Scientists predict that larger specimens exist. The species is known to occur around Putao, at altitudes above 400m in the far north of Myanmar[59]. There are some striking differences between the males and females of this species; females reach a greater size, with a thin, white or whitish-blue streak on the head, and deep yellow eyes **[7a]**; males are shorter, have a red stripe on the head, and bright red or deep red eyes **[7b]**.

This species is mainly found in rugged, forested areas, often in the vicinity of streams, as well as bamboo thickets. It also occurs near human settlements and along trails. Mostly nocturnal, this snake is arboreal, but can also be found on the ground. The largest known specimens were collected while they were resting on branches near a stream. Rodents and skinks have been recorded as prey, but the species has also been observed killing and eating other pitvipers of a similar size.

Another nocturnal snake, Zaw's wolf snake *(Lycodon zawi)* **[7c]**, was discovered dwelling in forests and near streams at elevations of less than 500m high in Assam, India, including in the Garbhange Reserve Forest and in northern Myanmar. The black snake, with white bands, can grow to half a metre in length, and feeds mainly on geckos[60]. The find increases the diversity of the Lycodon genus to four in Myanmar and to five in north east India.

In 1999, a new species of blind snake was officially described from Darjeeling, Assam, near India's border with Nepal[61]. Also called the Darjeeling worm snake on account of its appearance, *Typhlops meszoeyli* **[7d]** was discovered in the forest-covered foothills of the Himalayas. As the name suggests, the snake's eyes and body are covered by smooth shiny scales, a sign of its adaptation to a subterranean life, allowing it to move easily through earth. The snake feeds mainly on the eggs and larvae of termites and ants, and can occasionally be found high in trees, having reached these heights by using termite galleries. *Typhlops meszoeyli* belongs to super family Typhlopidae, which comprises more than 200 different blind snake species world-wide.

According to scientists, several new species of reptiles still await description[62], including a new species of pitviper caught after a one-year hunt in the rainforests of north-east India. The new species can measure longer than two metres and is already the stuff of local legend. "Barta", as the snake is known by the local Nyishi tribesmen, is the most-feared creature among the tribes in Arunachal Pradesh. According to Nyishi folklore, sighting of a barta, meaning the deadliest of all snakes, is a very bad omen[63].

A 100 million-year-old gecko

Perhaps the most fascinating and globally significant new reptile species discovery over the past 10 years is one that is not 'new' in the classic sense. *Cretaceogekko burmae*, a 100 million-year-old gecko **[7e]**, the oldest fossil gecko species known to science, was discovered in an amber mine excavated in the Hukawng Valley in the Himalayan region of far north Myanmar[64]. Originally baffling scientists, who were unable to assign the gecko preserved in amber to any known taxon, they officially described the species and genus as entirely new in 2008.

The species discovery is significant, as it transformed the existing understanding about the origin of geckos. Because the species has the foot proportions and adhesive toe pads found in modern geckos, the discovery provided evidence that modern geckos had already evolved 100 million years ago. The specimen is tiny, even when compared with hatchlings of the smallest geckos living today. However, the high numbers of lamellae on its toe pads suggest it is from a species with a relatively large adult body size. The find even surprised the scientific community. Cretaceous amber from Myanmar includes a plethora of plant and invertebrate remains but vertebrate fossils are very rare[65]. Further new amber discoveries include a termite that has intestinal protozoa **[7f]**, showing the oldest example of mutualism; the oldest known mushroom **[7g]**; the oldest described tick; and the oldest fern in amber **[7h]**.

Above: Anti-poaching staff display a leopard skin, a python skin, and a tiger skin at the Tikauli Museum, Terai Arc, Nepal. WWF funds education programmes at the museum that help educate visitors and local people about the effects of poaching on Nepal's wildlife.

Right: Forest destruction in Arunachal Pradesh.

Once remote, now in danger

The remarkable Eastern Himalayas is an extraordinary region of unique life and natural wonder, but one that is also gravely threatened. Despite protection efforts, in the last half-century the region has rapidly faced a disastrous combination of pressures as a result of population growth and the rapidly increasing demand for commodities by global and regional markets.

The host of threats include forest destruction as a result of unsustainable and illegal logging, leading to floods; shifting cultivation; unsustainable fuel wood collection; overgrazing by domestic livestock; illegal poaching and wildlife trade for pelts and traditional Asian medicine; mining; water diversion and pollution; tourism; and poorly-planned infrastructure, especially dam and road construction. The region is also among the most vulnerable to global climate change, which will amplify the impacts of these existing threats.

The result is severe habitat loss, degradation and fragmentation, eroding a fragile and vibrant landscape. Only 25% of the original habitats in the region remain intact[66].

The impact human activity has wrought on the unique diversity of the Eastern Himalayas is devastating. For the species of the Eastern Himalayas, this means that today 163 are considered globally threatened - comprising 45 mammals, 50 birds, 17 reptiles, 12 amphibians, 3 invertebrates, and 36 plant species[67] [III]. Species endemic to the Eastern Himalayas, account for approximately half this number, therefore representing globally important populations[68]. An alarming 14 species are considered Critically Endangered by IUCN, currently facing the abyss of extinction, with a further 46 considered Endangered[69].

Among the important globally-threatened mammals are Asia's three largest herbivores - the Asian elephant, the greater one-horned rhinoceros and the wild water buffalo - and its largest carnivore, the tiger, as well as snow leopard, Ganges river dolphin and several large birds such as vultures, adjutant storks and hornbills.

The human cost is also severe. The environment is the base for all human development, so while the impact on wildlife is taking its toll, the once plentiful resources and cultural treasures available to people have continued to decline. In the long term, this will transform livelihoods, the availability of essential food and freshwater, and ultimately exacerbate poverty in the region. Little will change unless environmental protection and development are mutually supportive.

The governments of the region have recognized the importance of the Himalayas for biodiversity, livelihoods and fresh water, and are actively engaged with the work of conserving ecosystems.

[III] Of the 163 species 146 (90%) occur in north-eastern India, including 70 species that are endemic to the Eastern Himalayas region; 75 (46%) occur in Nepal; and 49 (30%) occur in Bhutan. As the figures suggest, many of these species occur in more than one country.

conclusions & recommendations

The Eastern Himalayas are a truly magnificent part of the world. The enormous cultural and biological diversity belies the fragile nature of the environment on which all depend and which risks being lost forever unless we take concerted action now.

As human populations grow and development activities unfold we must ensure that these take place in a way that is sustainable, not just for our own generation but for the sake of those to come as well. This will be our legacy to our children and grandchildren and one we hope they will thank us for.

WWF believes that real progress can be made in tackling the pressing issues in the Eastern Himalayas, like global warming, deforestation, the illegal wildlife and timber trade and the need for sensitive infrastructure development. At the same time, good environmental management will help increase livelihood options and help secure food and freshwater availability for millions of people throughout the region. This in turn, will address the poverty that underpins so many of the current, unsustainable, demands on the landscape.

In order to maintain a Living Himalayas, WWF believes several key undertakings have to be realized:

* That the governments of Bhutan, India and Nepal, who already recognize the importance of the Himalayas at a national level, develop a shared three-country vision for the region as a whole. This will result in a unified conservation and sustainable development plan that ensures the connectivity of landscapes within the Eastern Himalayas, allowing for the free movement of wildlife across political borders and combating illegal trade at a regional level.

* Broadening the scope and scaling up the local stewardship of forests, grasslands, and wetlands. Local communities already have many rights to manage the natural resources within the environment where they live, as these increase there will be mutual benefits for both biodiversity conservation and sustainable livelihoods. With increased rights come increased responsibilities but the future of the wildlife that live there is best assured by giving the people, who share these landscapes, a vested interest in their survival.

* Ensure that regional mechanisms are in place to respond to climate change and the inevitable changes that it will bring. Communities will need to be supported to cope with the rising threat of floods from glacial lake collapse and to respond to changing weather patterns. Water availability will be a key concern and, since major rivers rising in the Eastern Himalayas support millions of people downstream as well as the rich biodiversity, so river management will need to take place at a regional, river-basin scale, if it is to meet the needs of all.

* Development initiatives must take into account the environment if we are not to damage, irretrievably, the very resources on which economic development depends. This applies to all industries but is of particular relevance to growth in the energy and tourism sectors. Landscape level planning and the development of 'best practice' guidelines will help ensure that the richness of the Eastern Himalayas is maintained and that the economic growth requirements of the region are met.

Above: The environment is the base for all human development. Good environmental management can help increase livelihood options and help secure food and freshwater availability for millions of people.

Appendix: New species in the Eastern Himalayas, 1998-2008

Species	Scientist(s)	Date of discovery	Distribution within Eastern Himalayas
AMPHIBIANS			
Amolops aniqiaoensis	Dong et al	2005	Tibet
Amolops assamensis	Sengupta et al	2008	Assam
Amolops bellulus	Liu et al	2000	Myanmar
Amolops medogensis	Li & Rao	2005	Tibet
Hylarana chitwanensis	Das	1998	Nepal
Ichthyophis garoensis	Pillai & Ravichandran	1999	Assam
Kaloula assamensis	Das et al	2005	Arunachal Pradesh / Assam
Leptobrachium smithi	Matsui et al	1999	Assam
Nanorana medogensis	Fei & Ye	1999	Tibet
Odorrana zhaoi	Li, Lu, & Rao	2008	Tibet
Philautus sahai	Sarkar & Ray	2006	Arunachal Pradesh
Philautus terebrans	Das & Chanda	1998	Arunachal Pradesh
Pseudepidalea zamdaensis	Fei et al	1999	Tibet
Rhacophorus suffry	Bordoloi et al	2007	Arunachal Pradesh / Assam
Scutiger bhutanensis	Delorme & Dubois	2001	Bhutan
Tomopterna maskeyi	Schleich & Anders	1998	Nepal
		Sub-total	**16**
BIRDS			
Jabouilleia naungmungensis	Rappole et al	2005	Myanmar
Liocichla bugunorum	Athreya	2006	Arunachal Pradesh
		Sub-total	**2**
FISH			
Badis pyema	Kullander & Britz	2002	Myanmar
Batasio macronotus	Ng & Edd	2004	Nepal
Channa aurantimaculata	Musikasinthorn	2000	Assam
Conta pectinata	Ng	2005	Bengal
Erethistoides ascita	Ng & Edds	2005	Nepal
Erethistoides cavatura	Ng & Edds	2005	Nepal
Pseudecheneis eddsi	Ng	2006	Nepal
Pseudolaguvia foveolata	Ng	2005	Assam
Pseudecheneis crassicauda	Ng & Edds	2005	Nepal
Pseudecheneis serracula	Ng & Edds	2005	Nepal
Psilorhynchus amplicephalus	Arunachalam et al	2007	Assam
Psilorhynchus nepalensis	Conway & Mayden	2008	Nepal
Puntius tiantian	Kullander & Fang	2005	Myanmar
Psilorhynchoides arunachalensis	Nebeshwar et al	2007	Arunachal Pradesh
		Sub-total	**14**
INVERTEBRATES			
Aegialia (Silluvia) gansuensis	Frolov	2008	Tibet
Aegialia (Silluvia) igori	Frolov	2008	Tibet
Aegialia (Silluvia) yunnanica	Frolov	2008	Tibet
Agabus joachimschmidti	Brancucci & Hendrich	2008	Bhutan / Tibet
Bhutaniella dunlopi	Jäger	2001	Bhutan
Bhutaniella gruberi	Jäger	2001	Bhutan
Bhutaniella haenggii	Jäger	2001	Bhutan
Bhutaniella hillyardi	Jäger	2000	Nepal
Bhutaniella rollardae	Jäger	2001	Nepal
Chinattus chichila	Logunov	2003	Nepal
Heterometrus nepalensis	František Kovařík	2004	Nepal
Heterometrus tibetanus	Lourenco et al	2005	Tibet
Itagonia cordiformis	Ai-Min Shi & Guo-Dong Ren	2007	Tibet
Itagonia zayica	Ai-Min Shi & Guo-Dong Ren	2007	Tibet
Lucanus pani	Huang	2006	Tibet
Macrobrachium agwi	Klotz	2008	Bengal
Mesobuthus songi	Lourenco et al	2005	Tibet
Noseolucanus zhengi	Huang	2006	Tibet

Species	Scientist(s)	Date of discovery	Distribution within Eastern Himalayas
Prismognathus prossi	Bartolozzi & Xia Wan	2006	Tibet
Pseudopoda abnormis	Jäger	2001	Bengal / Sikkim
Pseudopoda albolineata	Jäger	2001	Nepal
Pseudopoda albonotata	Jäger	2001	Bhutan
Pseudopoda alta	Jäger	2001	Nepal
Pseudopoda ausobskyi	Jäger	2001	Nepal
Pseudopoda biapicata	Jäger	2001	Myanmar
Pseudopoda brauni	Jäger	2001	Nepal
Pseudopoda chauki	Jäger	2001	Nepal
Pseudopoda chulingensis	Jäger	2001	Nepal
Pseudopoda cuneata	Jäger	2001	Nepal
Pseudopoda dama	Jäger	2001	Nepal
Pseudopoda damana	Jäger	2001	Nepal
Pseudopoda dhulensis	Jäger	2001	Nepal
Pseudopoda diversipunctata	Jäger	2001	Nepal
Pseudopoda everesta	Jäger	2001	Nepal
Pseudopoda gogona	Jäger	2001	Bhutan
Pseudopoda grasshoffi	Jäger	2001	Nepal
Pseudopoda heteropo-doides	Jäger	2001	Nepal
Pseudopoda hingstoni	Jäger	2001	Bengal / Sikkim
Pseudopoda huberti	Jäger	2001	Nepal
Pseudopoda hyatti	Jäger	2001	Nepal
Pseudopoda jirensis	Jäger	2001	Nepal
Pseudopoda kalinchoka	Jäger	2001	Nepal
Pseudopoda khimtensis	Jäger	2001	Nepal
Pseudopoda latembola	Jäger	2001	Nepal
Pseudopoda marmorea	Jäger	2001	Nepal
Pseudopoda martensi	Jäger	2001	Nepal
Pseudopoda martinae	Jäger	2001	Nepal
Pseudopoda megalopora	Jäger	2001	Myanmar
Pseudopoda minor	Jäger	2001	Bengal / Sikkim
Pseudopoda monticola	Jäger	2001	Nepal
Pseudopoda platembola	Jäger	2001	Myanmar
Pseudopoda schawalleri	Jäger	2001	Nepal
Pseudopoda sicca	Jäger	2008	Bengal
Pseudopoda sinopodoides	Jäger	2001	Nepal
Pseudopoda tinjura	Jäger	2001	Nepal
Pseudopoda triapicata	Jäger	2001	Nepal
Pseudopoda trisuliensis	Jäger	2001	Nepal
Pseudopoda varia	Jäger	2001	Nepal
Suffasia kanchenjunga	Ono	2006	Nepal
Suffasia martensi	Ono	2006	Nepal
Umbopilio martensi	Klimes	2006	Assam
		Sub-total	**61**
MAMMALS			
Macaca munzala	Sinha et al	**2005**	Arunachal Pradesh
Muntiacus putaoensis	Rabinowitz et al	1999	Arunachal Pradesh / Myanmar
		Sub-total	**2**
PLANTS			
Askellia ladyginii	Tzvelev	2007	Tibet
Acronema ioniostyles	Farille & Lachard	2002	Nepal
Agapetes arunachalensis	D.Banik & Sanjappa	2007	Arunachal Pradesh
Agapetes dalaiensis	D.Banik & Sanjappa	2007	Arunachal Pradesh
Agapetes siangensis	D.Banik & Sanjappa	2007	Arunachal Pradesh
Aleuritopteris flavopygmaea	S.R.Ghosh	2004	Sikkim
Aleuritopteris sikkimensis	S.R.Ghosh	2004	Sikkim
Amblyanthus obovatus	G.S.Giri	2002	Arunachal Pradesh
Anaphalis yangii	Y.L.Chen & Y.L.Lin	2003	Tibet
Aphragmus bouffordii	Al-Shehbaz	2003	Tibet
Arisaema siangense	Gusman	2006	Arunachal Pradesh
Arisaema tsangpoense	J.T.Yin & Gusman	2006	Tibet
Artemisia mustangensis	Yonek.	2008	Nepal
Artemisia nepalica	Yonek.	2008	Nepal
Arthromeris indica	S.R.Ghosh	2004	Sikkim
Asplenium kukkonenii	Viane & Reichst.	2003	Bhutan / Nepal
Asplenium semivarians	Viane & Reichst.	2003	Assam
Astragalus barclayanus	Podlech	2004	Nepal
Astragalus baxoiensis	Podlech & L.R.Xu	2007	Tibet

Species	Scientist(s)	Date of discovery	Distribution within Eastern Himalayas
Astragalus blandulus	Podlech & L.R.Xu	2006	Tibet
Astragalus brachytrichus	Podlech & L.R.Xu	2007	Tibet
Astragalus despectus	Podlech & L.R.Xu	2007	Tibet
Astragalus golubojensis	Podlech & L.R.Xu	2007	Tibet
Astragalus griersonii	Podlech	2004	Bhutan
Astragalus hysophilus	Podlech & L.R.Xu	2006	Tibet
Astragalus jiazaensis	Podlech & L.R.Xu	2007	Tibet
Astragalus jumlaensis	Podlech	2006	Nepal
Astragalus lachungensis	L.B.Chaudhary	2006	Sikkim
Astragalus laetabilis	Podlech & L.R.Xu	2007	Tibet
Astragalus montivagus	Podlech & L.R.Xu	2006	Tibet
Astragalus notabilis	Podlech	2006	Nepal
Astragalus oreocharis	Podlech & L.R.Xu	2006	Tibet
Astragalus praeteritus	Podlech & L.R.Xu	2006	Tibet
Astragalus sanjappae	L.B.Chaudhary & Z.H.Khan	2005	Nepal / Sikkim
Astragalus tibeticola	Podlech & L.R.Xu	2004	Tibet
Astragalus zadaensis	Podlech & L.R.Xu	2007	Tibet
Asystasia indica	H.J.Chowdhery & Av.Bhattacharjee	2006	Bengal
Bambusa alemtemshii	H.B.Naithani	2007	Assam
Bambusa assamica	Barooah & Borthakur	2002	Assam
Bambusa barpatharica	Borthakur & Barooah	2002	Assam
Bambusa garuchokua	Barooah & Borthakur	2002	Assam
Bambusa nagalandiana	H.B.Naithani	2007	Assam
Bambusa rangaensis	Borthakur & Barooah	2002	Assam
Beilschmiedia bhutanica	M.Gangop.	2006	Bhutan
Biermannia arunachalensis	A.N.Rao	2006	Arunachal Pradesh
Bistorta albiflora	Miyam. & H.Ohba	2002	Tibet
Bistorta attenuatifolia	Miyam. & H.Ohba	2004	Tibet
Bistorta tubistipulis	Miyam. & H.Ohba	2002	Tibet
Bulbophyllum manipurense	C.S.Kumar & P.C.S.Kumar	2005	Assam
Butea tibetensis	X.Y.Zhu & Y.F.Du	2007	Tibet
Calanthe yuksomnensis	Lucksom	1998	Sikkim
Callitriche fuscicarpa	Lansdown	2006	Nepal

Species	Scientist(s)	Date of discovery	Distribution within Eastern Himalayas
Callitriche glareosa	Lansdown	2006	Bhutan
Caragana aliensis	Y.Z.Zhao	2008	Tibet
Carex gandakiensis	Katsuy.	2008	Nepal
Chaetoseris albiflora	Tzvelev	2007	Tibet
Chaetoseris ladyginii	Tzvelev	2007	Tibet
Chaetoseris neglecta	Tzvelev	2007	Tibet
Chaetoseris potaninii	Tzvelev	2007	Tibet
Cinnamomum bhaskarii	M.Gangop.	2006	Arunachal Pradesh
Cinnamomum bishnupadae	M.Gangop.	2006	Assam
Cinnamomum blandfordii	M.Gangop.	2006	Arunachal Pradesh / Myanmar
Cinnamomum champokianum	Baruah & S.C.Nath	2008	Assam
Cinnamomum lohitensis	M.Gangop.	2006	Arunachal Pradesh
Cinnamomum sanjappae	M.Gangop.	2006	Arunachal Pradesh
Cinnamomum suvrae	M.Gangop.	2006	Assam
Clematis erectisepala	L.Xie, J.H.Shi & L.Q.Li	2005	Tibet
Coelogyne pantlingii	Lucksom	2005	Sikkim
Colocasia tibetensis	J.T.Yin	2006	Tibet
Conioselinum nepalense	Pimenov & Kljuykov	2003	Nepal
Corydalis brachyceras	Lidén & Van De Veire	2008	Tibet
Corydalis kuruchuensis	Lidén	2008	Tibet
Corydalis milarepa	Lidén & Z.Y.Su	2007	Tibet
Corydalis nubicola	Z.Y.Su & Lidén	2007	Tibet
Corydalis regia	Z.Y.Su & Lidén	2008	Tibet
Corydalis tenuipes	Lidén & Z.Y.Su	2007	Tibet
Croton nepalensis	T.Kuros.	2005	Nepal
Cryptocarya burkillii	M.Gangop.	2006	Arunachal Pradesh
Cryptocarya dekae	M.Gangop.	2006	Assam / Sikkim
Ctenitis holttumii	Sarn.Singh & Panigrahi	2005	Arunachal Pradesh
Curcuma rubrobracteata	Škorničk., M.Sabu & Prasanthk.	2003	Assam
Cyathea nayarii	T.Bandyop,T.Sen & U.Sen	2003	Arunachal Pradesh
Cyathea sharmae	T.Bandyop,T.Sen & U.Sen	2003	Arunachal Pradesh
Cyclosorus holttumii	Sarn.Singh & Panigrahi	2005	Arunachal Pradesh
Cyclosorus krameri	Sarn.Singh & Panigrahi	2005	Arunachal Pradesh

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Cyclosorus mantoniae	Sarn.Singh & Panigrahi	2005	Arunachal Pradesh
Cyclosorus pseudoacuminatus	Panigrahi & Sarn.Singh	2005	Arunachal Pradesh
Cyclosorus pseudobalansae	Panigrahi & Sarn.Singh	2005	Arunachal Pradesh
Cyclosorus sledgei	Panigrahi & Sarn.Singh	2005	Arunachal Pradesh
Cymbidium chawalongense	C.L.Long, H.Li & Z.L.Dao	2003	Tibet
Dasymaschalon tibetense	X.L.Hou	2005	Tibet
Dehaasia arunachalensis	M.Gangop.	2006	Arunachal Pradesh
Delphinium lihengianum	Q.E.Yang & Y.Luo	2003	Tibet
Dendrobium arunachalense	C.Deori, S.K.Sarma, Phukan & A.A.Mao	2006	Arunachal Pradesh
Dendrobium meghalayense	Y.Kumar & S.Chowdhury	2003	Assam
Dendrobium numaldeorii	C.Deori, Hynn. & Phukan	2004	Arunachal Pradesh
Desideria mieheorum	Al-Shehbaz	2005	Tibet
Dinetus rhombicarpus	Staples	2006	Assam
Diplazium apicisorum	Panigrahi & Sarn.Singh	2005	Arunachal Pradesh
Diplazium chittagongense	Sarn.Singh & Panigrahi	2005	Arunachal Pradesh
Diplazium cuneipinnulum	Panigrahi & Sarn.Singh	2005	Arunachal Pradesh
Diplazium josephii	Sarn.Singh	2005	Arunachal Pradesh
Diplazium miaoense	Sarn.Singh & Panigrahi	2005	Arunachal Pradesh
Diplazium namdaphaense	Sarn.Singh & Panigrahi	2005	Arunachal Pradesh
Diplazium nanolobum	Sarn.Singh & Panigrahi	2005	Arunachal Pradesh
Diplazium paleaceum	Sarn.Singh & Panigrahi	2005	Arunachal Pradesh
Diplazium panigrahianum	Sarn.Singh	2005	Arunachal Pradesh
Diplazium pseudocrinipes	Sarn.Singh & Panigrahi	2005	Arunachal Pradesh
Diplazium sarojiniae	Sarn.Singh	2005	Arunachal Pradesh
Diplazium singhii	Panigrahi	2005	Arunachal Pradesh
Diplazium subdoederleinii	Sarn.Singh & Panigrahi	2005	Arunachal Pradesh
Diplazium tirapense	Panigrahi & Sarn.Singh	2005	Arunachal Pradesh
Draba micheorum	Al-Shehbaz	2004	Tibet
Draba poluniniana	Al-Shehbaz	2004	Nepal
Drepanostachyum merretii	Demoly	2006	Nepal
Dryoathyrium chingii	Sarn.Singh & Panigrahi	2005	Arunachal Pradesh
Eclipta angustata	Umemoto & H.Koyama	2007	Bengal /Nepal

Species	Scientist(s)	Date of discovery	Distribution within Eastern Himalayas
Eria annapurnensis	L.R.Shakya & M.R.Shrestha	2007	Nepal
Eria baniae	Bajrach., L.R.Shakya & Chettri	2002	Nepal
Eria kamlangensis	A.N.Rao	2002	Arunachal Pradesh
Eria nepalensis	Bajrach. & K.K.Shrestha	2003	Nepal
Eria pokharensis	Bajrach., Subedi & K.K.Shrestha	2003	Nepal
Fargesia daminiu	T.P.Yi & J.Y.Shi	2007	Tibet
Festuca chayuensis	L.Liu	2002	Tibet
Flickingeria abhaycharanii	Phukan & A.A.Mao	2005	Assam
Gastrochilus sonamii	Lucksom	2003	Sikkim
Gaultheria akaensis	S.Panda & Sanjappa	2006	Arunachal Pradesh
Gaultheria bryoides	P.W.Fritsch & L.H.Zhou	2008	Myanmar
Gaultheria lohitiensis	S.Panda & Sanjappa	2006	Arunachal Pradesh
Gentiana tetramera	Miyam.	2008	Nepal
Glochidion mandakamdevi	Borthakur & Kalita	2006	Assam
Glochidion mandakatense	Kalita & Borthakur	2006	Assam
Gomphogyne nepalensis	W.J.de Wilde & Duyfjes	2007	Nepal
Goniophlebium krameri	Panigrahi & Sarn.Singh	2005	Arunachal Pradesh
Himalayacalamus planatus	Stapleton	2007	Nepal
Hymenidium lhasanum	Pimenov & Kljuykov	2004	Tibet
Hymenidium mieheanum	Pimenov & Kljuykov	2004	Tibet
Hypecoum zhukanum	Lidén	2008	Tibet
Impatiens namchabarwensis	R.J.Morgan, Y.M.Yuan & X.J.Ge	2005	Tibet
Jasminum cardiomorphum	P.S.Green	2003	Assam
Juncus mustangensis	Miyam. & H.Ohba	2003	Nepal
Lepidogrammitis sikkimensis	S.R.Ghosh	2004	Sikkim
Leymus mundus	L.B.Cai & X.Su	2007	Tibet
Liparis chungthangensis	Lucksom	2004	Sikkim
Liparis dongchenii	Lucksom	2000	Sikkim
Mallotus bicarpellatus	T.Kuros.	2005	Nepal
Meconopsis chankheliensis	Grey-Wilson	2006	Nepal

Species	Scientist(s)	Date of discovery	Distribution within Eastern Himalayas
Meconopsis ganeshensis	Grey-Wilson	2006	Nepal
Meconopsis simikotensis	Grey-Wilson	2006	Nepal
Meconopsis staintonii	Grey-Wilson	2006	Nepal
Meconopsis tibetica	Grey-Wilson	2006	Tibet
Metathelypteris krameri	Sarn.Singh & Panigrahi	2005	Arunachal Pradesh
Microlepia macrorhomboidea	Sarn.Singh & Panigrahi	2005	Arunachal Pradesh
Microlepia singhii	Panigrahi	2005	Arunachal Pradesh
Microula mustangensis	Yonek.	2008	Nepal
Mulgedium roborovskii	Tzvelev	2007	Tibet
Myrmechis bakhimensis	D.Maity, N.Pradhan & Maiti	2007	Sikkim
Oberonia hynniewtaii	Lucksom	2007	Sikkim
Oxytropis iridum	Dickoré & Kriechb.	2006	Tibet
Oxytropis lhasaensis	X.Y.Zhu	2004	Tibet
Pedicularis bhutanomuscoides	T.Yamaz.	2003	Bhutan
Pedicularis cacuminidenta	T.Yamaz.	2003	Bhutan
Pedicularis elephantiflora	T.Yamaz.	2003	Bhutan
Pedicularis flexosoides	T.Yamaz.	2003	Bhutan
Pedicularis griniformis	T.Yamaz.	2003	Bhutan
Pedicularis inflexirostris	F.S.Yang, D.Y.Hong & Xiao Q.Wang	2003	Tibet
Pedicularis limithangensis	T.Yamaz.	2003	Bhutan
Pedicularis pseudohookeriana	T.Yamaz.	2003	Bhutan
Pedicularis rigidescens	T.Yamaz.	2003	Tibet
Pedicularis roseialba	T.Yamaz.	2003	Bhutan
Pedicularis sunkosiana	T.Yamaz.	2003	Tibet
Penkimia nagalandensis	Phukan & Odyuo	2006	Assam
Persea arunachalensis	M.Gangop.	2006	Arunachal Pradesh
Persea haridasanii	M.Gangop.	2006	Arunachal Pradesh
Persea himalayaensis	M.Gangop.	2006	Nepal
Persea lohitensis	M.Gangop.	2006	Arunachal Pradesh
Persea sharmae	M.Gangop.	2006	Assam
Persea sikkimensis	M.Gangop.	2006	Sikkim
Phoebe baishyae	M.Gangop.	2006	Arunachal Pradesh

Species	Scientist(s)	Date of discovery	Distribution within Eastern Himalayas
Phyllanthus pseudoparvifolius	R.L.Mitra & Sanjappa	2003	Assam / Bhutan / Sikkim / Myanmar / Nepal
Piper arunachalense	Gajurel, Rethy & Y.Kumar	2001	Arunachal Pradesh
Piper nirjulianum	Gajurel, Rethy & Y.Kumar	2007	Arunachal Pradesh
Polygala bomiensis	S.K.Chen & J.Parn.	2008	Tibet
Polystichum panigrahianum	Sarn.Singh	2005	Arunachal Pradesh
Polystichum sublentum	Sarn.Singh & Panigrahi	2005	Arunachal Pradesh
Porpax seidenfadenii	A.N.Rao	2004	Arunachal Pradesh
Potentilla spectabilis	Businský & Soják	2003	Tibet
Potentilla squalida	Soják	2006	Tibet
Potentilla stipitata	Soják	2006	Tibet
Primula rebeccae	A.J.Richards	2004	Bhutan
Pronephrium clarkei	Sarn.Singh & Panigrahi	2005	Arunachal Pradesh
Pseudocyclosorus subornatipes	Sarn.Singh & Panigrahi	2005	Arunachal Pradesh
Pteris beddomei	Sarn.Singh & Panigrahi	2005	Arunachal Pradesh
Pteris himalayensis	S.R.Ghosh	2004	Assam / Sikkim
Pteris panigrahiana	Sarn.Singh	2005	Arunachal Pradesh
Pteris pseudoconfusa	Sarn.Singh & Panigrahi	2005	Arunachal Pradesh
Pteris pseudoesquirollii	S.R.Ghosh	2004	Assam
Pteris subhirtula	Sarn.Singh & Panigrahi	2005	Arunachal Pradesh
Pteris submiaoensis	Sarn.Singh & Panigrahi	2005	Arunachal Pradesh
Pteris tirapensis	Panigrahi & Sarn.Singh	2005	Arunachal Pradesh
Pteris vijaynagarense	Sarn.Singh & Panigrahi	2005	Arunachal Pradesh
Ptilagrostis macrospicula	L.B.Cai	2003	Tibet
Puccinellia strictura	L.Liu	2002	Tibet
Pyrrosia arunachalensis	Sarn.Singh & Panigrahi	2005	Arunachal Pradesh
Rhynchostylis albiflora	I.Barua & Bora	2002	Assam
Rivina bengalensis	S.C.Srivast. & T.K.Paul	2003	Bengal
Roscoea ngainoi	A.A.Mao & Bhaumik	2008	Assam
Salix nepalensis	Yonek.	2008	Nepal
Salvia transhimalaica	Yonek.	2008	Nepal
Saussurea erecta	S.W.Liu, J.T.Pan & J.Quan Liu	2005	Tibet
Saussurea rolwalingensis	Fujikawa & H.Ohba	2007	Nepal
Saxifraga dingqingensis	J.T.Pan	2006	Tibet

Species	Scientist(s)	Date of discovery	Distribution within Eastern Himalayas
Schefflera zhuana	Lowry & C.B.Shang	2006	Tibet
Selaginella namdaphaensis	Sarn.Singh & Panigrahi	2005	Arunachal Pradesh
Silene akiyamae	Rajbh. & Mits.Suzuki	2007	Tibet
Silene davidlongii	Rajbh. & Mits.Suzuki	2007	Nepal
Silene greywilsonii	Rajbh. & Mits.Suzuki	2007	Nepal
Silene hideakiohbae	Rajbh. & Mits.Suzuki	2007	Nepal
Sinocarum latifoliolatum	Pimenov & Kljuykov	2006	Nepal
Sinocarum meeboldioides	Pimenov & Kljuykov	2006	Nepal
Solms-laubachia calcicola	J.P.Yue, Al-Shehbaz & H.Sun	2008	Tibet
Sorbus khumbuensis	McAll.	2005	Nepal
Sorbus kongboensis	McAll.	2005	Tibet
Sorbus parvifructa	McAll.	2005	Tibet
Sorbus rushforthii	McAll.	2005	Tibet
Sorbus sujoyi	Ghora	2007	Assam
Strobilanthes abbreviata	Y.F.Deng & J.R.I.Wood	2006	Assam / Myanmar
Strobilanthes paniculiformis	J.R.I.Wood	2006	Assam
Taraxacum candidatum	Kirschner, Štěpánek & Klimeš	2006	Tibet
Tectaria khonsaensis	Sarn.Singh & Panigrahi	2005	Arunachal Pradesh
Tectaria mehrae	Panigrahi & Sarn.Singh	2005	Arunachal Pradesh
Thamnocalamus unispiculatus	T.P.Yi & J.Y.Shi	2007	Tibet
Tibetoseris angustifolia	Tzvelev	2007	Tibet
Tibetoseris ladyginii	Tzvelev	2007	Tibet
Trachycarpus ukhrulensis	M.Lorek & K.C.Pradhan	2006	Assam
Trapa assamica	Wójcicki	2003	Assam / Bengal
Trichomanes indicum	S.R.Ghosh	2004	Arunachal Pradesh
Trigonospora loyalii	Panigrahi & Sarn.Singh	2005	Arunachal Pradesh
Trigonospora subcaudipinna	Sarn.Singh & Panigrahi	2005	Arunachal Pradesh
Vaccinium myodianum	S.Panda & Sanjappa	2008	Arunachal Pradesh
Vulpia alpina	L.Liu	2002	Tibet
Zeuxine pantlingii	Av.Bhattacharjee & H.J.Chowdhery	2006	Bengal
		Sub-total	**242**

Species	Scientist(s)	Date of discovery	Distribution within Eastern Himalayas
REPTILES			
Asymblepharus mahabharatus	Eremchenko et al	1998	Nepal
Asymblepharus nepalensis	Eremchenko et al	1998	Nepal
Cnemaspis assamensis	Das & Sengupta	2000	Assam
Cretaceogekko burmae	Arnold & Poinar	2008	Myanmar
Gonydactylus markuscombaii	Darevsky et al	1998	Nepal
Gonydactylus martinstolli	Darevsky et al	1998	Nepal
Gonydactylus nepalensis	Schleich & Kästle	1998	Nepal
Japalura dasi	Shah & Kästle	2002	Nepal
Laudakia papenfussi	Zhao	1998	Tibet
Laudakia wui	Zhao	1998	Tibet
Lycodon zawi	Slowinski et al	2001	Assam / Myanmar
Sitana fusca	Schleich & Kästle	1998	Nepal
Sitana schleichi	Anders & Kästle	2002	Nepal
Sitana sivalensis	Schleich et al	1998	Nepal
Trimeresurus gumprechti	David et al	2002	Myanmar
Typhlops meszoelyi	Wallach	1999	Assam
		Sub-total	**16**
		GRAND TOTAL	**353**

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