



Langoué Bai, Ivindo National Park, Gabon.
PHOTO DAVID GREYO / COURTESY OF WCS AND ANPN

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In this chapter ecologist Kevin Njabo from Cameroon tells about the value and the state of the Congo Basin rainforest, the largest rainforest in the world after the Amazon. He describes its megabiodiversity and the functions of animals and plants in the forest ecosystem. Njabo is Adjunct Associate Professor at the Institute of the Environment and Sustainability and the Department of Environmental Health Sciences at the University of California, Los Angeles (UCLA). He is also Associate Director and Africa Director at the UCLA Center for Tropical Research and the Congo Basin Institute. He teaches in the US, Cameroon, China and in Rwanda.

Megabiodiversity in the Congo Basin rainforest

by Kevin Yana Njabo

The Congo Basin is the world's second largest rainforest after the Amazon and makes up one of the most important wilderness areas left on earth. With its 228,000,000 hectares, the Congo Basin represents 70% of the African continent's plant cover and shelters approximately 26% of the planet's rain forests and a wealth of biodiversity.

The Congo Basin rainforest contributes to the collective 30 percent of the world's oxygen supplied by rainforests. While nine countries (Angola, Cameroon, Central African Republic, Democratic Republic of the Congo, Republic of the Congo, Burundi, Rwanda, Tanzania, Zambia) have part of their territory in the Congo Basin, only six countries (Cameroon, the Central African Republic, Democratic Republic of the Congo, Republic of the Congo, Equatorial Guinea and Gabon)¹ are conventionally associated with the Congo Basin in general.

¹ Atyi RE, Devers D, de Wasseige C et Maisels F. 2009. État des forêts d'Afrique centrale: synthèse sous-régionale, In C. de Wasseige, Devers D, de Marcken P, Eba'a Atyi R, Nasi R et Mayaux P, eds. Les forêts du Bassin du Congo – État des forêts 2008. Luxembourg: Office des publications de l'Union européenne. 17–44. ISBN 978-92-79-132 11- 7. doi: 10.2788 /32456



The removal of any species from its ecosystem can drastically alter the populations of other organisms.

The Congo Basin, with a medley of rivers, forests, savannas, swamps and flooded forests, is teeming with life². Large mammals such as gorillas, elephants, buffalo mingle in the understory and ecotone areas. The rich biodiversity comprises over 11,000 species of tropical plants, of which 30% are unique to the region, over 1,200 bird species, 450 mammal species, 700 species of fish, about 280 species of reptiles, including snakes, crocodiles and tortoises, amphibians (frogs, toads, salamanders, newts, and worm-like caecilians)³, ranging from the high canopy to streams and creeks.

CLIMATE STABILITY The Congo Basin rainforest also plays an important role in climate stability and helps regulate local and regional rainfall. The region has an average temperature of 20 to 25 degrees Celsius, which remains relatively stable throughout the year, and a high humidity averaging 80 to 90 percent. However, there are some areas in the Congo Basin rainforest where the temperature can drop as low as 10 degrees Celsius due to the unique geography. In general, there are two primary seasons, the wet or rainy season and the dry season, which may vary slightly in different parts of the Congo Basin. The wet season typically begins in March and lasts into November and has several months of heavy rain, about 1,500 mm on average per year, while the dry season is drier with little precipitation. The region is very wet for most of the year, therefore most of the rainfall in Africa comes from the Congo Basin.

The region absorbs rainfall and releases it slowly into the atmosphere throughout evaporation during sunshine, creating air masses and clouds, which in their turn result in rainfall. Forests are not the only contributor to rain, but



Nki falls, Nki National Park, Cameroon.

PHOTO JAAP VAN DER WAARDE, WWF

they can influence the amount and timing of downpours^{4,5}. Massive deforestation in the Congo Basin rainforest may change rain patterns in Africa and perhaps result in more drought. As the forest is cleared, the rain decreases at a faster rate, leading to longer droughts and higher temperatures. The longer droughts mean that the fires are also longer and hotter, which clear more forest, hence speeding up the process. This could therefore put human sustaining activities such as agriculture in the Congo Basin and elsewhere in Africa at risk.

The Congo Basin is abundant in natural resources such as timber, diamonds and petroleum, but current methods and rates of extracting these resources are unsustainable and threaten the future of this vast wilderness area. The region is regarded as a prime target for future agro-industrial expansion and deforestation is particularly severe, largely driven by expanding subsistence agriculture to support the

high population growth rate (over 3.0% per annum)⁶, but also by commercial agriculture and logging. The publication ‘The Forests of the Congo Basin – State of the Forest’⁷ reports that the region’s annual overall deforestation rate doubled from 0.13 percent to 0.26 percent between 1990 and 2005. On the other hand, gross degradation caused by logging, fire, and other impacts increased from 0.07 percent to 0.14 percent on an annual basis according to the same report.

HUNTING PRESSURE In addition, unsustainable hunting of wildlife such as forest elephants, gorillas, forest antelopes, and other seed-dispersers for the commercial bushmeat market threatens to wipe out many species, mainly the ‘forest architects’. This unsustainable hunting of wildlife could have long-term impacts on the health and resilience of Congo Basin rainforests. Unless effective management plans are put into place, the hunting pressure is likely to increase,

with knock-on ecological effects⁸. Indeed, if current levels of hunting are maintained or increased, the forest architects and intermediate-sized animals will be reduced, and smaller-sized animals (small-bodied seed predators) not hunted by poachers will become the dominant species. This in turn will promote fast-growing tree species that are dispersed by wind instead of large-seeded, animal-dispersed, slow-growing, shade-bearing tree species, reducing carbon storage, fruit availability and associated biodiversity. In the end, the forests’ ability to support large frugivorous,

² www.worldwildlife.org

³ <http://kids.mongabay.com/elementary/204.html>

⁴ Barbara Fraser 2014. Forests may play a greater role in rainfall than estimated. CIFOR Report. <http://blog.cifor.org/22060/report-forests-may-play-bigger-role-in-rainfall-than-estimated?fnl=en>

⁵ Sheil, D.; Murdiyarso, D. 2009. Climate change, environmental services, transpiration. *BioScience* 59(4): 341-347. 10.1525/bio.2009.59.4.12

⁶ Joel Houricq Carole Megevand. 2013. Deforestation Trends in the Congo Basin Reconciling Economic Growth and Forest Protection. Working Paper. The World Bank Africa Region

⁷ The Forests of the Congo Basin – State of the Forest 2013. Eds: de Wasseige C., Flynn J., Louppe D., Hiol F., Mayaux Ph. – 2014. Weyrich. Belgium. 328 p.

⁸ K. A. Abernethy, L. Coad, G. Taylor, M. E. Lee, and F. Maisels. 2013. Extent and ecological consequences of hunting in Central African rainforests in the twenty-first century. *Philos Trans R Soc Lond B Biol Sci.* 2013 Sep 5; 368(1625): 20120303. doi: 10.1098/rstb.2012.0303



PHOTOS: VIOLETTE DÉROZIER



Upper left: Black crested mangabey (*Lophocebus aterrimus*). Upper right: Red colobus (*Piliocolobus badius tholloni*).
Below: Male Mandrill (*Mandrillus sphinx*).



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800,000 hectares of the Congo Basin forests are lost every year.

seed-dispersing mammals will greatly decline, spurring a negative feedback loop whereby both large mammals and large-seeded, long-lived, hard-wooded trees will further decline, which in its turn will reduce carbon storage and hence global resilience to climate change. Critically threatened by the aforementioned pressures, the wildlife of the Congo Basin relies on refuges such as transboundary protected areas as the Sangha River Tri-national Protected Area in the Central African Republic, the Republic of Congo and Cameroon. Transboundary conservation⁹, an “eco-regional” approach to conservation, has acquired greater significance because international treaties, such as the Convention on Biological Diversity, have included such projects in their programme of work. Such sites also provide opportunities for ecotourists to seek glimpses of native fauna.

Humans have been known to inhabit the Congo Basin for more than 50,000 years, where their lives and well-being are linked intimately with the forest. The region provides food, medicine, fresh water, shelter and security to more than 75 million people of nearly 150 distinct ethnic groups. Unique among these ethnic groups are the Baka people who are among the most well-known representatives of the ancient hunter-gatherers. However, the Bakas are slowly becoming a more sedentary people due to the intensive deforestation of the rainforest¹⁰. Currently, the region has a low human population density (approximately 30 people per square kilometre in 2005), of which over 60% live in rural areas, but a high population growth rate (over 3.0% per annum). Historically, the region has been subject to relatively low levels of anthropogenic disturbance, related not only to low human population densities, but also to widespread poverty (gross income per capita was around 600 US dollars in Sub-Saharan Africa in 2015, and slightly over 380 US dollars annually for the Congo Basin countries¹¹.

MEGABIODIVERSITY In the Congo Basin the Democratic Republic of the Congo is known for its megabiodiversity. Megabiodiversity¹² refers to the number and variation of animal and plant species native to an area. The term was first introduced

in 1998 at the Conference on Biodiversity at the Smithsonian Institution in Washington D.C. Among the countries listed as megabiodiverse, the Democratic Republic of the Congo was the only one in the Congo Basin. The other countries listed were Australia, Brazil, China, Colombia, Ecuador, India, Indonesia, Madagascar, Malaysia, Mexico, Papua New Guinea, Peru, Philippines, South Africa, United States, and Venezuela.

The factors that influence biodiversity include hot temperature, the amount of rainfall, soil, and altitude, among others. Such simple descriptions indicate that the countries within the Congo Basin, in addition to the Democratic Republic of the Congo listed at the Conference on Biodiversity, are megabiodiverse since they are all close to the earth’s equator and the hot, moist, stable environments of the ecosystems within the Congo Basin rainforests allow flora and fauna to thrive.

BIODIVERSITY PER COUNTRY IN BRIEF

Democratic Republic of Congo (Kinshasa, Congo DRC) With an area covering over 100 million hectares, the Democratic Republic of Congo (DR Congo) has the greatest extent of tropical rainforests in Africa. The forests in the eastern sector are amazingly diverse and one of the few forest areas in Africa to have survived the ice age^{13, 14}. Almost half of the DR of Congo is covered by primary forest, and this forest cover provides a refuge for several large mammal species such as the African forest elephant, golden cat,

⁹ Saleem H. Ali. 2011. Transboundary Conservation and Peace-building: Lessons from forest biodiversity conservation projects. ITTO and the United Nations University Institute of Advanced Studies (UNU-IAS). UNU-IAS Policy Report.

¹⁰ <http://www.pygmies.org/baka/introduction.php>

¹¹ Tchatchou B, Sonwa DJ, Ifo S and Tiani AM. 2015. Deforestation and forest degradation in the Congo Basin: State of knowledge, current causes and perspectives. Occasional Paper 144. Bogor, Indonesia: CIFOR.

¹² <http://www.conservation.org/documentaries/Pages/megadiversity.aspx>

¹³ Hamilton, A.C. 1982. African forests, in *Tropical Rainforest Ecology and Management*

¹⁴ Mayaux, P. and J-P. Malingreau. 1996. Central Africa forest cover revisited: an iterative approach based on a multi-satellite analysis, *Ambio* July, 1996.

golden wolf, leopard, and manatee driven to extinction in other African countries. Overall, the country is known to have more than 11,000 species of plants, 450 mammals, 1,184 birds of which 20 are endemic and 41 globally threatened, 300 reptiles, and 200 amphibians.

Republic of Congo (Brazzaville)

The Republic of Congo (Brazzaville) is second only to the Democratic Republic of Congo in terms of tropical rainforest coverage among African countries. It is also strikingly diverse for its size and home to 727 species of birds of which 13 are globally threatened, 166 mammals, 58 amphibians, 149 reptiles, and more than 6,000 species of plants.

Gabon

With an area of nearly 270,000 square kilometres of which 80% is forested, Gabon holds some of Africa's most biodiverse rainforests. It has an estimated 8,000- 10,000 species of plants (20 percent of which are endemic), more than 757 species of birds of which 16 are globally threatened, and nearly 200 mammals including lowland gorillas, chimpanzees, 10 species of monkeys, forest elephants, and even hippos that surf ocean waves. Gabon is one of unique places of the world where a primary tropical rainforest extends to the Atlantic Ocean beach¹⁵. Offshore the country has a wealth of marine life, including a large population of humpback whales, while the forested coastal terrain of its famed Loango National Park shelters a diversity of wildlife.

Cameroon

The country has some 978 species of birds of which 11 are endemic and 33 globally threatened, 211 mammals, 322 reptiles, 192 amphibians, and 8,260 species of plants.

¹⁵ <http://rainforests.mongabay.com/zogabon.htm>

¹⁶ Kenneth, Whitney, Mark K. Fogiel, Aaron M. Lamperti, Kimberly M. Holbrook, Donald J. Stauffer, Britta Denise Hardesty, V. Thomas Parker and Thomas B. Smith 1998. Seed dispersal by *Ceratogymna* hornbills in the Dja Reserve, Cameroon. *Journal of Tropical Ecology* 14:351-371

Central African Republic

The Central African Republic is home to about 3,600 species of plants, 794 birds of which 13 are globally threatened, 131 mammals, 187 reptiles, and 29 amphibians.

Equatorial Guinea

Equatorial Guinea is found in a region of high animal diversity, including 194 species of mammals, 853 birds of which one is endemic and 18 globally threatened, and 91 reptiles. The country is also home to 3,250 species of plants.

BIRDS OF THE CONGO BASIN The Congo Basin forests are indeed rich in birdlife, from the African grey parrot to the western bronze-naped pigeon and the bare-cheeked trogon to the African crowned eagle, the vermiculated fishing-owl and the white-crested hornbill, plantain-eaters and numerous parrot species. These birds play a great role in the movement (dispersal) of seeds, which is a crucial part of forest regeneration. Indeed, birds disperse the seeds of more than two-thirds of the plant species in Congo rainforests and hornbills alone disperse 22% of the known tree flora of the Dja forest in Cameroon¹⁶. The dispersal of seeds throughout the forest increases the chances that seedlings will grow and survive. Moreover, dispersal allows plants to colonize new areas, including land that has been cleared. Parrots, hornbills, turacos as well as other fruit-eating animals, feed on fleshy fruits of Congo rainforest plants and spread them by regurgitating, defecating or burying seeds to help the tropical trees reproduce. Some plants also grow sticky or have spiky seeds that latch onto birds' feet and feathers. There is evidence that the colour of certain fruits have evolved to attract birds and plants have been shown to put the minimum possible flesh around their seeds – just enough to attract the birds to eat them. Birds are likely to become increasingly important in forest regeneration as the populations of larger mammalian seed dispersers, such as forest elephants, primates and other megafauna decrease. Most of the plants that are not dispersed by animals are dispersed by wind.

Top left: *Pyrenestes ostrinus*; top right: *Smithornis rufolateralis* bis; middle left: *Anhinga rufa*; middle right: *Chalcomitra rubescens*; below left: *Malimbicus malimbicus*; below right: *Malimbus coronatus*.
PHOTOS VIOLETTE DÉROZIER





PHOTO JAAP VAN DER WAARDE, WWF



PHOTO JAAP VAN DER WAARDE, WWF



PHOTO LEE WHITE / ANPN



PHOTO MATTHIAS DAHMEN



PHOTO JAAP VAN DER WAARDE, WWF

If the forest elephants disappear, the forests will be greatly threatened or may vanish as well.

MAMMALS OF THE CONGO BASIN The Congo Basin is home to at least 450 mammal species and is well known for its large population of forest elephants (*Loxodonta cyclotis*) and primates (apes, monkeys, and prosimians such as bush babies). The forest elephant is the largest terrestrial mega-herbivore in the rainforest and weighs approximately 5,000 kilograms. Several tree species strongly rely on forest elephants as seed dispersers and they play an important ecological role in maintaining forest ecosystem diversity. The main diet of elephants is the fruit of forest trees, but they also commonly feed on bark and leaves. They are thus considered as super spreaders, that is, they spread and plant more seeds in the Congo Basin than any other species, and if the forest elephants disappear, the forests will be greatly threatened or may vanish as well. The number of elephants have fallen from around 700,000 to below 100,000 due to the extreme demand for ivory and the resultant poaching, and half of the population that remains is found in Gabon. The good news is that some places in Central African Republic, Congo-Brazzaville and Gabon have relatively undisturbed elephant populations.

The Congo Basin is also well known for its large population of primates, with the highest diversity found in the Atlantic coastal forests (from Cameroon to Gabon) and in eastern DRC. Species such as the bonobo (*Pan paniscus*), the sun-tailed monkey (*Cercopithecus solatus*), the lesula monkey (*Cercopithecus lomamiensis*) and the black colobus monkey (*Colobus satanas*) can only be found in the Congo River Basin.

The endangered western lowland gorilla (*Gorilla gorilla*) and eastern lowland gorilla (*Gorilla berengei graueri*), also find their home in the Congo Basin. The mountain gorilla (*Gorilla beringei beringei*) in eastern Democratic Republic of Congo (DRC), is one of the two subspecies of the eastern gorilla.

From top to bottom: Female Sitatunga (*Tragelaphus spekii*); Hippopotamus, Loango National Park, Gabon; Genetta servalina and forest buffaloes.



Above: Chimpanzees (*Pan troglodytes*). Below: Mountain gorillas (*Gorilla beringei beringei*).



Lesula (*Cercopithecus lomamiensis*). Endemic to the Democratic Republic of Congo. Discovered in 2007 by western scientists, previously undescribed.

PHOTO MAURICE EMETSHU, HART ET AL. (2012)



CHIMPANZEES The distribution of chimpanzees across Equatorial Africa is wide but discontinuous. It expands from southern Senegal across the forested belt north of the Congo River to western Uganda and western Tanzania, with the largest remaining populations occurring mainly in Gabon, Democratic Republic of Congo (DRC), and Cameroon. Three subspecies have been described in this region based on differences in appearance and distribution: the most numerous of the three is the Central chimpanzee (*Pan troglodytes troglodytes*). The other two are the Eastern chimpanzee (*Pan troglodytes schweinfurthii*), and the Nigeria-Cameroon chimpanzee (*Pan troglodytes ellioti*). These three subspecies have been known to exhibit a wide range of behavioural differences between the groups, so it is important to protect each as the loss of any one group is a loss of cultural as well as biological heritage.

A population of “super-sized” chimpanzees, the so-called Bili apes that the local people believe to feed on birds, has been reported from Bili Forest in the far north of the Democratic Republic of Congo. Indeed, these chimpanzees have been observed eating the carcass of a leopard, but there is no scientific evidence that they hunt and kill big cats. However, the Bili chimpanzees exhibit unusual behaviour, because they sleep in large nests on the ground rather than in trees. This is a possible indication of the lack of fear of predators.

The populations of the mammals of the Congo Basin are seriously threatened. Gorillas are slaughtered, packaged and shipped around the world, while elephants are hunted for meat, skin, bones, and tusks. In 1989 the hunting of the African elephant for ivory trading was forbidden, but trophy hunting continues despite increasingly severe penalties imposed by governments against illegal hunting. Like elephants, primates play an integral role in the ecology of the forest. They help the forest by being pollinators, seed predators (feeding on the seeds of plants as a main or exclusive food source), and seed dispersers (movement or transport of seeds away from the parent plant). Their predominantly vegetarian diet allows them to build up higher population densities than the carnivorous mammals,

and their tree-living nature or arborealism permits them to make use of all edible plant material available in a tridimensional environment.

“GHOSTS IN THE DARKNESS” Other interesting mammals found in the Congo Basin include three species of pangolins¹⁷, the only mammals in the world covered in scales and the world’s most hunted animal. Pangolin scales are believed to cure everything from cancer to acne. The little-known leopards (*Panthera pardus*), also known as the “ghosts in the darkness”, find their home in the Congo Basin occupying both the rainforest and arid desert habitats. Hoofed mammals, or ungulates, several varieties of wild pigs, the red river hog and – largest of all – the dark, hairy giant forest hog can also be found here. Other interesting mammals include the small to medium-sized antelopes (such as the blue and yellow-backed duikers), the bushbuck and the swamp-dwelling sitatunga or marshbuck. The biggest rain forest antelope is the mostly nocturnal forest ungulate, commonly called the bongo – the only spiral-horned antelopes in which both sexes have horns. The largest ungulate in the Congo Basin, the hippopotamus, which can weigh up to 3,500 kilograms, inhabits a diminished range of waterways within the Congo Basin. The only close relative of the giraffe, the tall, elegant but short-necked okapi finds its home in gaps and clearings. Forest buffalo, smaller and redder than the savanna subspecies of African buffalo, graze and wallow in marshy glades.

¹⁷ Gaudin, Timothy. 2009. The Phylogeny of Living and Extinct Pangolins (Mammalia, Pholidota) and Associated Taxa: A Morphology Based Analysis. *Journal of Mammalian Evolution*. 16 (4): 235–305

Massive deforestation in the Congo Basin rainforest may change rain patterns in Africa and perhaps result in more drought.

PLANTS OF THE CONGO BASIN With more than 11,000 species of tropical plants, including over 600 tree species, the Congo Basin is very rich in plant life. Several common foods and medicinal plants are harvested from the rainforest, biochemicals are extracted and are used to synthesize drugs. International Cancer Institutes have identified 1,400 tropical forest plants with a potential to fight cancer¹⁸. Of the tropical plants 1,100 are endemic to the Congo Basin forest and found nowhere else. Around 69 of these plants are threatened. Broad-leaved trees, such as African oak, red cedar, and mahogany, form a dense upper canopy, usually over 40 metres above ground, while smaller trees of various sizes form several canopies below. The competition for light in the understory implies that tall growth is necessary, as only about 1% of the light reaches the ground. The African hardwood mahogany is abundant and popular for its dark-coloured wood. It is used to make furniture, wood flooring, and the exterior of yachts and boats because it has an interlocking grain which makes it resistant to water damage and seepage. Due to its light weight, the okoume tree is heavily logged, and used to make plywood as well as wood veneer products. Lianas and Ficus (strangler figs), also known as climbers, send shoots around the trees to obtain more sunlight. The very bottom layer of the forest is made up of rapidly decomposing dead leaves, moss growing on downed and rotting trees, and small ferns, because few plants can survive on this layer. The dead trees provide shelter and breeding sites for bats and birds, as well as other small animals. The decomposition of dead materials is therefore very important to the rainforest as plants depend on mineral nutrients.

CORRELATION Plants are the most important producers. They use energy from sunlight to convert carbon dioxide into glucose (or other sugars) through the process of photosynthesis, providing organic molecules for energy (food) for the entire ecosystem. Plants also produce oxygen, required by most organisms including humans, and shelter many great animals of the earth as well as small organisms among their leaves and roots. There is a direct correlation between the

number of plants found in an area of the rainforest, and the number of insects because there is an interdependent relationship between insects and plants. Many insects eat plants, their dung goes into the soil, which provides nutrients for the plants to grow. Insects also play an important role in the pollination of plants insuring their survival. Other insects inhabiting the forest are also linked to human diseases, such as the tsetse fly, which causes severe sleeping sickness and the mosquito, which carries malaria and yellow fever. Other important roles of plants include helping to hold soil in place and they can help filter the air and water, removing certain contaminants such as formaldehyde, benzene, and carbon monoxide from the air by absorbing these gases through their leaves and roots through a technique known as phytoremediation. The micro-organisms that live in the soil also play an instrumental role in neutralizing volatile organic compounds (VOCs) and other pollutants.

Unfortunately, 800,000 hectares of the Congo Basin forests are lost every year due to human activities such as logging, mining, agriculture and fuel wood for a growing population¹⁹. This forest loss negatively impacts the lifestyle of people and threatens the wildlife established in this area. It also causes greenhouse gas emissions, therefore igniting the repercussions on global climate change. Scientists believe that two thirds of the Congo Basin forests could be lost by 2040, unless adequate efforts are firmly implemented to protect them. Rainforest restoration will bring back landscapes that support healthy populations of seed dispersers. Some plants are not likely to be dispersed naturally in small rainforest remnants, regrowth or replanted sites. Planting or directly seeding locally native species from these groups will mean that they will be present in future forests in these areas.

¹⁸ Global Biodiversity: Status of the Earth's Living Resources. 1992. Report by World Conservation Monitoring Centre. Editor Brian Groombridge. Natural History Museum London.

¹⁹ The State of Forests in the Amazon basin and Southeast Asian. Brazzaville, Republic of Congo: Food and Agriculture Organization of the United Nations (FOA). ISBN 978-92-5-106888-5. 2012





Top: Rhampholeon spectrum spectrum, photo Matthias Dahmen. Below: Blueish viper, photo Jonas Eriksson Abana.



In some areas reptiles such as constrictor snakes, help control serious agricultural plagues by consuming rodents and insects that can destroy crops.

REPTILES OF THE CONGO BASIN Over 280 species of reptiles, including snakes, crocodiles and tortoises are found in the Congo Basin. The forest indigenous hinge-back tortoises thrive in marshy areas along rivers and streams. Unlike other tortoises, the forest hinge-back tortoise can only lay two to five eggs at a time on the ground covered with leaves. The Congo Basin is also home to some of the world's venomous snakes, including the black mamba, cobras and vipers. Gaboon vipers inhabit savannas and the rainforest as the heaviest vipers with the longest fangs and the highest amount of venom among venomous snakes²⁰. Gaboon vipers are fast strikers, though they are considered to be tolerant and would not bite unless severely provoked. There are hundreds of species of snakes living in the world's tropical rainforests and all are carnivores, including the African black iguana (*Endothermis iguanaformis*). It is not related to true iguanas, in fact it is a snake believed to have evolved from the black mamba of sub-saharan Africa and it retains the extreme venom of its ancestor, the black mamba, which it uses to hunt. Snakes are either venomous or non-venomous, but most snakes of the Congo Basin are non-venomous.

The African slender-snouted crocodiles dwell in the rivers, marshes, ponds and lakes within the Congo rainforest and other parts of West and Central Africa. This crocodile has an extremely slender snout that limits its diet to fish, amphibians, crustaceans and small mammals. It is the least known crocodile and also the only crocodylian species that can climb as high as several metres in the limbs of fallen trees. The Nile and dwarf crocodiles are also native to the Congo River Basin.

NUTRIENT RECYCLING In freshwater ecosystems of the Congo Basin, several species of turtles are critical components for nutrient recycling through ingestion and excretory processes, as well as nutrient retention. Freshwater turtles feed and spend most of their time in aquatic systems, but all species

emerge to lay eggs throughout the terrestrial landscape. Turtles are therefore an important component of the food webs in the Congo Basin forest ecosystem, and they play a critical role both as predators of plants that grow in the water, small insects, snails, worms, and even dead marine animals and fish, as well as prey species of crocodiles, some big cats may gnaw at a turtle shell until they reach the turtle.

The herbivorous reptiles such as tortoises can also be important seed dispersers. Reptile species may also have a useful anthropogenic role in ecosystems. For example, they have been popularly used in symbology and myth. Some local communities of the Congo Basin use snakes as a symbol of power and for medicine and sometimes evil. Turtles, on the other hand, usually represent longevity and stability, and are also often associated with creation stories. In some areas, reptiles such as constrictor snakes, help control serious agricultural plagues by consuming rodents and insects that can destroy crops.



Northern four-horned chameleon (*Triceros quadricornis gracilior*). PHOTO JAAP VAN DER WAARDE, WWF

²⁰ Mallow D, Ludwig D, Nilson G. 2003. True Vipers: Natural History and Toxinology of Old World Vipers. Malabar, Florida: Krieger Publishing Company

AMPHIBIANS OF THE CONGO BASIN The Congo Basin rainforest is home to hundreds of species of frogs and toads, as well as species of caecilians. The caecilians superficially resemble worms or snakes and lay eggs in soils. The eggs hatch into aquatic larva that live in streams or seepages of the soil, though some species skip the larva stage and develop into juveniles at once. The altitude ranges of the amphibians vary, with some species such as the Schmidt's snouted frog, *Mertensophryne schmidti*²¹ living at extremely high altitudes. The habitats of these toads and frogs also tend to extend to

other regions of Western Africa, and some species are also found in East Africa. Some examples of amphibians from the Congo Basin rainforests include the very distinctive patterned African Painted Frog (about 250 (!)) species of this frog find their home in the Congo Basin) and the Bushoho Reed Frog.

²¹ Frost, Darrel R. (2015). *Mertensophryne schmidti* Grandison, 1972. Amphibian Species of the World: an Online Reference. Version 6.0. American Museum of Natural History.

From top to bottom: *Afrivalus paradorsalis*, *Hyperolius adpersus*, *Cardioglossa nigromaculata*, *Hyperolius flusciventris*, *Hyperolius bolifambae*. Large picture, far right: *Leptopelis brevirostris*.
PHOTOS MATTHIAS DAHMEN



HERPS

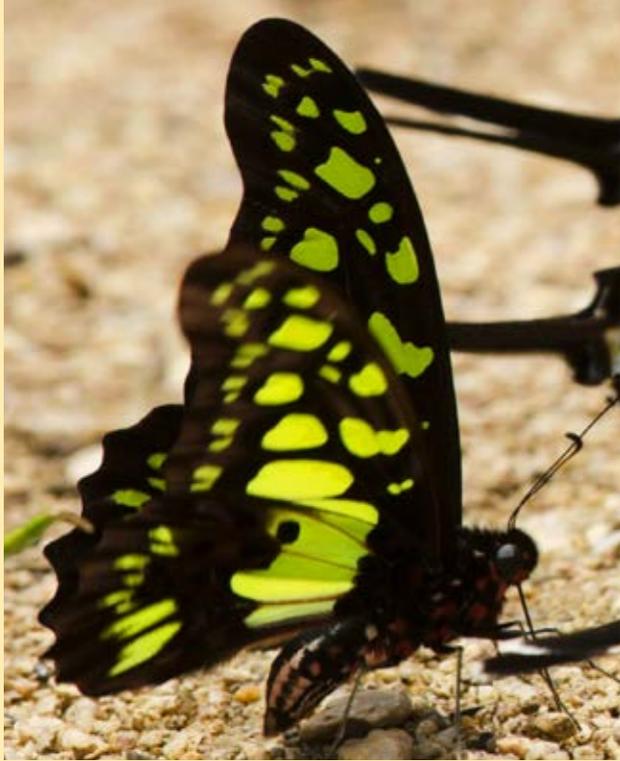
Collectively, reptiles and amphibians are known as herps and can achieve remarkable densities and biomass and have high metabolic efficiencies, which means that they have an ability to use internally stored nutrients, specifically carbohydrates and fats, more efficiently. Because of their “low-energy life styles”, herps can also prey extensively on small invertebrates such as mites and ants. Many of the invertebrates that are important in the diets of herps influence the decomposition, distribution and abundance of plant species.

The removal of any species from its ecosystem can drastically alter the populations of other organisms, but those that have a particularly influential role within an ecosystem are known as keystone species. Top predators, such as the crocodile, are often keystone species, though they also contribute to the food chain as prey while they are still young. Some species of crocodiles such as the slender-snouted crocodile of the Imame and the Lomami River of DRC are considered to be critical for the way they adapt to their habitats. Such adaptations include body armour that protects them from

predators, strong jaw muscles that allow them to crush bones, a powerful immune system to fight off illness, behaviours that allow them to control body temperature, an evolved metabolism that allows them to go for extended periods without food, and the ability to shut down their body and live from its own tissue if the need arises.

Many herps are threatened by habitat loss, and environmental change. Amphibians for example, are particularly at risk from a deadly disease caused by the Chytrid fungus²² that is spreading around the globe. This disease has already caused the extinction of at least 170 species of frogs and toads over the past 30 years and scientists are not sure what is causing the outbreak or how it can be controlled. Emergency measures are currently implemented for some endangered species, which are collected and kept in zoos, aquariums, and botanical gardens until a cure can be found.

²² Olson, Deanna H. et al. (2013). Stajich, Jason E, ed. Mapping the Global Emergence of *Batrachochytrium dendrobatidis*, the Amphibian Chytrid Fungus. PLoS ONE. 8 (2): e5680z.



INSECTS OF THE CONGO BASIN There could be around 30 million of all sorts of amazing insect species on earth and a great many live in the world's tropical forests. Some colourful, some scary, and some very strange looking. The Congo Basin rainforest is home to butterflies, ants, stick insects, and a considerable diversity of other insects ranging from the smallest wasps commonly called fairy flies (*Mymaridae*) to the giant rainforest insects such as goliath and titan beetles. The most abundant insects are believed to be ants (for example, the African weaver ants – *Oecophylla longinoda* – are a dominant ant species and well known for their painful bite), but beetles account for the highest known diversity and include over 370,000 different species in the Congo Basin. The common name of the African weaver ants reflects their weaving behaviour, where they use their silk-exuding larvae as living glue guns gluing leaves into hollow balls where they nest. Their nests are spread through the trees and they even build small leafy barracks at territory boundaries. The weaver ants are very aggressive and fiercely territorial.

RHINOCEROS BEETLES The Rhinoceros beetles (*Dynastinae*) are the most common and diverse beetles in the Congo Basin. Although found worldwide, little is known about their life history. They seem to only live in forests and probably feed on soil humus. The males have larger horns than females

and use these to carry females or for defence mechanism. When males carry out these behaviours, they make a mysterious sound and its function and cause are not yet known. An interesting beetle native to West and Central Africa feeding on sap and nectar is the goliath beetle. The goliath beetles belong to the heaviest insects in the world and are often desired by collectors. Despite their weight, they can still fly competently. Other examples include the little-known titan beetles (*Titanus giganteus*) and the Stingless bees (*Meliponinae* family), also known as barber bees and hair-cutting bees. The bees have a defensive behaviour when disturbed and attacked. Some species are harmless and simply try and fly into your mouth and ears to make you move, whereas others cut the skin and spray an acrid solution into wounds, which explains their other name of fire bees. Other sting-lacking bees, ants and wasps have a similar defence.

BUTTERFLIES There are well over 1,000 species of butterflies and moths in the Congo Basin. A few examples of butterfly species in these forests are the emperor moth (*Saturniidae*) and swallowtail butterfly (*Papilionidae*) families, the clear-wing butterfly, owl butterfly, leaf-wing butterfly (family *Nymphalidae*), and the blue morph butterfly (family *Morphidae*). Butterflies are perhaps the most beautiful

insects in the rainforest and adult butterflies feed by sipping liquid food with their long tongue (called a proboscis). Mostly, this food is nectar from flowers, but some butterflies live on other types of liquid, such as from rotting fruit.

Insects play a very important role in the health of all tropical rainforests, including the Congo Basin rainforest, and their rapid demise can have severe consequences for these biomes. For example, insects serve as an important food source for many higher animals such as birds, lizards, frogs, and bats. They are also agents of soil fertility, because many insects eat leaves, bark and other parts of plants. The insects' excrement is deposited into the soil with the organic matter already significantly broken down into micro-organisms that decompose the organic matter even further, supplying nutrients into the soil for plant growth. Some insects, such as the bark beetle, colonize dying trees and kill them as a result of their feeding. The benefits are that nutrients from the trees bark are returned to the soil, room is made for new trees and plants, and a little more sunlight may be made available for forest layers below the canopy.

Because plants are an important part of the rainforest, insects help plants reproduce by transporting pollen from one plant to another. Many plants produce nectar that attracts numerous insects, including butterflies, flies, and beetles. These insects drink the nectar and eat the plants pollen, carrying the pollen to other plants and pollinating them. Many plant species can only be pollinated successfully by one or two species of insects. Therefore eliminating the insect from the forest will result in the extinction of the dependent plant species.

KNOWLEDGE OF INDIGENOUS PEOPLE IS IMPORTANT FOR NATURE CONSERVATION



Bakas, southern Cameroon.

In addition to containing thousands of species of plants and animals, and sources of water, food and medicine, the Congo Basin rainforests are also home to tens of thousands of indigenous forest communities, who are directly impacted in many ways by both forest exploitation and conservation. These indigenous peoples play a key role in climate change mitigation and adaptation. Preserving the forests would not only support the climate change objectives, but it would respect the rights of indigenous peoples and conserve biodiversity as well. A climate change agenda fully involving indigenous peoples has many more benefits than when only government and/or the private sector are involved. Deforestation and degradation disrupt these communities, and in some cases trigger conflict. Indigenous peoples have the most intimate contact with the diverse ecosystems they inhabit, and are characterised by traditions, cultures, and knowledge of their environments, plants, medicine, astronomy, inner science, and land and soil management. For example, indigenous peoples have developed adaptation models to climate change over the millennia. They have also developed genetic varieties of medicinal and useful plants and animal breeds with a wider natural range of resistance to climatic and ecological variability. They are therefore carriers of ancestral knowledge and wisdom about the biodiversity. Even the Paris Agreement on climate change²³ recognizes the intrinsic relationship between indigenous peoples and their environments. What all indigenous peoples have in common is a deep connection to the natural environments in which they live. Their effective participation in biodiversity conservation programmes and in managing natural resources would result in a greater comprehensive and cost effective conservation and management of biodiversity in the Congo Basin.

²³ http://ec.europa.eu/clima/policies/international/negotiations/paris/index_en.htm