Who studies lianas and what needs to be studied? Lianas are currently studied by a widespread and a broad community of ecologists and plant biologists around the world. Our research efforts on lianas, like perhaps many other 'specialist' groups, depends on a dedicated interest, often carried out in parallel with other research and other institutional obligations. Like many specialist research groups, our work on lianas is all too often maintained despite a reluctance of national agencies to fund it.

The fact that lianas might have a profound effect on forest dynamics possibly as a result of global climate change reflects a general situation relevant to many other working groups — that specialist knowledge and research on particular, perhaps one might say 'arcane' groups of plants and animals, their identification, their functional traits, their ecology and evolution are pivotal for understanding potentially global patterns of change in biodiversity.

Recent discussions among liana specialists have focused on the need for more ecological and long-term census-plot information to add to the patterns emerging from work in the Neotropics. Also, it is becoming clear that more experimental work is required to understand the functional traits and potential cause–effect patterns that explain why certain life histories might be favoured by certain conditions. Finally, little is known about liana roots, though experimental results over recent years indicate that below-ground competition for resources might be just as important as above-ground competition.

What new stuff is to be learned about lianas? Besides all of the well-documented ethnobotanical uses of liana species world-wide — as food products, medicines, rope substitutes, textiles, basketry, etc., — lianas develop highly derived morphological traits that are of interest to bio-inspired research for many potential technological innovations. Attachment organs from highly sensitive hook and spine-bearing stems to sticky pads that form attachments at the cellular level and then produce natural adhesives, to tendril-bearing organs that optimize attachment via highly optimized growth, are all of potential interest for bioinspired attachment devices of use for technological applications such as smart textiles and robotics. Furthermore, many liana stems produce structures that are highly resistant to fracture that have a potential interest for many applications where cable, tube and pipe systems must ensure delivery of electricity, fluids or gasses following high levels of mechanical stress.

In summary, lianas are an important growth form in tropical forests and potentially changing dynamics of tropical forests. Large-scale studies investigating biomass sequestration and biodiversity levels in tropical forests must take into account this functional group as well as many other kinds of plant and animal life histories. Besides their role as potential ecosystem changers, lianas can potentially offer a wide range of ecosystem services — from supporting current high levels of biodiversity and habitat diversity to providing new lines of research for bioinspired technologies.

Where can I find out more?

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The Sumatran rhinoceros was extirpated from mainland East Asia by hunting and habitat loss

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The sequencing and analysis of the Sumatran rhinoceros genome provides vital data for understanding the history of the subspecies in Sumatra [1], but not for reconstructing the history of the population on the mainland after the two were separated by rising seas in the early Holocene. Evidence from zooarchaeology, texts and artifacts makes clear that the Holocene range of the Sumatran rhinoceros extended all the way from the tropics to the temperate Yellow River Valley of North China (35° North), and that humans have extirpated the species from most of its range. While the name 'Sumatran' suggests that these are tropical animals, in fact they are the only extant hairy rhinoceros, which presumably protected them from cold, and are the most closely related of all living rhinoceroses to the extinct cold-adapted woolly rhinoceros [2].

Zooarchaeologists have identified Sumatran rhinoceros bones at five mid-late Holocene sites in North China [3], but China lacks comparative collections of rhinoceros bones, so the only way they can identify bones to the species level with certainty is with a well-preserved skull, as Sumatran rhinoceros are the only Asian rhinoceros with two horns. They have yet to find an intact skull, but fortunately we have another form of evidence in the form of several bronze artefacts from the first millennium BC that depict rhinoceros [3]. All of these have two horns, which seems to confirm that the Sumatran rhinoceros was the only species in North China. But it may not have been the only rhinoceros in South China: Javan rhinoceros has only been identified at one archaeological site outside of

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Figure 1. Sumatran rhinoceros in art.
Bronze vessel in the shape of a Sumatran rhinoceros, c. 200–0 BCE. Unearthed at Xingping, Shaanxi, China, in 1963. Photo: BabelStone - CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=16191697

southeast Asia (and this identification is based only on a poorly-preserved skull excavated in the 1970s at Hemudu, Zhejiang), but its range may once have extended into Southeast China [4,5].

Historical texts from the first millennium BC record that North Chinese people hunted rhinoceroses for their hides, which they used to make armor [3]. The lack of subsequent evidence from the region suggests that Sumatran rhinoceroses had been extirpated from North China by the time of the first census of 2 AD, when there were already over 40 million people living in the region, and many of its natural ecosystems had been replaced with farmland. Although rhinoceros were gone from North China, their horns had come to be seen as a material with magical properties, so drinking cups and fashion accessories made of rhinoceros horn continued to be luxury commodities in Chinese high society [6,7]. Rhinoceros horns were fashioned into cups because they were believed to neutralize poison, and this belief is probably related to the idea that they are a powerful medicine, which has since become the main use of horns [7,8]. These ideas spread across East Asia, from Korea to Vietnam, creating a large market for rhinoceros horns. For many centuries China's imperial governments required people in South China to send horns to the court as tribute. For example, the central Yangzi Valley sent horns north as tribute until about 1000 AD, by which time rhinoceros seem to have been extirpated from most of the Yangzi Valley, after which they were imported from regions further south [9]. The fact that rhinoceros horns were already being shipped from Africa to China in the eighteenth century reveals the power of the East Asian market in funding rhinoceros hunting, but Asian horns were considered superior to those from Africa, and fetched higher prices [6], so the African supply probably did little to reduce hunting pressure on remaining Asian populations.

While hunting was a key factor, habitat loss also had a major impact: by the 18th century, there were well over 200 million people in East Asia, and the human population has increased many-fold since then, with the result that most of the region's natural ecosystems have been replaced with agriculture [10]. Rhinoceros were not the only animals affected by this process: other species that were extirpated or which survive on small remnants of their former ranges include Asian elephants, aurochs, wild horses, Père David's deer, wild water buffaloes and tigers [3,4]. While Sumatran rhinoceros populations may well have fluctuated during the climate changes of the Pleistocene (something that should be tested with ancient DNA data from the mainland), they thrived in the stable Holocene climate for millennia until they were extirpated from mainland East Asia by overhunting and the destruction of their habitat by expanding agricultural societies. These are the same factors that now threaten all rhinoceros with extinction.

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