The Afromontane Bamboo, Yushania alpina, on Kilimanjaro

Author: Grimshaw, John M.

Source: Journal of East African Natural History, 88(1) : 79-83

Published By: Nature Kenya/East African Natural History Society

URL: https://doi.org/10.2982/0012-8317(1999)88[79:TABYAO]2.0.CO;2

Journal of East African Natural History **88**: 79–83 (1999)

THE AFROMONTANE BAMBOO, *YUSHANIA ALPINA*, ON KILIMANJARO

John M. Grimshaw
Department of Zoology, University of Oxford
South Parks Road, Oxford OX1 3PS, UK[1]
john.grimshaw@zoo.ox.ac.uk

'My companion drew my attention to the fact that he had seen no bamboos in the forest. Afterwards I found that this was one of the peculiarities of Kilimanjaro. Every other high mountain in Africa possesses a broad bamboo-zone, Kilimanjaro not. But why not? I respectfully leave the puzzle to botanists.' Julian Huxley (1932)

The rarity of Afromontane bamboo, *Yushania alpina* (K.Schum.) W.C.Lin (syn. *Arundinaria alpina* K.Schum), on Kilimanjaro, is one of the great biogeographical mysteries of the East African mountains. The cause of this scarcity has never been satisfactorily resolved and although in this article I confirm its existence on the mountain, I can only offer suggestions for its restricted occurrence there. The unfamiliar name is the result of the taxonomic revision of old, catch-all bamboo genera; *Arundinaria* was one such. Although this species has been referred to recently as *Sinarundinaria alpina* (K.Schum.) Chao & Renv. (*e.g.* Lovett, 1994), Chris Stapleton at Kew informs me that the best name, as generic concepts at present permit, is *Yushania alpina*. It seems, however, that this is still unsatisfactory, and a further change is mooted. Bambusologists avoid the difficulty by simply calling it *alpina*!

Afromontane bamboo *Yushania alpina* is a conspicuous element in the vegetation of most East African mountains from Ethiopia to the Southern Highlands of Tanzania and Malawi, also occurring on the Bamenda Mountains of Cameroon. *Y. alpina* characteristically occurs between 2,400–3,000 m, with isolated occurrences in favoured places between 1,630 m and 3,200 m (Clayton, 1970; White, 1983), favouring volcanic soils with rainfall in excess of 1,250 mm/yr^{-1} (Lind & Morrison, 1974; White, 1983), although on Mt Kenya Bussmann (1994) found that 800-1,000 mm/yr^{-1} was sufficient. Temperature has also been found to be limiting, with bamboo and bamboo-*Podocarpus* forest on the eastern slopes of the Aberdares confined to areas with a mean annual temperature of 11.6–15.9°C (Schmitt, 1991); on Mt Kenya pure bamboo stands occur in the temperature range 10–12°C, with mixed forest in the range 12–14°C (Winiger, 1979, in Schmitt, 1991). This agrees with observations from Fries & Fries (1948) onwards that bamboo does not occur in valleys where cold katabatic winds flow or cold air accumulates. Where conditions are favourable it can cover large areas (*e.g.* 65,000 ha on the Aberdares, 51,000 ha on the Mau, 39,000 ha on Mt Kenya (Clayton in FTEA, 1970)). On other mountains, *e.g.* Ruwenzori and Mt Elgon, it is most abundant on the

[1] Address for correspondence: John M. Grimshaw, 35 Wessex Way, Cox Green, Maidenhead, Berks SL6 3BP, UK

wettest aspect (Lind & Morrison, 1974). This prevalence led Hedberg (1951) to define a 'bamboo zone' as a characteristic vegetation horizon on East African mountains, which emphasises the curiosity of its absence from Kilimanjaro.

In Tanzania bamboo is less abundant, the total area being 64,700 ha (Forest Department, 1962, in Lovett 1994), although it is widespread, with records from most of the Southern Highlands (especially the Livingstone Escarpment east of Lake Malawi (Gilchrist, 1952)), Mahali Mountains, the southern portion of the Eastern Arc Mountains (but not the Usambaras or Pares), and some of the northern volcanic mountains (Lovett, 1994).

The distribution of Afromontane bamboo in the northern volcanic mountains is particularly interesting. It is best known from Oldeani Mountain in the Crater Highlands, whose upper parts are covered by it (Hanby & Bygott, 1990; pers. obs., 1990), and Mt Meru, where it forms a distinct horizon between 2,300-2,700 m on the southern slope (Hedberg, 1951). It also occurs on the summit of the practically unknown Gelai on the eastern edge of the Gregory Rift (Elliott, 1948; Page-Jones, 1948), although this record seems not to have filtered into the botanical literature. The literature is ambivalent about the status of bamboo on Kilimanjaro, reflected by Lovett's (1994) statement 'possibly on Kilimanjaro'. Lind & Morrison (1974) actually state that it is absent. Perhaps they meant that no bamboo 'zone' occurs, because the presence of bamboo had been recorded by Moreau (1944) and the species was acknowledged to be present but rare by Wimbush (1945), Hedberg (1951), Greenway (1965), and White (1983).

Moreau (1944) stated that the Tanganyika Forest Department knew of one patch "*scarcely fifteen acres in extent ... situated at the extreme top edge of the forest on the right bank of the Kitenden River on the north of the mountain*", and also indicated that there might be other small areas of bamboo. These have not been heard of since, and the precisely located patch was not confirmed or revisited by Europeans for nearly fifty years, although its exact location is well known to the local people. In 1993 I was led to this historic colony, and found it to be just as Moreau had described, extending over approximately 6 ha (15 acres) centred on one of the branches of the Kitenden River at 2,500 m. Fifty years ago this would indeed have been close to the top of the forest, since the now mature *Erica excelsa*-dominated forest above here would then have been regenerating low scrub (Grimshaw, 1996).

The Kitenden bamboo colony is centred on the east bank of the Korongo, with only a small area on the western bank, although there are outlying clumps of short ($\pm$1.5 m) culms up to 100 m away from the main colony. On the eastern bank the bamboo forms a dense thicket, with fewer outliers. Most clumps are on gentle gradients, but a few, in which the culms are much larger, occur on the steep slopes of the Korongo itself (east bank only).

The presence of bamboo has a very strong impact on other plants, greatly reducing their abundance and diversity through its competitive effects. For example in a 30x50 m quadrat located within the bamboo colony, only 29 trees, of 6 species, were found, a striking difference to the 166 individuals of 15 woody species found in an immediately adjacent quadrat of the same size. For most species, however, the mean size of trees inside the bamboo colony is larger than those nearby, indicating that recruitment is greatly reduced. Conditions for successful recruitment within a bamboo stand are clearly unusual events. Agnew (1985) has speculated that conditions are only suitable following the death of the bamboo after a mass-flowering event, but although this seems eminently probable it has yet to be confirmed. The dense bamboo understorey imposes a lollipop-like morphology on the emergent trees, which only have branches above the height of the bamboo canopy.

Like most bamboos, *Yushania alpina* is well known to undergo cyclic sequences of development following mass-flowering (Wimbush, 1945; Agnew, 1985; Bussmann, 1994). The Kitenden colony is in the building stage, when new shoots exceed the previous year's in

height; overall height increases rapidly, but the plants remain as distinct clumps. In the absence of records it is possible only to guess at the date of the last flowering of the Kitenden colony, but if Agnew's timescale is correct, it was at least 10 to 15 years ago, and possibly longer. Unfortunately there is no indication of how the colony looked in the 1940s.

Although the question of the occurrence of bamboo on Kilimanjaro has been resolved, the biogeographic questions *Why here?*, *why only here*? and *why so little*? remain unanswered.

Although seed dispersal is clearly not a problem, since the species is present, and Kilimanjaro is in the centre of its geographic distribution, it is possible that *Y. alpina* is a relatively recent arrival on Kilimanjaro and has not yet 'got going'. Friis (1992) believes that in Ethiopia *Y. alpina* is often deliberately planted by people, but this would seem a remote possibility on the (formerly) sparsely populated northern slope of Kilimanjaro.

Meteorological records indicate that climatic conditions on Kilimanjaro are appropriate for this species, although it is curious that rainfall on the drier northern slope (*c.* 1,000 mm/yr^{-1} at 2,000 m (Grimshaw, 1996)) is probably marginal for this species. The wetter southern slope (*c.* 2,400 mm/yr^{-1} at 2,000 m (Coetzee, 1967; Sarmett & Faraji, 1991)) would seem to offer more favourable hydrological conditions, and it may be significant that the 'bamboo korongo' has permanent water, indicating a high water table in the vicinity. The calculated annual mean temperature for 2,500 m on mountains east of the rift is 13.35°C (apparently optimal for *Y. alpina*), with a mean minimum of 6.45°C (Kenworthy, 1966). It is possible that the very cold nocturnal katabatic winds experienced on the northern slope cause actual minimum temperatures to drop to levels marginal or insufficient for bamboo growth, but this requires testing.

Another possible clue is the geological discontinuity at the Kitenden River between Lent Group phonolites to the east and the Ol Molog basalts and Shira lavas to the west (Downie & Wilkinson, 1972). Phonolites (fine-grained, alkaline lavas) are the principal rocks of most of the area of Mt Kenya occupied by *Y. alpina* (geological map in Bussmann, 1994), and are important on Mt Meru (Guest & Leedal, 1953) but occur only on the northern slope of Kilimanjaro (Downie & Wilkinson, 1964, 1972). It is possible that phonolite favours bamboo growth, while other substrates are, for some reason, inimical to *Y. alpina*. A few other woody species are also confined to phonolites on the northern slope of Kilimanjaro.

The distribution of *Y. alpina* may also be limited by its own reproductive behaviour. Lovett (1994) suggests that irregular mass-flowering must pose some danger if regeneration fails, and this may particularly be the case if a colony is in marginal conditions. Following mass-flowering, regeneration is usually from surviving rhizomes (Agnew, 1985; Bussmann, 1994) and only very seldom from seed. Bussmann (1994) found evidence that rhizomes can persist for decades before making clumps, and both he and Agnew (1985) emphasise the vulnerability of young shoots to large mammal browsing, although there is no proof that this ultimately causes the extinction of a regenerating bamboo-area. There is considerable evidence that *Y. alpina* is a pioneer species that benefits from disturbance, especially fires (Lebrun, 1960; Glover & Trump, 1970; Lovett, pers. comm., 1996), and it is possible that there has been no suitable local disturbance to encourage the Kitenden colony to spread outwards. It would be interesting to know over what area individual clones of bamboo extend on, say, Mt Kenya, and from this to gain an estimate of both their age and the frequency of establishment from seed. If establishment from seed is very rare, requiring extremely specific conditions for success, the fortunes of the colony rest solely on its vegetative success; flowering and seeding will be in vain until those conditions recur.

A study of the factors determining the distribution of *Yushania alpina* is long overdue, and would make an interesting project for an advanced degree, especially if coupled with a conclusive treatment of its taxonomy. As well as the Kilimanjaro conundrum there are other

distributional mysteries to be explained; is geological specificity really the major limiting factor for this species? and if so, why is it absent from the Pare and Usambara Mountains but present on the equally non-volcanic Ulugurus?

ACKNOWLEDGEMENTS

I should like to thank the many sponsors who made my fieldwork on Kilimanjaro in 1992–1994 possible, especially Magdalen College, Oxford, National Geographic Society, and the Wildlife Conservation Society. My study of the Kitenden bamboo colony would not have been possible without the assistance of Mtapa Abdalla and Lembris Kephas of Lerang'wa village, for which I am extremely grateful. Jon Lovett made useful comments on the manuscript, and I am grateful to Chris Stapleton for taxonomic advice.

REFERENCES

Agnew, A.D.Q. (1985). Cyclic sequences of vegetation in the plant communities of the Aberdares Mountains, Kenya. *Journal of the East Africa Natural History Society and National Museums* **75**: 1–12.

Bussmann, R.W. (1994). The forests of Mt. Kenya, (Kenya). Vegetation, Ecology, Destruction and Management of a Tropical Mountain Forest Ecosystem. Ph.D. thesis, Bayreuth University.

Clayton, W.D. (1970). *Gramineae (Part 1)*. In E. Milne-Redhead & R.M. Polhill, (eds), *Flora of Tropical East Africa*. Crown Agents, London.

Coetzee, J.A. (1967). Pollen analytical studies in East and Southern Africa. In E.M. van Zinderen Bakker (ed.), *Palaeoecology of Africa* 3. A.A. Balkema, Cape Town.

Downie, C. & P. Wilkinson (1964). *Geological map of Kilimanjaro, 1:125,000 (Kilimanjaro-Moshi special sheet)*. Geological Survey of Tanganyika, Dodoma.

Downie, C. & P. Wilkinson (1972). *The Geology of Kilimanjaro*. Department of Geography, The University of Sheffield, Sheffield.

Elliott, H.F.I. (1948). Some hints on climbing Masailand mountains. *Tanganyika Notes and Records* **26**: 68–76.

Fries, R.E. & Th.C.E. Fries (1948). Phytogeographical researches on Mt Kenya and Mt Aberdare, British East Africa. *Kungliga Svenska Vetenskapsakademiens Handlingar. Tredje Serien* **25**: 1–83

Friis, I. (1992). Forests and Forest Trees of Northeast Tropical Africa. *Kew Bulletin Additional Series XV*. HMSO, London.

Gilchrist, B. (1952). In *Report of Central African rail link—Development Survey 1–2*. Overseas Consultants Inc. & Sir Alexander Gibb & Partners. Colonial Office, London.

Glover, P.E. & E.C Trump. (1970). *An ecological survey of the Narok District of Kenya Masailand*. Pt. 2. *Vegetation*. Kenya National Parks: Nairobi. Mimeograph.

Greenway, P.J. (1965). The vegetation and flora of Mt. Kilimanjaro. *Tanganyika Notes and Records* **64**: 97–107.

Grimshaw, J.M. (1996). Aspects of the ecology and biogeography of the forest of the northern slope of Mt. Kilimanjaro, Tanzania. D.Phil. thesis, University of Oxford.

Hanby, J. & D. Bygott (1990). *Ngorongoro Conservation Area*. David Bygott & Co., Karatu, Tanzania.

Hedberg, O. (1951). Vegetation Belts of the East African Mountains. *Svensk Botanisk Tidskrift* **45** (1): 140–204.

Huxley, J. (1932). *Africa View*. Chatto & Windus, London.

Kenworthy, J.M. (1966). Temperature conditions in the tropical highland climates of East Africa. *East African Geographical Review* **4**: 1–11.

Lebrun, J. (1960). Sur une methode de délimitation des horizons et étages de végétation des montagnes du Congo oriental. *Bulletin du Jardin Botanique de l'État à Bruxelles* **30**: 75–94.

Lind, E.M. & M.E.S. Morrison (1974). *East African Vegetation*. Longman Group, London.

Lovett, J.C. (1994). Notes on moist forest bamboos and bambusoid grasses in eastern Tanzania. *Bulletin of the East Africa Natural History Society* **24**: 2–5.

Moreau, R.E. (1944). Kilimanjaro and Mt. Kenya: some comparisons, with special reference to the mammals and birds: and with a note on Mt. Meru. *Tanganyika Notes and Records* **18**: 1–41.

Page-Jones, F.H. (1948). Water in Masailand. *Tanganyika Notes and Records* **26**: 51–59.

Sarmett, J.D. & S.A. Faraji (1991). The hydrology of Mount Kilimanjaro: an examination of dry season runoff and possible factors leading to its decrease. In W.D. Newmark (ed.), *The Conservation of Mount Kilimanjaro*. IUCN, Gland & Cambridge. Pp. 53–70

Schmitt, K. (1991). The vegetation of the Aberdare National Park, Kenya. *High Mountain Research* 8. Wagner, Innsbruck.

White, F. (1983). The vegetation of Africa. *Natural Resources Research 20.* Unesco, Paris.

Wimbush, S.H. (1945). The African alpine bamboo. *Empire Forestry Journal* **24**: 33–39 (also (identical) in *East African Agriculture and Forestry Journal* **13**: 56–60, 1947).

Winiger, M. (1979). Bodentemperaturen und Niederschlag als Indikatoren einer klimatisch-ökologischen Gliederung tropischer Gebirgsraüme. Methodische Aspekte und Anwendtbarkeit diskutiert am Beispiel des Mt. Kenya (Ostafrika). *Geomethodica* **4**: 121–150.