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Malawi's Mountainous Areas are Critically Important Orchid Refuges

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Abstract

Personal surveys and detailed literature searches indicate that a total of 135 species of epiphytic orchids occur in Malawi, with seven species regarded as endemic. While over 90% of Malawi's epiphytic orchids occur in the rapidly diminishing areas of moist and dry woodland across the country, most epiphytic species are restricted to relatively small areas of suitable habitat, usually at higher elevations. Five particular mountainous habitats, three in northern Malawi and two in southern Malawi, contain 108 species of epiphytic orchids, including all the endemic species. These mountainous habitats represent critically important refuges for epiphytic orchids and deserve improved conservation.

Introduction

The geographic features of Malawi are dominated by the Great Rift Valley which runs through the eastern portion of Africa from the Red Sea in North Africa to the Zambezi valley in the south. In Malawi, the Rift Valley is marked by long ranges of high hills and steep escarpments – some reaching 1,500 to 2,400 metres above sea level – along the length of the valley, and decreasing in height from north to south (**Figure 1**).

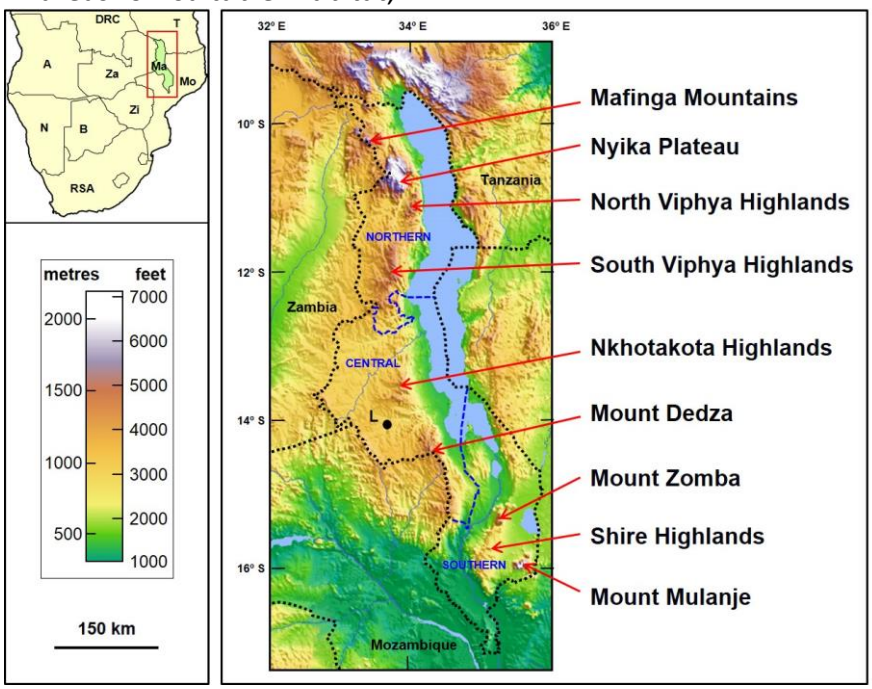

Figure 1. Topographic map of Malawi showing the positions of important highland areas. Inset shows position of Malawi in southern Africa. The administrative boundaries between Northern, Central and Southern Malawi are shown in blue dashed lines.

Lake Malawi is the most prominent feature of the rift valley in Malawi, covering some 19% of the country's area, and is the third largest freshwater lake in Africa. The only outlet from Lake Malawi is the Shire River which flows southwards from the southern tip of the lake across undulating lowlands to join the Zambezi River at an elevation of approximately 40 metres above sea level. Southern Malawi also has several isolated

hills and mountain areas; the highest of these being Zomba Mountain and the Mulanje Massif, with several smaller peaks in the Dedza and Thyolo areas, as well as the Shire Highlands – a line of hills marking the eastern flank of the lower Shire River. From north to south, there are distinct changes in elevation from the undulating Nyika Plateau and the Viphya Highlands in Northern Malawi, through the slightly lower Nkhotakhota Highlands in Central Malawi, to the low-lying Shire River valley of Southern Malawi. The mountain massifs of Zomba and Mulanje rise sharply some 1,350 to 2,000 metres above the surrounding lowlands.

The diversity and extent of the natural vegetation in Malawi reflect the combined effects of elevation and annual rainfall, with the highest rainfalls recorded in areas of higher elevation. The most extensive vegetation type is the mixed woodland savannah – known across Central Africa as 'Miombo' – that used to cover some 45% of the country and characterized by the prominence of *Brachystegia*, *Julbernadia* and *Isoberlinia* tree species (Chidumayo, 1997). Miombo woodlands in the higher rainfall areas of northern and central Malawi are characterized by larger, more vigorous trees (15-25 metres tall) with almost closed canopies. These are interspersed with occasional grassy areas and small rivers that flow eastwards towards Lake Malawi.

The trees become progressively shorter (7-15 metres tall) towards the lower elevation areas of southern Malawi as rainfall declines. At higher elevations across Malawi, the frequent nocturnal mists condense on rocks and trees, ensuring that the vegetation remains moist and evergreen throughout the year (**Figure 2**). Dry, often deciduous, Miombo woodlands occur at lower elevations; these woodlands experience virtually no nocturnal mists and receive lower annual rainfalls.

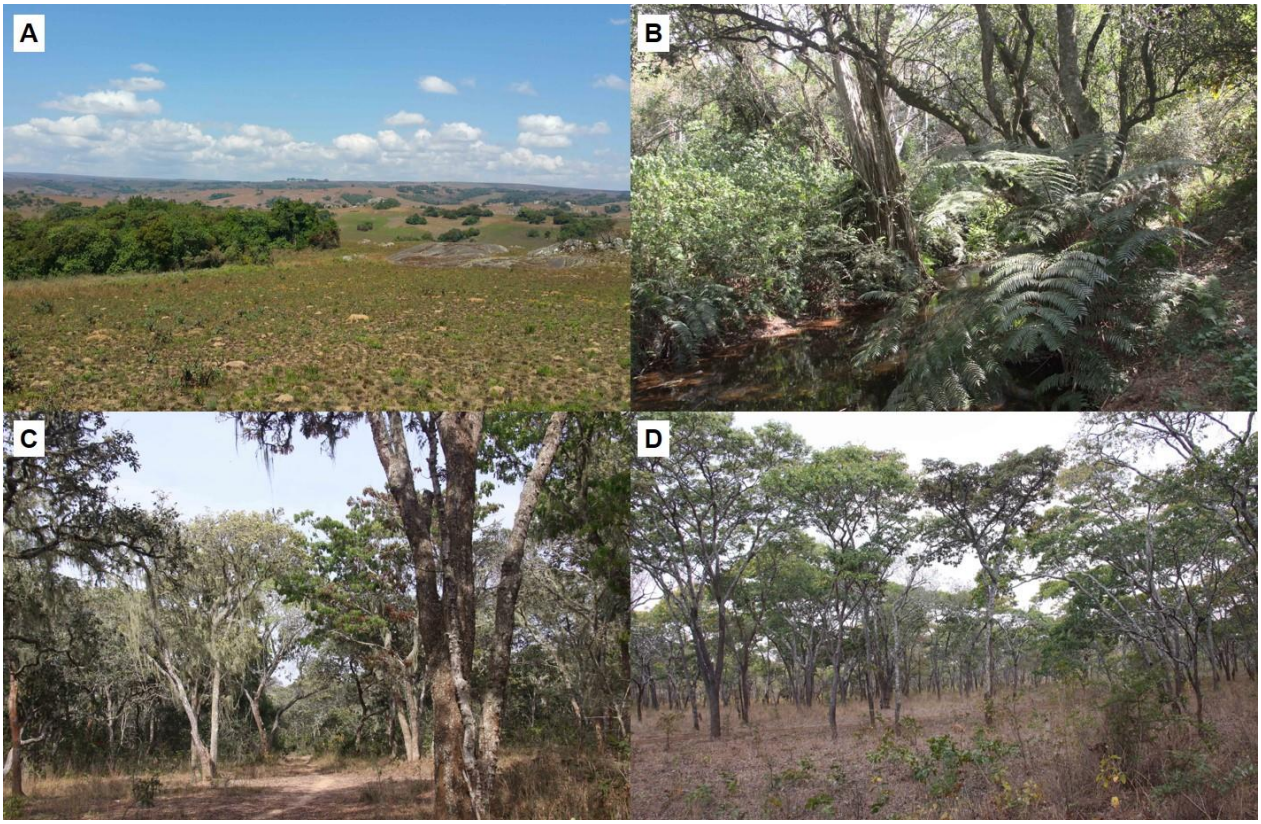

Figure 2. Four views of typical epiphytic orchid habitats in Malawi. **A**. High elevation grasslands and relict forest patches on Nyika Plateau; **B**. Dense riparian woodland in the South Viphya

Highlands; **C**. Tall, moist Miombo woodland in the North Viphya Highlands; and **D**. Tall dry Miombo woodland in the southern portion of the Nkhotakhota Highlands.

There are distinct differences in the distribution patterns of epiphytic orchid species in Malawi. These differences are linked to the availability of specific habitat types (particularly cool, higher elevation woodlands and moist forests) and to seasonal climatic differences (particularly higher rainfall during the summer months). In this paper I have focussed my attention on the rich epiphytic orchid flora of five of the higher elevation forested areas in Malawi to draw attention to the importance of these and other high elevation sites for orchid conservation.

The epiphytic orchid flora of Malawi

To date, 135 species of epiphytic orchids in 27 genera have been recorded from Malawi, with seven of these species considered to be endemic to the country (Morris, 1970; la Croix et al., 1991; la Croix & Cribb, 1995; 1998). Interestingly, a recent survey (2017) of one remote woodland in south-western Malawi revealed the presence of two additional species of *Polystachya* that had not previously been recorded in Malawi. Therefore, it is possible that further surveys of the many remote forested areas of Malawi could reveal the presence of additional new records for the country.

The epiphytic orchid species present in Malawi have close affinities to those found in north-eastern Zambia and south-eastern Zimbabwe (Morris, 1970; Williamson, 1977), while the species found in Northern and Central Malawi also have affinities with the orchid flora of southern Tanzania (Cribb, 1984; 1989). The orchid genera with the greatest numbers of species present in Malawi are: *Aerangis* (11), *Angraecum* (8), *Bulbophyllum* (20), *Cyrtorchis* (6), *Diaphananthe* (7), *Microcoelia* (9), *Polystachya* (33) and *Tridactyle* (10). The 104 species in these eight genera comprise 77% of the 135 epiphytic orchids recorded to date from Malawi (**Tables 1 and 2**).

Table 1. The variety of epiphytic orchid species recorded from five important highland areas in Malawi (**Figure 3**). (An asterisk indicates that an endemic species occurs in more than one of the highland areas).

Category	Country Total	Orchid numbers in five important highland areas				
		Nyika Plateau	North Viphya	South Viphya	Mt. Zomba	Mt. Mulanje
Total No. of Species	135	62	72	54	47	80
% of Species Found in Malawi	-	46%	53%	40%	35%	59%
No. of Genera	27	15	20	15	16	18
No. of Endemic Species	7	0	2 *	2 *	1	5 *
Eight Key Genera %	77%	82%	75%	80%	74%	75%

The summary data in **Table 1** reveal most of the important highland areas have similar numbers of epiphytic orchid genera, though Mount Mulanje has the highest species total. Mount Mulanje also has the highest number of endemic species (**Table 1**), one of which is shared with South Viphya. South Viphya also shares a second endemic species with

North Viphya. **Table 2** shows that all of the important highland areas have several species of *Bulbophyllum* and *Polystachya*, with Mount Mulanje having the greatest number of species in these two genera. The epiphytic orchids that are endemic to

Malawi consist of one *Aerangis* species and six *Polystachya* species.

Table 2. The number of species in eight key genera present in each of the five important highland areas shown in **Figure 3**. (The numbers of endemic species in a genus are shown in brackets).

Genus	Country total species for each genus	Numbers of species in each genus				
		Nyika Plateau	North Viphya	South Viphya	Mt. Zomba	Mt. Mulanje
Aerangis	11 (**1**)	4	5	3	1	4
Angraecum	8	3	3	2	3	5
Bulbophyllum	20	8	9	2	3	13
Cyrtorchis	6	2	5	2	3	5
Diaphananthe	7	3	4	2	2	4
Microcoelia	9	3	2	2	1	6
Polystachya	33 (**6**)	9	9	9	7	20
Tridactyle	10	5	5	2	2	5

Over 80% of Malawi's epiphytic orchid species occur in the patchwork of moist Miombo woodlands and relict forests located in the higher elevation parts of the country
(**Figure 3**). The best examples of suitable epiphytic orchid habitat are found on the tops or flanks of isolated mountain massifs such as the Nyika Plateau, Zomba and Malosa mountains and Mulanje Mountain, followed by the moist forests of the North and South Viphya Highlands (**Figure 2**). These higher elevation moist forests and woodlands support a far higher diversity of epiphytic orchids than the open, drier woodlands located away from streams and rivers. While relatively few epiphytic orchid species grow in the dry, low elevation patchy woodlands located along the lower Shire River valley in southern Malawi, the small woodland patches in forest reserves on isolated hills in Southern Malawi (e.g., the Shire Highlands) have slightly higher numbers of orchid species than the surrounding lowlands.

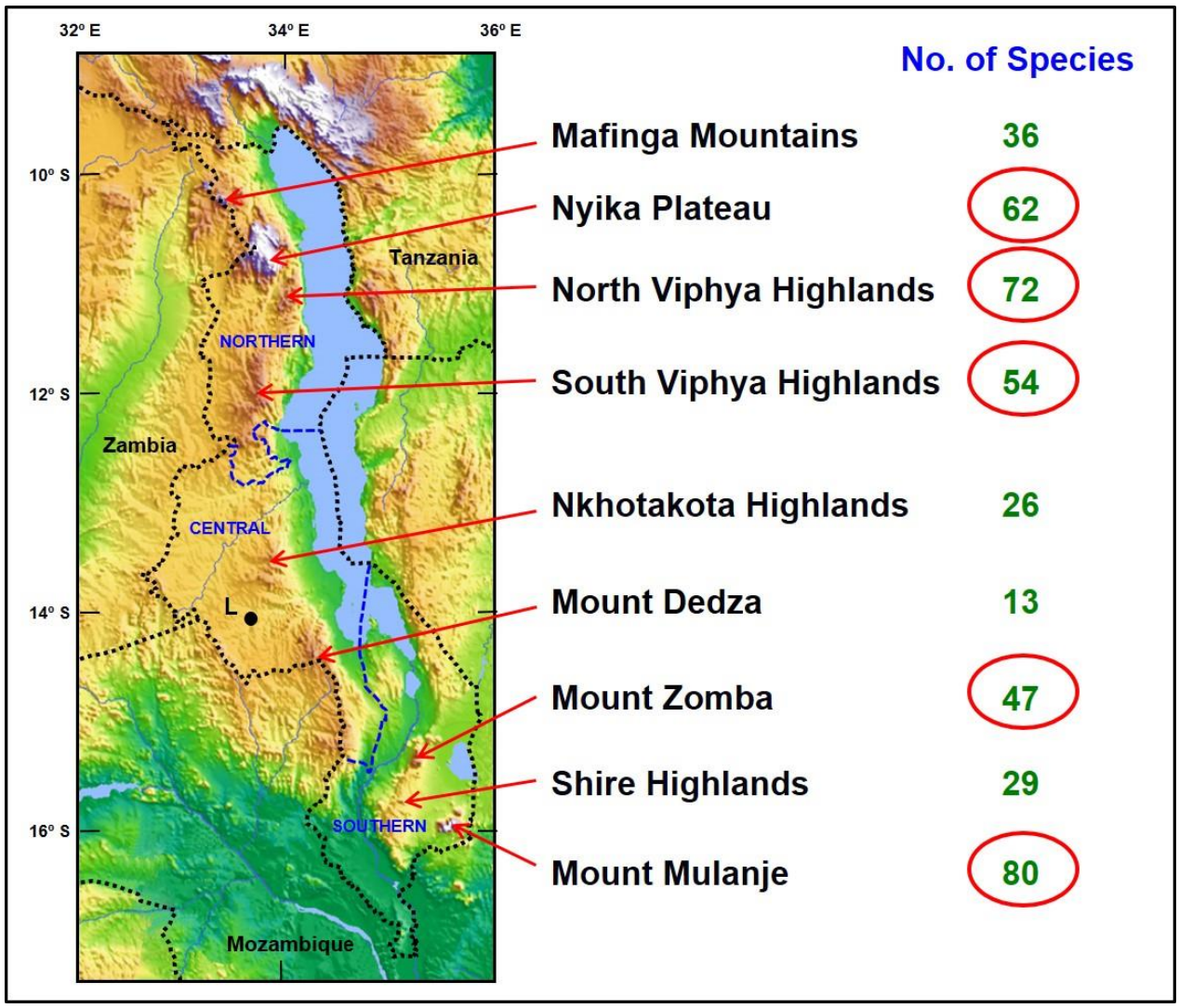

Figure 3. Sketch map showing the numbers of epiphytic orchid species recorded in each of the higher elevation habitats across Malawi. (The five important high elevation areas are circled in red).

A few examples of some of the unusual epiphytic orchids found in Malawi are shown in **Figures 4 and 5**, while three of the seven endemic epiphytic orchid species are shown in **Figure 6**.

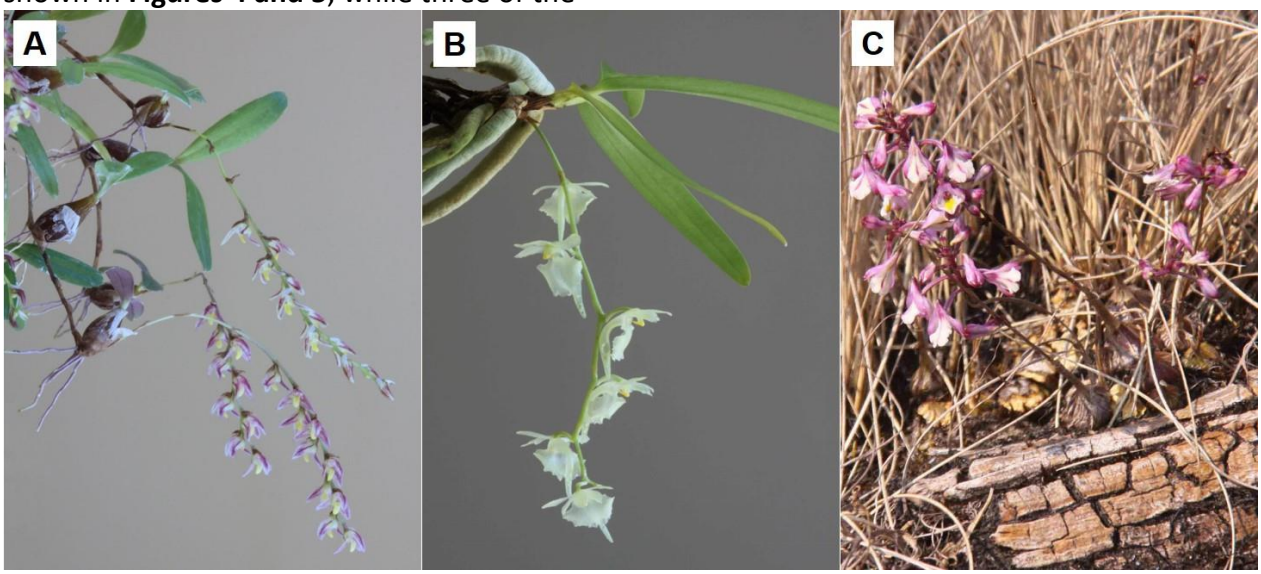

Figure 4. Composite photograph of three epiphytic orchid species from Mount Zomba. **A**. *Bulbophyllum stolzii*; **B**. *Diaphananthe pulchella*; and **C**. *Polystachya songaniensis*.

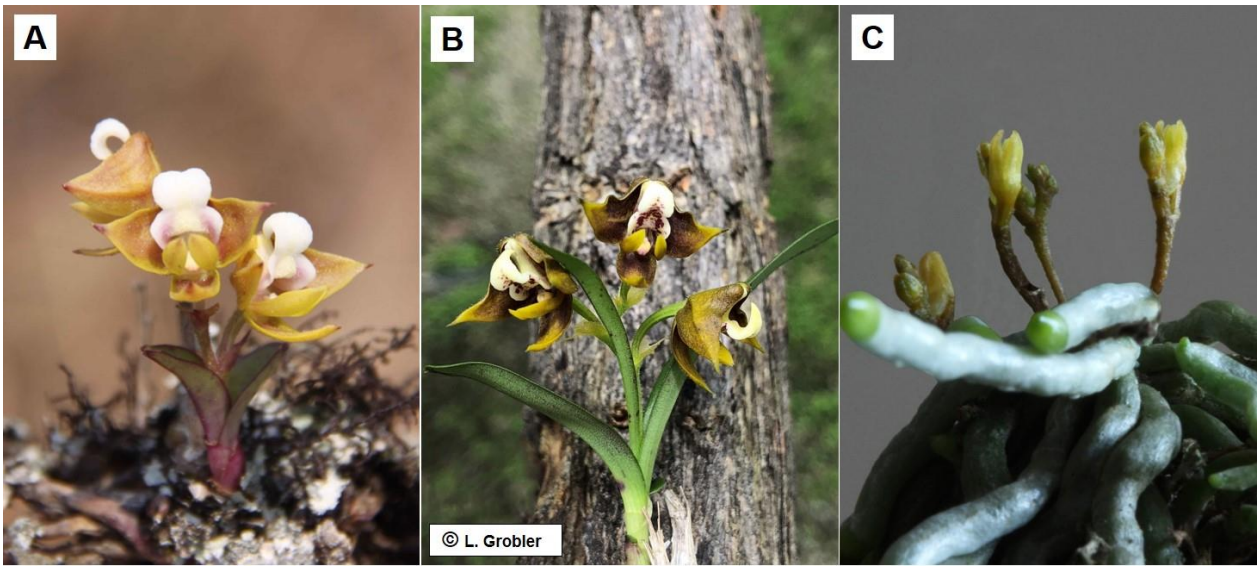

Figure 5. Composite photograph of three epiphytic orchid species from high elevation woodlands. **A**. *Polystachya campyloglossa* from Mount Zomba; **B**. *Polystachya malilaensis* from the South Viphya Highlands; and **C**. *Taeniophyllum coxii* from the North Viphya Highlands.

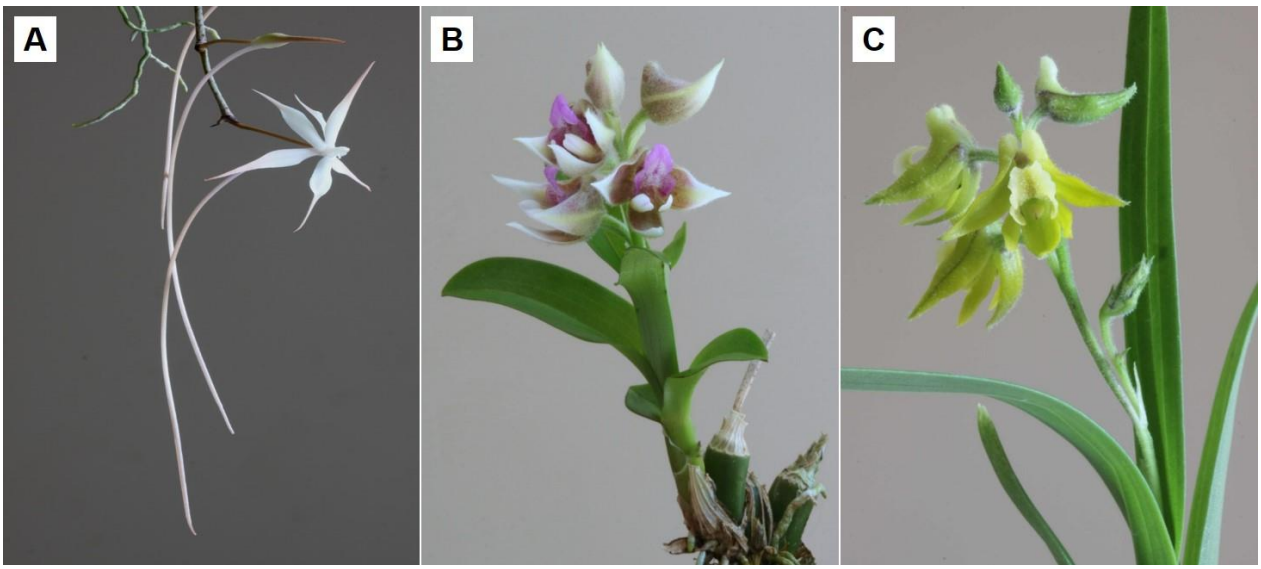

Figure 6. Composite photograph of three epiphytic orchid species from high elevation woodlands that are endemic to Malawi. **A**. *Aerangis distincta* from the North Viphya Highlands; **B**. *Polystachya johnstonii var. roseopurpurea* from Mount Zomba; and **C**. *Polystachya minima* from the Shire Highlands.

One of the most noticeable features of the various populations of epiphytic orchids in Malawi's high elevation areas is that the populations at a particular locality are almost always relatively small, seldom exceeding at most a few dozen plants of each species. For the most part, this seems to be due to a progressive reduction in the extent of orchid habitats that has taken place over the course of many years. Early orchid surveys carried out by Morris (1968; 1970); Williamson (1979, 2005), the la Croix family (la Croix *et al*., 1983; 1991) and Kurzweil (1992) revealed that suitable epiphytic orchid habitats in localities such as the Nyika Plateau, Mount Zomba, Mount Mulanje and the Shire Highlands were more much extensive and contained far higher numbers of plants than can be seen today.

Threats to orchid conservation

A careful examination of the orchid habitats and the surrounding terrain in each of the five high elevation areas and comparisons of recent findings with old descriptions and forest surveys of these areas (White *et al.*, 2001; Muambeta *et al*., 2010; Bone *et al*., 2017), indicates that there has been a considerable loss of woodland habitat over the last fifty years. In some cases, such as the Shire Highlands, almost all of the woodlands on the hills have disappeared. This is particularly evident in areas close to the larger urban centres of Lilongwe, Limbe-Blantyre and Zomba (**Figure 7**). These changes are heavily influenced by the widespread and continuing modification of woodland habitats in Malawi linked to, or driven by, the socio-economic situation in the country (Katumbi *et al*., 2015; Bone *et al.*, 2017). On the positive side, concerted actions to promote plantation forestry and to replant native woodland species as alternative sources of timber and fuelwood have helped to reduce some of the pressure on natural woodlands and forests.

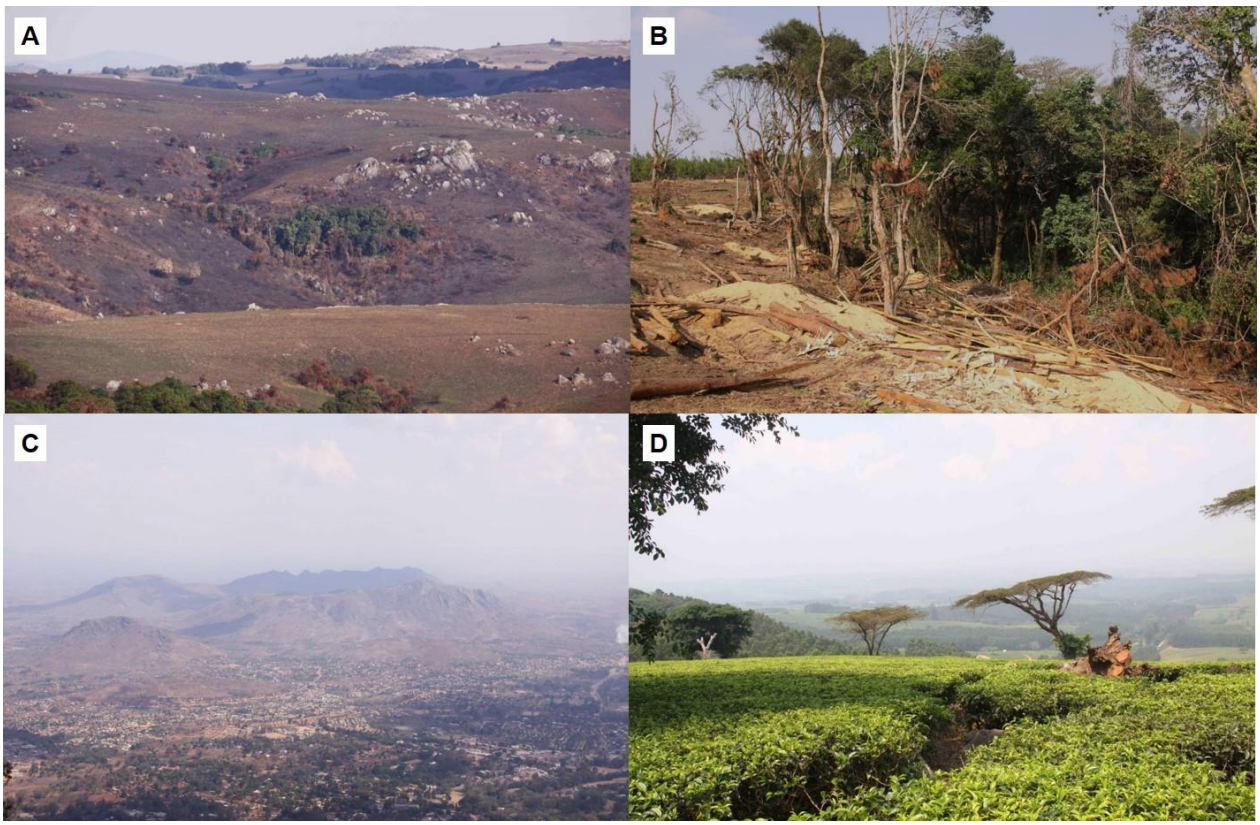

Figure 7. Composite photograph showing examples of the different types of habitat changes that occur in Malawi. **A**. Uncontrolled burning of relict forests and grasslands on the Nyika Plateau; **B**. Intensive logging of natural forests on Mount Zomba; **C**. Extensive clearing of woodlands around Zomba town for cultivation and fuelwood; and **D**. Woodlands cleared for tea and coffee plantations and fuelwood plantations around Mount Mulanje.

Malawi is one of the ten most densely populated countries in Africa with a population that has quadrupled in size since independence in 1964 and amounts to over 18 million people in 2016, resulting in an average population density of 158 people per square kilometre (FAO, 2013; Bone *et al.*, 2017). The Southern and Central regions of Malawi have the highest population densities while the Northern region has the lowest population density.

One of the key influences on Malawi's rapid population growth was the influx of almost one million refugees from Mozambique during that country's prolonged civil war. The combination of high population density, with over 50% of the population regarded as being below the poverty line, has placed huge pressures on the available natural resources in the country. The two most important influences on deforestation in Malawi are continued land clearing for agriculture for the growing population, and tree harvesting for use as fuel (wood and charcoal) and for construction (Katumbi *et al*., 2015; Bone *et al*., 2017).

Agriculture remains the dominant economic activity in Malawi, with large-scale and smallholder farms occupying some 59% of the total land area in 2016 and involving an estimated 84% of the country's total workforce. With a growing population and a heavy reliance on traditional methods of cultivation, there is a continual demand for more land to be cleared for agriculture. However, there is now very little land left that is suitable for agriculture.

Against a background of widespread poverty in Malawi, recent estimates indicate that less than 5% of Malawi's population (most urban dwellers) have access to and can afford to use electricity. The majority of the population (both urban and rural) rely on fuelwood / charcoal and kerosene for their energy needs. Added to this, large amounts of timber are used for traditional methods of house construction. There is now also an increasing trend of farmers abandoning their traditional agricultural activities and turning to the more lucrative activity of producing fuelwood and charcoal for sale in urban and rural centres (Katumbi *et al*., 2015). There has also been a trend of communities shifting from the over-populated Southern Region to the sparsely populated Northern region where more natural resources are available (Muambeta *et al.*, 2010; Bone *et al*., 2017).

As ever larger areas of natural woodland are harvested for fuel and construction (**Figure 7B**), there is growing pressure to utilize wood harvested from the country's designated forest reserves and other protected areas. To counter this trend, the Malawi Government has started to appoint some military units to provide longer-term protection to designated forest reserves that also serve to protect important water sources and headwater streams (Muambeta *et al*., 2010).

The traditional African practice of widespread burning of grasslands and woodlands at the end of the dry season is widespread across Malawi and other countries in Central Africa (Chidumayo, 1997). Unfortunately, many of these fires are not properly controlled and result in extensive areas of non-target grassland and woodland being accidentally burnt, resulting in accelerated soil erosion and habitat loss. In sensitive montane areas such as the Nyika Plateau and the Zomba and Mulanje mountains, uncontrolled fires often destroy many of the small patches of relict forests that contain small populations of epiphytic orchids (**Figure 7A**).

Conclusions

There have been several conflicting reports on the extent of loss of natural woodlands and forests in Malawi. In part, the discrepancies between different estimates of woodland loss are the result of different estimation techniques being used, and the difficulty in distinguishing between natural woodlands and forests and those areas that have been replanted with trees, including some plantation forests (Bone *et al.*, 2017). To date, the best estimates indicate that some 36% of Malawi's natural forests and woodland have been lost between 1972 and 2009. These authors also indicate that the replanting of natural woodlands, fuelwood lots and plantation forests has helped to alleviate the overall loss of biomass in Malawi. While this observation is no doubt true from a total biomass perspective in terms of the demand for wood and wood products, the replanted woodlands and plantations do not provide suitable habitats for epiphytic orchids (la Croix *et al.*, 1991). Therefore, the loss of natural woodland and forest habitats, especially those highland woodlands that support most of Malawi's epiphytic orchids, represent an enormous threat to the conservation of Malawi's epiphytic orchids.

To a limited extent, this threat is being addressed by the proclamation of 17 new forest reserves across the country (**Figure 8**). While this is a very welcome development, there has been no indication as to how the resource-constrained Malawi Department of Forestry will be able to protect and manage these new forest reserves in future. Given the extent to which illegal logging activities continue to occur around the edges of the existing forest reserves in Malawi, and the limited protection that the military can assist the Department of Forestry, it is clear that the

Malawi Government will need to expand the scope and extent of activities allocated to the Department of Forestry. In addition, representatives from the Forestry Department and the National Government will have to increase the degree of interaction with the local communities who are responsible for most of the illegal logging activities.

Essentially, the different sets of stakeholders must reach agreement on the specifics of the governance structures that will be needed to protect proclaimed forest reserves from further incursions and simultaneously ensure that civil society is also able to benefit from the forest protection scheme. It is only when there is a mutually beneficial partnership between the government and civil society that the future prospects for sustainable forest conservation can be achieved.

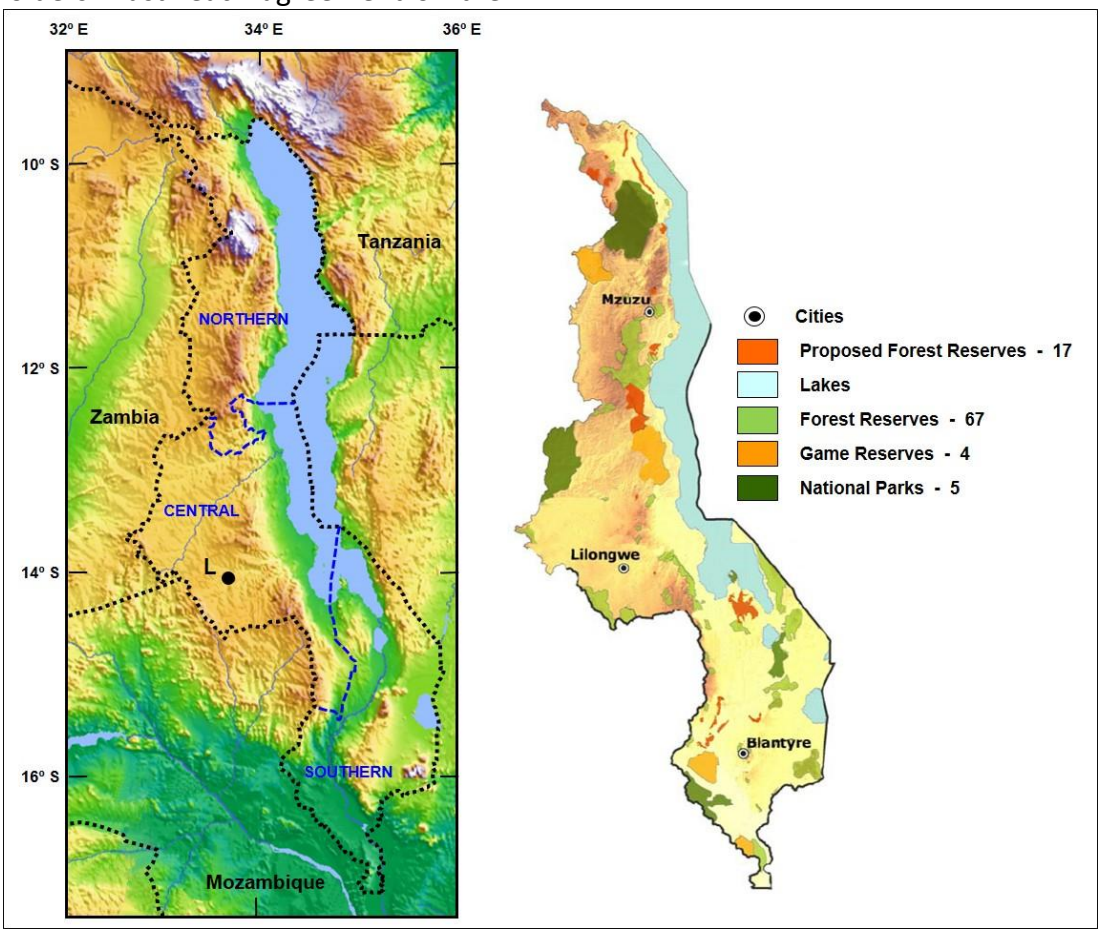

Figure 8. Map showing the number and extent of existing protected areas (national parks, game reserves and forest reserves) and planned new forest reserves in Malawi.

Acknowledgements

I thank Lourens Grobler for kindly allowing me to use his photograph of *Polystachya malilaensis* in my **Figure 5**.

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