

# Introduced plants on Kilimanjaro: tourism and its impact

Andreas Hemp

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**Abstract** Kilimanjaro, a world heritage site and an icon of global change, not only suffers from climatic alterations but also is undergoing a drastic socio-economic upheaval. A strong increase of tourism enhances the risk of introducing alien plant species in particular in the upper zones of Kilimanjaro. One such species is *Poa annua* L., a cosmopolitan weed of European origin on roadsides and pastures. The aim of this study is to document its distribution, the speed of its propagation and risks for the indigenous vegetation of Kilimanjaro, and to compare the findings with other introduced species on this mountain. Based on a complete survey of the vegetation of Kilimanjaro with about 1,500 vegetation plots, plant communities invaded by *Poa annua* are determined. As with most of the other neophytes on Kilimanjaro, *Poa annua* invades only anthropogenic vegetation but not undisturbed natural vegetation. Similar to the situation in middle Europe, this neophyte is on Kilimanjaro a constituent of the vegetation of trampled ground, occurring between about 1,600 and 4,000 m asl along climbing routes or their vicinity. On a newly opened climbing route a rapid invasion (5.6 km in 3 months) was observed, which makes it likely that *Poa annua* spread on Kilimanjaro during the last 30 years in parallel to the increase of the

climbing tourism. Although *Poa annua* is still in the stage of propagation, an invasion of natural vegetation types seems to be unlikely.

**Keywords** *Adiantum raddianum* · Global change · Kilimanjaro National Park · Neophytes · *Poa annua* L. · (Ruderal) vegetation of trampled ground

## Introduction

Kilimanjaro, a world heritage site and an icon of global change, is undergoing several substantial changes (Hemp et al., in press). The vanishing glaciers of Kilimanjaro attract broad interest. Less conspicuous but ecologically far more significant is the associated increase of frequency and intensity of fires on the slopes of Kilimanjaro, as result of a drier (warmer) climate since the last century (Hemp 2005). Other ongoing changes on this mountain are due to increasing international tourism, which has impacts on the environment of Kilimanjaro, as well as on socio-economical aspects (Hemp et al., in press). One particular danger is the introduction of alien plant species. Neophytes (i.e. introduced species, which became naturalized) are—due to the globalization of trade, industry and tourism—a worldwide phenomenon, sometimes giving problems to the indigenous vegetation (D’Antonio and Kark 2002; Millennium Ecosystem Assessment 2003). Examples

A. Hemp (✉)  
Ecological Botanical Garden, Universität Bayreuth,  
Universitätsstr. 30, 95440 Bayreuth, Germany  
e-mail: andreas.hemp@uni-bayreuth.de

of aggressive invaders in tropical environments are the water plants *Eichhornia crassipes* (C. Martius) Solms-Laub. and *Salvinia molesta* D. S. Mitchel in Africa or *Pistia stratiotes* L. in America (Perrings et al. 2000). These water plants are of economic importance as they can block shipping routes on rivers and hydroelectric power plants. From a conservation point of view such “additions” to the indigenous flora are problematic, in particular on remote islands with a high proportion of endemic species such as Hawaii, where about 5,000 introduced species compete with about 1,000 indigenous, mostly endemic species (Juvik and Juvik 1998).

On Kilimanjaro, tourism, in particular mountain climbing, has increased rapidly during the last decades (Hemp et al. in press). In 2005, about 28,000 tourists tried to reach the top of Kilimanjaro. As the climate of the upper zones of Kilimanjaro inside the national park resembles in many aspects that of the temperate zones, there is a high risk of accidental introduction of alien species by visitors from Europe or North America (Hedberg 1964).

The aim of the present study is to document the recent distribution of a cosmopolitan weed of European origin (Tutin 1957) on roadsides and pastures, *Poa annua*, which is obviously dispersed by tourists on the mountain, and to compare it with other neophytes. The opening of a new climbing route made it possible, to study the speed of its propagation. Based on a complete survey of the vegetation of Kilimanjaro using the method of Braun-Blanquet (1964), plant communities that are invaded by *Poa annua* are determined, and risks for the indigenous vegetation of Kilimanjaro are discussed. As Kilimanjaro has similar environmental conditions to the other high mountains in East Africa, the conclusions of this study are relevant to many other areas in the eastern part of Africa.

## Study Area

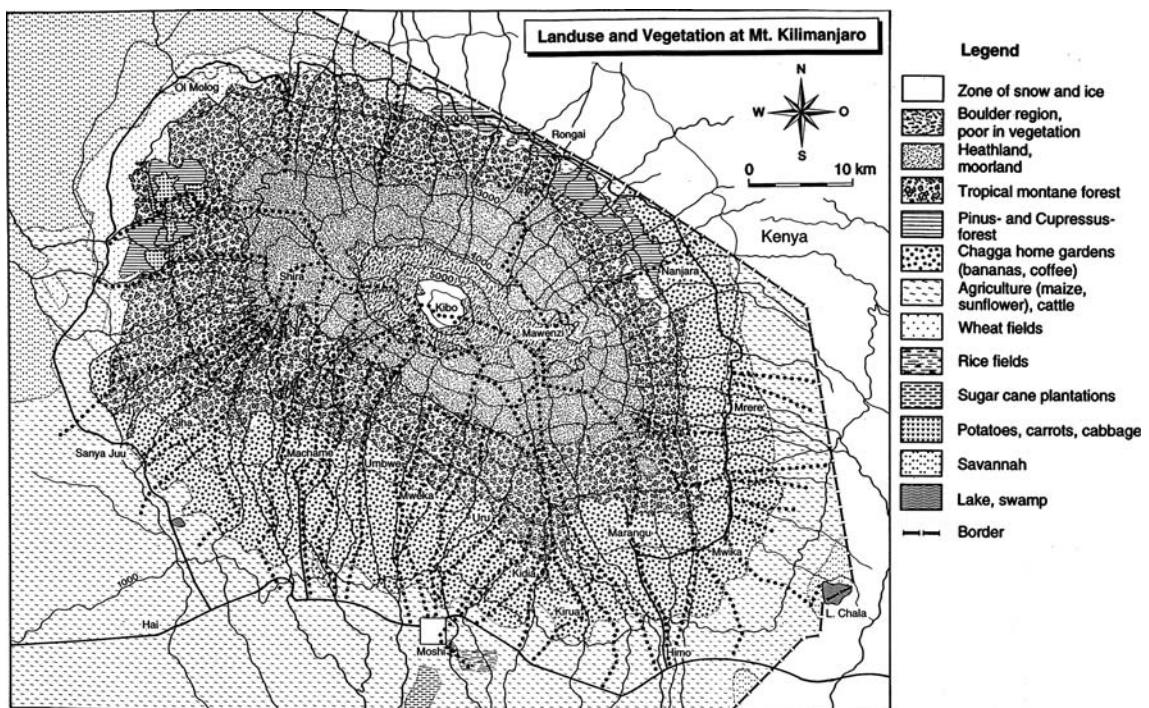
Mt. Kilimanjaro, a relic of an ancient volcano, rising from the savanna plains at 700 m elevation to a snow-clad summit of 5,895 m altitude, is located 300 km south of the equator in Tanzania close to the border with Kenya. Its climate is characterized by a bimodal rainfall pattern with the long rains from March to May forming the main rainy season, and the

short rains centred around the month of November. The foothills of the southern slopes receive an annual rainfall of 800–900 mm and the lower slopes at 1,500 m receive 1,500–2,000 mm. The forest belt between 2,000 and 2,300 m receives partly over 3,000 mm (Hemp 2001, 2006a), which is more than on other high mountains of East Africa. In the alpine zone the precipitation decreases to 200 mm.

According to the changing climatic conditions several vegetation zones are apparent on Mt. Kilimanjaro (Fig. 1). Between 700 and 1,000 m asl the dry and hot colline (hillside) savanna zone stretches around the mountain base, where most areas are farmed with maize, beans and sunflowers, in West Kilimanjaro with wheat. Around Lake Chala at the eastern foot of the mountain, and around Ngare Nairobi of West Kilimanjaro, savanna grasslands are still intact. The main (submontane) cultivation zone with its coffee–banana plantations is located between 1,000 and 1,800 m on the southern and eastern slopes. Natural forests cover an area of about 1,000 km<sup>2</sup> on Mt. Kilimanjaro. In the lower parts of the southern slope the montane forests are characterized by the tree *Ocotea usambarensis* Engl. and higher up in the cloud forest zone by *Podocarpus latifolius* (Thunb.) Mirb., *Hagenia abyssinica* (Bruce) J. F. Gmel. and *Erica excelsa* (Alm & Fries) Beentje. On the drier northern slope forests start with *Croton-Calodendrum* forests, *Cassipourea*-forests at mid-altitudes and *Juniperus* forests at higher altitudes. At around 3,100 m the forests are replaced by *Erica* bush. At an altitude of about 3,900 m the subalpine *Erica* heathlands grade into alpine *Helichrysum* cushion vegetation that reaches up to 4,500 m. Higher altitudes are very sparse in vegetation while the highest elevations of Kibo peak are covered with glaciers.

## Methods

Between 1996 and 2006 over 1,500 plots (relevés) of all vegetation types were examined along 34 elevational transects using the method of Braun-Blanquet (1964) (Fig. 1). Special attention was given to homogeneity and representation of the stands. Plot size was chosen with respect to the minimum areas of the different vegetation formations. In forests it was mainly 1,000 m<sup>2</sup>, in forest clearings, grasslands and heathlands 100 m<sup>2</sup>, in salt marshes, swamps and ruderal and trampled vegetation 25 m<sup>2</sup>, and in rock habitats 5 m<sup>2</sup>.



**Fig. 1** Land use and vegetation cover of the study area. Dotted lines represent the transects that were investigated

The relevés were clustered according to floristic similarity and the resulting plant communities were united into nine formations: rocks, ruderal vegetation (i.e. vegetation on road sides, waste places and fallow arable land), vegetation of trampled grounds, grasslands, salt marshes, freshwater swamps, forest clearings, forests, ericaceous bushlands and alpine scrub. Based on their constancy in the different formations (or vegetation classes) character species of these formations were determined.

The pH was measured in the main root horizon of selected plots using a WTW pH-meter (pH 330). Two parallel samples were taken and measured in distilled water and 0.01 M CaCl<sub>2</sub> solution, respectively. Nomenclature follows Beentje (1994) and FTEA (1952–2005).

## Results

### Phytosociological affiliation of *Poa annua* on Kilimanjaro

Evaluating over 1,500 plots in all vegetation formations of Kilimanjaro with about 2,500 species—

ranging from salt marshes in the savanna, montane forests, to alpine dwarf scrub—the habitats occupied by *Poa annua* were determined. A description of Kilimanjaro's forest vegetation, where *Poa annua* does not occur, is presented by Hemp (2001, 2006c). In order to demonstrate the ecological preferences and habitat selection of *Poa annua* in the vegetation outside forests Appendix 1 gives an overview of the 33 major vegetation units of open land, showing the relative frequency of the species and comprising 777 plots with over 1,800 vascular plant species. For the description of these vegetation units (except that of trampled ground) see Hemp (2001, 2005b), Hemp and Hemp (2003), and for the delimitation of the altitudinal zones see Hemp (2006a).

Within the vegetation of open land *Poa annua* was found as a major constituent only in the formation of trampled ground (Appendix 1, Table 1) on roads and paths within the (sub-)montane coffee–banana plantations, in the montane forest belt and in the alpine zone. An exception is community 5 (Appendix 1), where *Poa annua* occurs accidentally in rock ledges and caves that are used as campsites or resting places near climbing routes.



Within the formation of trampled ground, two distinct plant communities (associations) can be distinguished, in which *Poa annua* occurs (Community 11 and 12, Appendix 1, Table 1). In the upper areas above 3000 m asl, outside the forest belt in open situations *Poa annua* is often monodominant in a community (11) poor in species (mean species number per plot 5.8). Here, in the (sub-)alpine zone, only *Poa leptoclada* A. Rich. as another typical constituent of pathside vegetation was found growing together with *Poa annua*. In a variant of only local importance around Horombo at 3,700 m asl the grass *Hordeum murinum* L. co-dominates on trampled ground (plots 3–5, Table 1). On waste ground behind the huts plot 5 belonging to this community was established; *Hordeum murinum*, *Rumex ruwenzoriensis* Chiov. and *Capsella bursa-pastoris* (L.) Med. indicate the ruderal influence and form together with *Poa annua* and the dominating alpine plants *Peucedanum kerstenii* Engl. and *Senecio purtschelleri* O. Hoffm. a ruderal vegetation resembling the “Lägerfluren” of the Alps.

In the *Plantago palmata* Hook. f. community (community 12) of lower areas *Poa annua* grows together with many other plants typical of path sides such as *Plantago palmata*, *Panicum calvum* Stapf, *Polygonum nepalense* Meisn., *Ranunculus multifidus* Forsk. and *Poa leptoclada*.

Community 12 can be divided into smaller vegetation units: Communities 12a and 12b represent the vegetation of shady, humid paths in the coffee–banana plantations and in the forest belt, where *Plantago palmata* dominates. Community 12a occurs in higher altitudes between 2,200 and 2,930 m asl, community 12b in lower altitudes between 1,390 and 2,050 m asl. Similarly to the situation at Horombo hut in the alpine zone (3,700 m), around Mandara hut (2,700 m asl) *Poa annua* grows together with neophytes such as *Hordeum murinum*, *Capsella bursa-pastoris*, *Bromus unioloides* Kunth and *Lolium perenne*, the “perennial rye grass”, another plant species (like *Poa annua*) of European pastures and path sides.

In contrast to the communities 12a + b, communities 12c + d occur on more open habitats as is obvious from the presence of light demanding meadow species such as *Eragrostis tenuifolia* (A. Rich.) Steud., *Monopsis stellaroides* (Presl.) Urb. and *Hypericum peplidifolium* A. Rich., and resemble the wet montane *Tolpis capensis* (L.) Sch. Bip. meadows of Kilimanjaro (Hemp and Hemp 2003). Community 12d

represents the semi-natural (disturbed) vegetation on sandy stream banks.

### Distribution and site factors

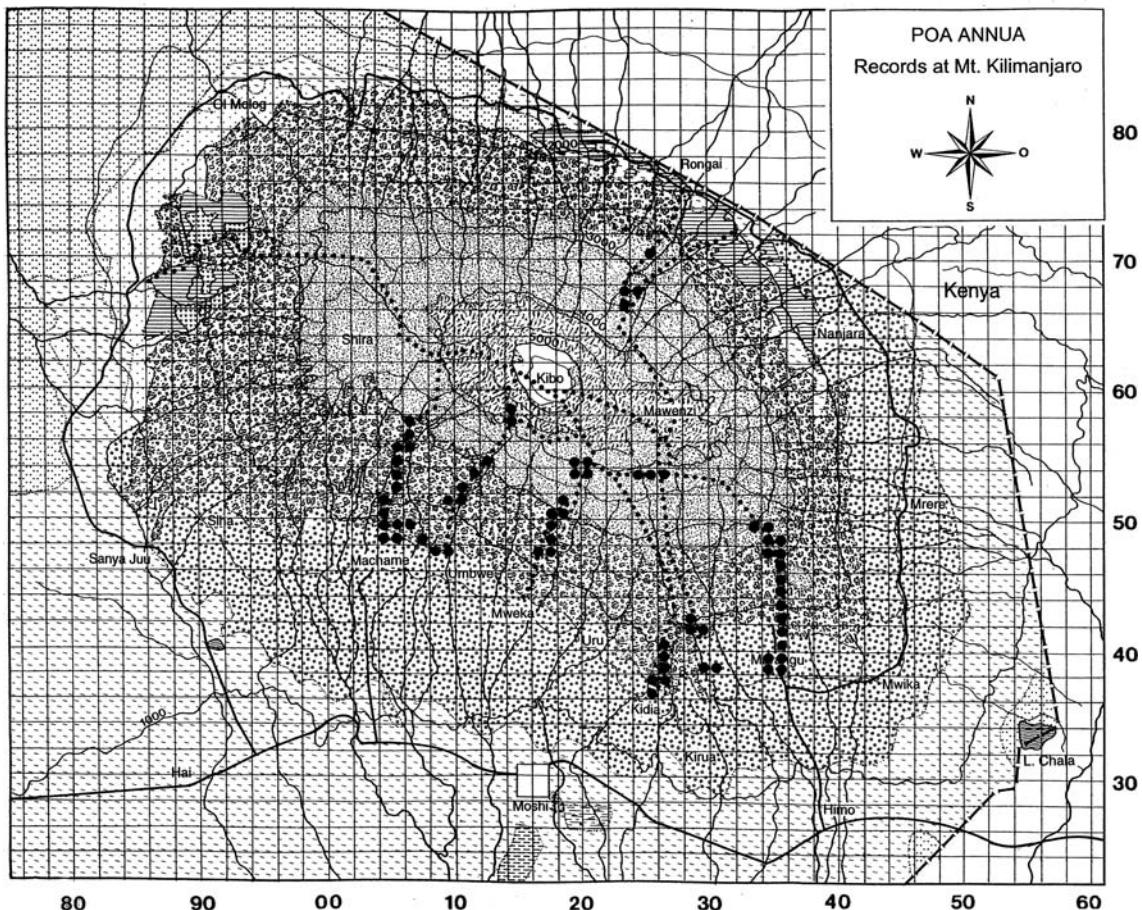
*Poa annua* was found in an altitudinal range of 1,600–3,980 m asl, i.e. from the lower montane to the alpine zone, occurring in a mean annual temperature range of 17–5°C and a mean annual precipitation range of 2,800–500 mm (data from Hemp 2006a). All localities with *Poa annua* are situated on climbing routes or in their vicinity (Fig. 2). The pH of plots with *Poa annua* varied between 6.3 ( $\text{CaCl}_2$ )/6.5 ( $\text{H}_2\text{O}$ ) and 4.1 ( $\text{CaCl}_2$ )/4.2 ( $\text{H}_2\text{O}$ ) (Table 1).

### Dispersal speed

In the year 2002, the Kidia climbing route was opened temporary as an alternative exit for the Mweka route, which was under reconstruction. This route follows in its lower part (between 1,680 and 2,150 m asl) an old logging track, which was used up to then only by the local people for collecting wood and fodder, densely covered by typical vegetation of trampled ground (communities 12b + c). This vegetation was surveyed intensively before opening of the route, and no *Poa annua* was found. Three months after the opening of the route, *Poa annua* occurred and had spread along the route between 1,680 (at the gate) and 2,150 m asl over a distance of 5.6 km (plots 25–27, 29 + 30 in Table 1). It is estimated that during this time about 2,500 tourists had used the track.

### Discussion

The *Plantago palmata* community of Kilimanjaro (community 12) is the vicarious community of the European plant association *Lolio-Polygonetum* of trampled ground with another dominant *Plantago* species (*P. major* L.) exhibiting the same growth form as a rosette plant. This plant community belongs to the vegetation class of trampled ground of the *Plantaginea-tea majoris*, in which *Poa annua* has its main occurrence within Middle Europe (cp. Oberdorfer 1983). Community 11 corresponds to the *Poa annua* community within the same vegetation class (Oberdorfer 1983). This means, *Poa annua* occupies exactly the



**Fig. 2** Records of *Poa annua* on Mt. Kilimanjaro, at the base of the UTM grid. The scale of the grid cells is 4 km<sup>2</sup>. *Poa annua* was found only on climbing tracks (dotted lines) or their vicinity. Compare this map with the location of investigated transects in Fig. 1

same habitat on Kilimanjaro as in Europe, not invading undisturbed natural vegetation types. Within the *Plantago palmata* community it rarely becomes dominant, usually not exceeding 25% coverage (Table 1). Only in one relevé (plot 7) it reached over 50% coverage. This relevé represents extreme conditions, being a heavily used campsite at the upper forest border. The other extreme is community 12d, where only one single specimen of *Poa annua* was found within a species rich semi-natural disturbed vegetation type. Thus in the lower (montane) areas *Poa annua* does not drive out indigenous plants, even nearly related species such as *Poa leptoclada* and other grasses (e.g. *Eragrostis tenuifolia*) with similar habitat demands.

In the (sub-)alpine zone *Poa annua* becomes dominant, however, only in anthropogenic vegetation of trampled ground around huts and campsites. In the bordering natural vegetation, e.g. in the *Helichrysum*

dwarf scrub, *Poa annua* does not occur. Only once, a few specimens of this neophytic grass were found in a stream bank near a climbing path, where it grew together with *Sedum meyeri-johannis* Engl., *Senecio purtschelleri*, *Peucedanum kerstenii*, *Cineraria deltoidea* Sond. and *Helichrysum splendidum* (Thunb.) Less. (no relevé in Table 1) in a similar situation as documented in community 12d of much lower altitudes.

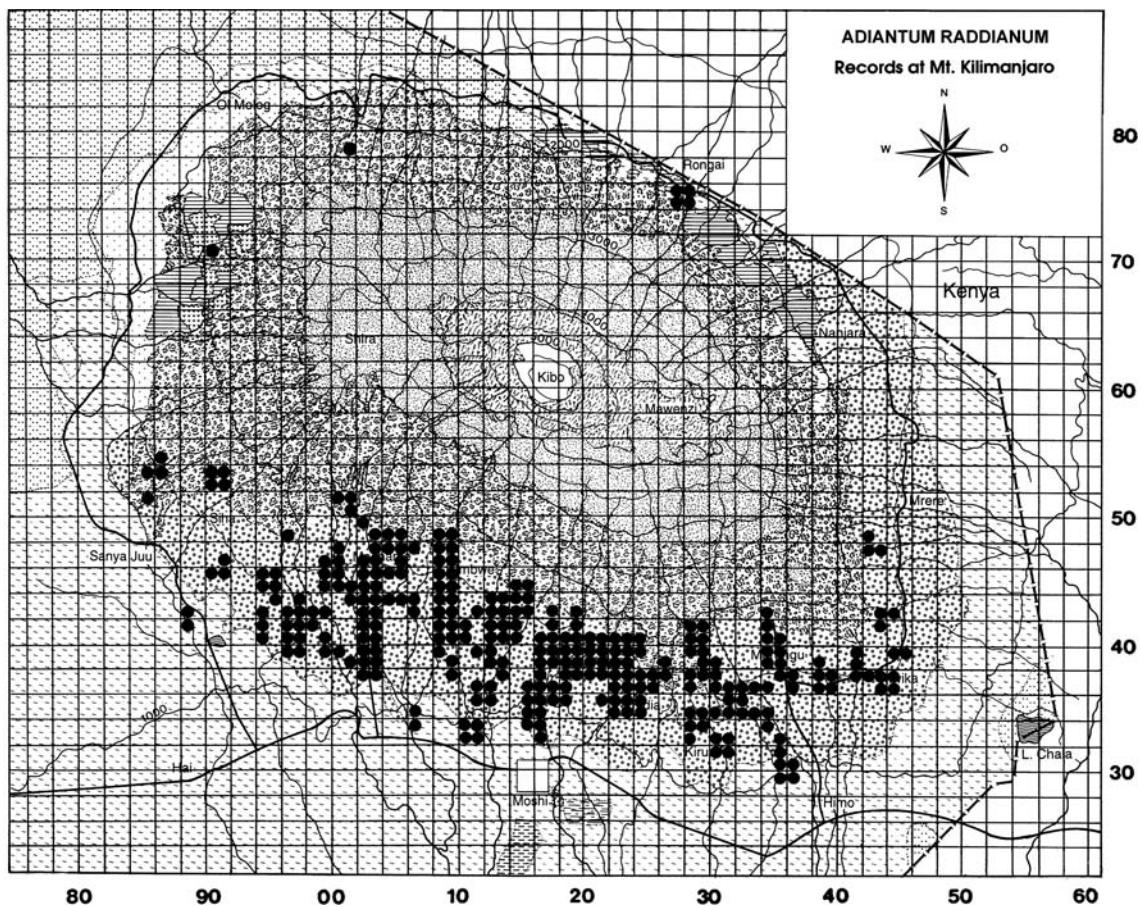
The restriction of *Poa annua* to the climbing routes, its absence from trampled vegetation of elephant paths of the northern slope (plot 8, Table 1) and the observations on the Kidia route suggest that this grass species is introduced and dispersed mainly by tourist activities. On the Kidia route distribution gaps of several 100 m between the single populations were observed, which are still (4 years after the closing of the route) not occupied by *Poa annua* and the populations seem to be stable. This means on one

hand that the dispersal units (the caryopsis) are dispersed by the sole of fissured trekking boots whereas the bare foot sole of the local people fails to do so, and on the other hand that *Poa annua* is an established flora element and not only a temporary constituent of the pathside vegetation.

A characteristic feature of the ruderal vegetation on Kilimanjaro is the high contribution of neophytes. In the Chagga homegardens, an agroforestry system typical of Kilimanjaro, nearly a quarter of the 520 plant species found are introduced, with 99 cultivated species and 41 (= 8% of the species) neophytes (Hemp 2006b). Some of these neophytes are very widespread within the cultivated areas, e.g. *Adiantum raddianum* C. Presl., a neophytic fern inhabiting shady embankments of roads and water canals (community 15, Appendix 1) in the coffee–banana

belt (Hemp 2006d). From the distribution of this fern (Fig. 3) it becomes obvious that it spread over the whole coffee–banana belt and that tourism was surely not the cause for its propagation. Similar to *Poa annua*, this neophyte invaded mainly anthropogenic vegetation (Chagga homegardens, roadsides, waste places), but is rare in natural (forest) vegetation. In the vegetation of trampled ground a similar high proportion of neophytic species occurs as in the Chagga home gardens (15 out of 210 species = 7%). In contrast, only about 2% of the whole flora of Kilimanjaro (comprising about 2,500–3,000 species) are neophytes (Hemp, unpublished data). This means that alien plant species mainly invade anthropogenic vegetation types on this mountain.

Mean annual temperature at the highest observed location of *Poa annua* at 3,980 m (5°C) is within the



**Fig. 3** Records of *Adiantum raddianum* on Mt. Kilimanjaro, at the base of the UTM grid. The scale of the grid cells is 4 km<sup>2</sup>. This introduced fern spread over the whole submontane and

lower montane banana plantation belt. Gaps within the distribution area inside the banana plantations (especially in its eastern part) are mostly due to lack of data

temperature range, where *Poa annua* is replaced in Middle Europe by *P. supina*, a closely related vicarious species of trampled ground vegetation at higher altitudes (Lenski and Ludwig 1964; Oberdorfer 1983). However, this species was not encountered during field work on Kilimanjaro.

*Poa annua* prefers open to semi-shaded conditions at Kilimanjaro as in Europe (Ellenberg 1991), indicated by its rarity on shady, humid tracks, where it is driven out by *Plantago palmata*. On such sites *Plantago* dominates. Natural habitats of *Plantago* are on buffalo and elephant paths (plot 8, Table 1) and stream banks in riverine forests, where *Plantago palmata* occurs up to 3,000 m (Hemp, unpublished data). This holds for many other species of the *Plantago palmata* group in Table 1 also indicating the origin of the constituents of this (mainly) anthropogenic vegetation type. *Plantago palmata* rarely grows under sunny conditions; this may be the one reason for the dominance of *Poa annua* outside the forest in the alpine zone. Another reason is the fact that the climate of the (sub-)alpine zone resembles in many aspects that of the temperate zones, which promotes the establishment of introduced species (Hedberg 1964). This is corroborated by the occurrence of the grass *Hordeum murinum* in ruderal vegetation and trampled ground around Horombo hut (plots 3–5, Table 1). This grass was introduced and planted in the beginning of the last century as fodder for horses, which were used at this time for transporting goods for tourists. About 100 years later it still dominates a certain ruderal vegetation type but has—similar to *Poa annua*—not invaded undisturbed natural vegetation types. The same holds for “the rescue grass” *Bromus inioloides* at Mandara hut (plot 6, Table 1). Other alien plant species found around Horombo and Mandara hut were *Capsella bursa-pastoris* and *Lolium perenne*.

Hedberg (1970) gives some examples of introduced plants from East African mountains. The assumption of *Arabis alpina* L. as man-dispersed species on Kilimanjaro (Sampson 1953; Hedberg 1970) is not corroborated by its distribution pattern, which suggests a natural dispersion mode (i.e. wind dispersal) on Kilimanjaro (Hemp, unpublished data).

On the other hand it is surprising that *Poa annua* is not mentioned by Hedberg (1957, 1970) or the Flora of tropical East Africa (Clayton 1970) for Kilimanjaro and that no herbarium material from this mountain exists at the East African Herbarium in Nairobi, which harbours the most extensive collection of this region.

Either *Poa annua* was overseen or did not attract attention of collectors, or it was at this time (before the opening of the park and the strong increase of tourism) not yet present at Kilimanjaro. This would mean that its present day distribution (as shown in Fig. 2) has arisen during the last 30 years (in line with the increasing tourism from 5,000 climbers in 1975 to 28,000 climbers in 2005). Regarding its rapid spread on the Kidia route this recent distribution on Kilimanjaro seems to be possible. Records of other invasive weeds at the same herbarium in Nairobi revealed a similar rapid spread during recent decades in East Africa (Stadler et al. 1998). Tutin (1957) suggests that *Poa annua* is a species of recent origin (by hybridization of *Poa supina* Schrad. and *P. infirma* Kunth. and following chromosome doubling). Therefore it must have spread rapidly to have attained its present world-wide distribution. This rapid spread can be readily accounted for—beside its association with man—by several characteristics (Tutin 1957): it shows great phenotypic and genotypic variability; it flowers and fruits throughout the year; it germinates rapidly; its self-fertility and rapid life-circle ensure that a single plant is able to build up a large population in the course of a year. Its “seeds” are readily dispersed, e.g. in mud sticking to shoes.

Summarising, field observations indicate that *Poa annua* is restricted on Kilimanjaro to climbing routes and their vicinity. It appears unlikely that invasion of natural vegetation types will take place. These findings are relevant to other high mountains in East Africa, which have similar environmental conditions and are similarly affected by tourism, e.g. Mt. Meru (Tanzania), Mt. Kenya, Mt. Elgon and Aberdares (Kenya) or the Bale and Simien Mts. in Ethiopia.

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## Appendix 1

## **Appendix 1** Percentage degree (constancy) table of vegetation units of open habitats on Kilimanjaro

1: alpine <i>Helichrysum</i> scrub	13-16: ruderal vegetation	24-28: freshwater swamps							
2-4: Subalpine ericaceous bushland	13: Chagga home gardens (coffee-banana fields) of higher areas (lower montane)	24: vegetation of muddy streambeds in the alpine zone							
2: <i>Erica</i> trimera bush	14: Chagga home gardens (coffee-banana fields) of lower areas (colline-submontane)	25: <i>Carex monostachya</i> swamps of the (sub-)alpine zone							
3: <i>Erica arborea</i> bush	15: roadsides and waste places of higher areas (lower montane)	26: swamps on talus-sides in the colline-montane zone							
4: Stoebe bush	16: roadsides, fallow arable fields and waste places of lower areas (colline-submontane)	27: vegetation of floating mats in the colline zone							
5-10: rocks	17: subalpine <i>Festuca obtusifolia</i> tussock grasslands	28: swamps on lake shores in the colline zone							
5: vegetation under alpine rock ledges	18: wet <i>Bulbostylis capensis</i> meadows of the lower montane zone	29-32: tall herb vegetation in montane riverine forests							
6: alpine rocks	19: wet <i>Tolpis capensis</i> meadows of the lower montane zone	30-32: forest clearings							
7: upper montane and subalpine rocks	20: wet grasslands of the submontane zone	30: forest clearings of the lower montane zone							
8: middle montane rocks	21: dry <i>Hyparrhenia rufa</i> meadows of the submontane zone	31: forest clearings of the middle-upper montane zone							
9: lower montane rocks	22: dry <i>Cyperus niveus</i> savanna grasslands	32: forest clearings of the northern slope (influenced by large herbivores)							
10: colline rocks									
11-12: vegetation of trampled ground	23: salt marshes								
11: Alpine vegetation of trampled ground									
12: Montane vegetation of trampled ground									
E=epiphyte, S=shrub (1 to 10 m tall), T=tree (>10 m tall), no label=herb layer; UKWF=Agnew and Agnew (1994)									
Community number	1 2 3 4 5 6 7 8 9 10 11 12	13 14 15 16 17 18 19 20 21 22 23	24 25 26 27 28 29 30 31 32 33						
Number of relevés	29 15 14 7 6 16 28 12 44 26 5 26	36 28 14 58 18 46 17 15 55 117 13	3 4 20 5 32 6 26 19 12 4						
Mean altitude (10 m asl.)	420 364 347 272 385 383 306 218 150 102 379 202	148 119 143 103 282 174 169 141 131 116 95	366 387 140 108 115 199 187 252 200 282						
Mean species number per plot	11 14 19 30 13 9 10 11 11 9 6 29	53 55 37 32 15 23 30 28 34 40 5	7 6 17 6 6 16 20 16 21 22						
Slope (degree)	12 12 12 8 8 102 96 96 82 6 5	12 3 39 6 10 19 10 3 26 11 0	5 5 6 0 1 5 23 9 13 15						
Mean pH H <sub>2</sub> O	6.0 5.4 5.2 4.9 7.0 4.8 7.4 6.0 5.4 6.0 6.8 6.1 6.7 4.9 5.0 5.9 6.3 6.7 6.6	6.8 6.5 6.4 7.2 5.7 4.1 6.3 6.7							
Mean pH CaCl <sub>2</sub>	6.0 4.6 4.8 4.3 5.9 4.9 7.2 5.8 4.9 5.6 6.5 5.7 6.3 4.9 4.6 5.4 6.0 6.2 6.3	6.6 6.0 5.8	5.3 3.7 6.0 6.5						
Mean cover herb layer (%)	26 33 31 59 37 9.4 25 62 48 20 62 75 55 44 81 85 72 65 93 95 73 68	86 43 93 83 90 95	100 98 91 95 100						
Mean cover moss layer (%)	4 31 20 3 28 24 61 48 53 32 0 0	0 0 12 0 3 21 3 0 1 0 0	28 1 2 0 11 0 0 0 0 0						
	alpine scrub ericaceous bush	rocks	trampled ground	ruderal vegetation	grasslands	salt	freshwater swamps	tall herb	forest clearings
<b>Alpine <i>Helichrysum</i> scrub</b>									
<i>Helichrysum citrispinum</i>	79 33 7	50 19	.	.	.	.	.	.	.
<i>Senecio teleki</i>	62 .	33 13	.	.	.	.	.	.	.
<b>Alpine and subalpine vegetation</b>									
<i>Pentaschistis borussica</i>	90 67 71	33 38 4	.	.	.	6	.	.	.
<i>Helichrysum newii</i>	79 93 79	50 19	.	.	.	.	.	.	.
<i>Senecio schweinitzii</i>	62 67 79	29 33 19	.	20	.	11	.	25	.
<i>Agrostis kilimandscharica</i>	3 7 43 14	17 31	.	20	.	28 4	.	.	.
<i>Festuca abyssinica</i>	66 53 14	17 6	.	40 4	.	4 24	.	.	.
<i>Alchemilla johnstonii</i>	28 53 36	.	4	40	.	.	75	.	.
<i>Helichrysum forskahlii</i> var. <i>compactum</i>	55 20 43	17 6	.	.	.	6	.	.	.
<i>Senecio meyeri-johannii</i>	41 20 7 4	17 6	.	.	.	11	.	.	.
<i>Luzula abyssinica</i>	34 67 43	.	.	.	.	17	.	.	.
<i>Eryops dacydoides</i>	S 34 47 14	.	.	.	.	.	.	.	.
<b>Subalpine <i>Erica</i> trimera bush</b>									
<i>Erica trimera</i>	S 24 100 64	.	.	.	.	.	.	.	.
<i>Pentaschistis chrysanthus</i>	.	13 43	6 4	.	.	.	.	.	.
<i>Adenocarpus manni</i>	.	13 43	.	4	4	6 4	.	.	.
<i>Thesium kilimandscharicum</i>	.	33 14	.	.	22	4	1	.	.
<i>Helichrysum kilimanjari</i>	3 20 36	6	.	.	22 11	.	.	.	.
<b>Subalpine <i>Erica</i> bush</b>									
<i>Anthospermum usambarensense</i>	S .	27 57 57	.	.	.	.	.	.	.
<i>Adenocarpus manni</i>	S .	13 50 29	.	.	.	.	.	.	.
<i>Protea caffra</i> ssp. <i>kilimandscharica</i>	S .	20 36 14	.	.	.	.	.	.	.
<i>Ficinia gracilis</i>	.	20 29 14	.	4	.	6	.	.	.
<i>Bleria johnstonii</i>	7 87 100 29	6	.	.	39 20	.	.	.	.
<i>Kniphofia thomsonii</i>	3 13 36 29	.	7	.	22	.	.	.	.
<b>Subalpine <i>Erica arborea</i> bush</b>									
<i>Erica arborea</i>	S .	86 57	.	.	.	.	.	.	.
<i>Erica arborea</i>	.	7 43 14	6 11	.	.	17	.	.	.
<i>Hypericum revolutum</i> ssp. <i>keniense</i>	.	29 43	6 4	2	4	33 6	.	.	4 8 25
<i>Myrica salicifolia</i>	S .	7 29 43	.	.	.	.	.	.	.
<b>Subalpine Stoebe bush</b>									
<i>Stoebe kilimandscharica</i>	S .	7 14 86	.	.	.	.	.	.	.
<i>Artemisia afra</i>	S .	.	57	.	.	.	.	.	.
<i>Lithospermum afrontanum</i>	.	.	43	.	.	.	.	.	.
<i>Peucedanum aculeolatum</i>	.	.	43	.	.	.	.	.	.
<b>Vegetation under alpine rock ledges</b>									
<i>Senecio pustulosus</i>	10 . .	67 19	.	.	40	.	.	.	.
<i>Anthoxanthum niveale</i>	10 7 .	50 13	.	.	.	.	.	.	.
<i>Alchemilla argyrophylla</i>	7 13 .	33 .	.	.	.	.	50	.	.
<i>Helichrysum formosissimum</i>	7 7 .	33 13 4	.	.	.	.	.	.	.
<b>Alpine rock crevices</b>									
<i>Asplenium uligin</i>	3 . 7	17 [56] 7	.	.	.	.	.	.	.
<b>Upper montane and subalpine rocks</b>									
<i>Chelidonium farinosum</i>	.	.	17 . 64	7	.	14	.	.	4
<i>Elaphoglossum subcinnamomeum</i>	.	.	17 . 46	.	.	.	.	.	.
<i>Anogramma leptophylla</i>	.	.	17 . 36	.	.	.	.	.	.
<i>Elaphoglossum decemnii</i>	.	.	.	36	.	.	.	.	.
<b>(Sub-)alpine - upper montane rocks</b>									
<i>Arabis alpina</i>	34 13 . 14	83 56 11	.	.	20	.	.	.	50
<i>Asplenium decompositum</i>	17 20 7 14	17 63 11	.	.	.	.	.	11 . 25	.
<i>Polystichum wilsonii</i>	.	29 33 6 50	.	.	4	.	.	.	25
<i>Sedum meyeri-johannii</i>	3 . .	33 56 14	.	.	.	.	.	.	.
<i>Cystopteris nivalis</i>	10 . .	17 38 29	.	.	.	.	.	.	.
<i>Xiphopteris flabelliformis</i>	.	.	17 56 18	.	.	.	.	.	.
<b>Middle - upper montane rocks</b>									
<i>Elaphoglossum hybrida</i>	.	.	39 50 5	.	.	.	.	.	16
<i>Athyrium scandicinum</i>	.	.	18 50	.	12 3	.	.	.	.
<i>Stegogramma pozoi</i>	.	.	32 25 2	.	.	.	.	.	5
<i>Sibiraea europea</i>	.	.	25 25 2	8	.	.	.	.	.
<i>Cystopteris fragilis</i>	.	17 . 54 33	7	3	.	.	.	.	8
<b>Middle montane rocks</b>									
<i>Hydrophyllum splendens</i>	.	.	75	.	.	.	.	.	.
<i>Trichomanes botanicum</i>	.	.	58 2	.	.	.	.	.	.
<i>Blechnum attenuatum</i>	.	.	67 9	.	.	.	.	.	.
<i>Elaphoglossum aubertii</i>	.	.	67	.	.	.	.	.	.
<i>Streptocarpus montanus</i>	.	.	58 2	.	.	.	.	.	.
<i>Blechnum ikonoviense</i>	.	.	42 2	.	.	.	.	.	.
<i>Streptocarpus caulescens</i>	.	.	33 23	15 6 21	.	.	.	.	.
<b>Submontane-lower montane rocks</b>									
<i>Selaginella abyssinica</i>	.	.	25 [70]	4 28 43	.	.	2	.	.
<i>Adiantum capillus-veneris</i>	.	.	61	.	.	.	.	.	.
<i>Pilea rivularis</i>	.	11 25 41	.	.	.	.	.	33	.

## **Appendix 1** continued

## **Appendix 1** continued

Colline roadsides and fallow arable fields													
<i>Oxygonum sinuatum</i>	.	.	.	.	.	.	11	25	. 60	.	13	2	9
<i>Urochloa panicoides</i>	.	.	.	.	.	.	4	48	.	.	25	.	.
<i>Lagascea mollis</i>	.	.	.	.	.	.	14	48	.	.	4	5	.
<i>Boerhaavia diffusa</i>	.	.	.	.	.	.	7	47	.	.	9	.	.
<i>Acanthospermum hispidum</i>	.	.	.	.	.	.	11	47	.	.	8	.	.
<i>Solanum incanum</i>	.	.	.	.	.	.	8	7	. 41	.	4	18	.
<i>Trichodesma zeylanicum</i>	.	.	.	.	.	.	11	40	.	.	11	21	.
<i>Brachiaria leiosperma</i>	.	.	.	.	.	.	7	38	.	.	7	.	.
<i>Argemone mexicana</i>	.	.	.	.	.	.	7	38	.	.	.	.	.
<i>Panicum spec.</i> 2770	.	.	.	.	.	.	14	36	.	.	11	.	.
<i>Cyperus rotundus</i>	.	.	.	.	.	.	4	34	.	7	23	.	.
<i>Launaea comuta</i>	.	.	.	.	.	4	18	. 33	.	7	8	.	.
<i>Panicum maximum</i>	.	.	.	.	.	11	31	.	.	4	9	.	.
<i>Hypsis suaveolens</i>	.	.	.	.	.	7	31	.	.	2	.	.	.
Subalpine tussock grasslands													
<i>Festuca obturans</i>	7	27	43	29	17	. 4	.	.	.	100	.	.	.
<i>Helictochrysum splendidum</i>	10	7	50	29	17	6	.	.	.	89	.	.	.
<i>Goranum kilimandscharicum</i>	.	53	21	43	.	.	.	.	.	44	.	.	.
<i>Koeleria canescens</i>	34	13	.	17	6	.	20	.	.	50	.	.	.
<i>Bulbostylis atrosanguinea</i>	.	7	43	.	.	.	.	.	.	67	.	.	.
<i>Cyperus kerstianus</i>	.	7	43	.	.	.	.	.	.	61	.	.	.
<i>Dierama cupuliflorum</i>	.	7	14	.	.	.	.	.	.	39	.	.	.
<i>Conyza ruwenzoriensis</i>	.	.	.	14	.	.	.	.	.	33	.	.	.
<i>Aristea alata</i>	.	7	29	.	.	.	.	.	.	39	11	.	.
<i>Exotheca abyssinica</i>	.	.	.	.	.	.	.	.	.	61	39	6	1
<i>Eragrostis olivacea</i>	.	.	.	.	.	.	44	15	.	.	.	.	.
Colline - montane grasslands													
<i>Emilia discifolia</i>	.	.	.	.	.	.	8	50	. 38	83	24	33	95
<i>Rhynchelytrum repens</i>	.	.	.	.	.	12	.	7	.	50	12	85	42
(Sub-)montane grasslands													
<i>Phyllanthus boehmeri humilis</i>	.	.	.	.	2	.	62	8	. 7	76	71	40	44
<i>Digitaria thoureana</i>	.	.	.	.	.	.	6	6	.	2	47	53	25
<i>Dyschoriste radicans</i>	.	.	.	4	.	.	35	6	. 3	9	65	53	25
<i>Justicia flava</i>	.	.	.	.	.	.	31	11	4	36	4	63	41
<i>Dichondra repens</i>	.	.	.	.	.	.	31	33	11	57	10	28	94
<i>Richardia scabra</i>	.	.	.	.	.	.	19	17	29	. 41	76	59	60
<i>Pseudognaphalium luteo-album</i>	.	.	.	.	11	.	4	22	14	14	20	47	27
<i>Thunbergia alata</i>	.	.	.	.	.	.	4	31	21	43	10	13	12
<i>Eragrostis schweinfurthii</i>	.	.	.	.	.	.	2	12	.	4	.	74	76
<i>Lactuca inermis</i>	.	.	.	.	.	.	.	.	.	2	27	85	19
<i>Digitaria longiflora</i>	.	.	.	.	.	.	.	4	.	30	41	20	24
<i>Crotalaria distantiiflora</i>	.	.	.	.	.	.	.	.	.	72	24	20	22
<i>Sporobolus piliferus</i>	.	.	.	.	.	.	.	.	.	26	6	7	31
Dry montane Bulbostylis meadows													
<i>Bulbostylis densa</i>	.	.	.	.	.	.	.	.	.	100	29	.	4
<i>Helictochrysum forskaahlii</i>	14	67	50	43	.	6	.	4	.	33	91	35	5
<i>Cyperus pseudoleptocladus</i>	.	.	.	.	.	.	.	7	.	74	.	.	30
<i>Anisopappus oliverianus</i>	.	.	.	.	.	.	.	.	.	30	12	.	10
Montane meadows													
<i>Oldenlandia herbacea</i>	.	.	.	.	.	.	.	.	.	85	35	.	18
<i>Eragrostis kiwuensis</i>	.	.	.	.	.	.	31	.	.	65	47	.	.
<i>Eragrostis atrovirens</i>	.	.	.	.	.	.	.	.	.	46	41	20	4
<i>Spermecocca princeae</i> var. <i>princeae</i>	.	.	.	27	3	.	.	.	.	46	41	.	.
<i>Digitaria abyssinica</i>	.	.	.	.	.	.	3	3	.	37	53	33	1
<i>Alectra sessiliflora</i>	.	.	.	4	12	.	.	.	.	30	47	11	2
<i>Conyza subscaposa</i>	.	.	.	.	4	.	.	.	.	39	76	7	16
Wet (sub-)montane meadows													
<i>Eragrostis tenella</i>	.	.	.	.	.	.	46	6	. 7	4	88	80	9
<i>Hypericum peplidifolium</i>	.	14	.	.	.	.	42	9	14	22	17	41	27
<i>Digitaria pectoralis</i>	.	.	.	.	.	.	2	50	17	29	9	35	47
<i>Vigna parkeri</i>	.	.	.	2	.	.	58	3	7	2	71	53	.
<i>Centella asiatica</i>	.	.	.	.	.	.	12	3	7	50	7	24	47
<i>Hydrocotyle manii</i>	.	7	5	.	.	.	15	19	29	.	71	53	2
<i>Cyperus brevifolius</i>	.	.	.	.	.	.	6	6	. 12	17	47	100	4
<i>Cyperus rigidifolius</i>	.	.	.	.	.	.	8	7	.	28	71	73	5
<i>Cyperus richardii</i>	.	.	.	.	.	.	.	.	.	7	65	33	.
Wet montane Tolpis meadows													
<i>Monopsis stellaroides</i>	.	.	.	.	.	.	54	.	.	24	94	.	.
<i>Tolpis capensis</i>	.	.	.	.	.	.	15	.	.	11	94	13	2
<i>Oldenlandia monanthos</i>	.	.	.	.	.	.	15	.	.	2	65	.	.
Wet submontane meadows													
<i>Chloris pycnothrix</i>	.	.	.	.	.	.	.	9	.	12	60	22	2
<i>Apium leptophyllum</i>	.	.	.	.	.	.	6	7	3	.	60	7	.
<i>Cynodon dactylon</i>	.	.	.	.	.	.	.	3	.	60	.	1	.
<i>Indigofera spicata</i>	.	.	.	.	.	.	3	16	.	33	4	4	.
Colline - submontane grasslands													
<i>Sporobolus fimbriatus</i>	.	.	.	.	.	.	4	4	. 10	9	53	49	18
<i>Euphorbia hirta</i>	.	.	.	4	.	.	25	34	.	6	40	62	29
<i>Justicia calyculata</i>	.	.	.	8	3	4	5	.	.	40	36	11	8
Dry submontane and colline grasslands													
<i>Heteropogon contortus</i>	.	.	.	.	4	.	.	.	.	15	.	56	62
<i>Hyparrhenia rufa</i>	.	.	.	.	4	.	.	.	.	.	71	45	.
<i>Crepis carbonaria</i>	.	.	.	.	.	.	3	4	.	.	42	19	.
<i>Aristida advena</i>	.	.	.	.	.	.	8	4	.	11	6	13	84
<i>Laggera alata</i>	.	.	.	.	.	.	.	.	.	.	53	35	25
<i>Satureja abyssinica</i>	.	2	4	.	.	.	.	.	.	.	7	82	9
<i>Microchloa kunthii</i>	.	.	12	.	.	.	.	.	.	.	65	5	.
<i>Wahlenbergia abyssinica</i>	.	4	4	.	.	.	.	.	.	.	17	40	8
<i>Piloselloloides hirsuta</i>	.	.	.	.	.	.	.	.	.	2	.	47	3
<i>Cyperus cyperoides</i> ssp. <i>cyperoides</i>	.	.	.	.	.	.	7	2	.	4	.	42	3
<i>Andropogon greenwayi</i>	.	.	4	4	.	.	.	.	.	4	.	40	.
<i>Triumfetta tomentosa</i>	.	.	4	.	.	.	.	.	.	31	9	.	.
Dry submontane Hyparrhenia meadows													
<i>Hyparrhenia rufa</i>	.	.	.	.	8	.	.	3	.	9	7	91	21
<i>Crepis carbonaria</i>	.	.	.	.	.	.	4	.	.	75	27	.	.
<i>Aristida advena</i>	.	.	.	.	.	.	.	.	.	56	14	.	.
<i>Laggera alata</i>	.	.	.	.	.	.	.	.	.	40	13	.	.
<i>Satureja abyssinica</i>	.	2	4	.	.	.	.	.	.	.	82	9	.
<i>Microchloa kunthii</i>	.	.	12	.	.	.	.	.	.	.	65	5	.
<i>Wahlenbergia abyssinica</i>	.	4	4	.	.	.	.	.	.	.	17	40	8
<i>Piloselloloides hirsuta</i>	.	.	.	.	.	.	7	2	.	2	.	47	3
<i>Cyperus cyperoides</i> ssp. <i>cyperoides</i>	.	.	4	4	.	.	.	.	.	4	.	42	3
<i>Andropogon greenwayi</i>	.	.	4	.	.	.	.	.	.	4	.	40	.
<i>Triumfetta tomentosa</i>	.	12	.	.	.	.	.	2	.	31	9	.	.

## Appendix 1 continued

Dry colline <i>Cyperus niveus</i> grasslands														
<i>Cyperus niveus</i>	.	.	.	.	.	.	2	.	.	29	64	.	.	.
<i>Bothriochloa insculpta</i>	.	.	.	.	.	.	22	.	.	51	8	.	.	.
<i>Melania velutina</i>	.	.	.	.	.	.	21	.	.	4	.	.	.	.
<i>Gutembergia cordifolia</i>	.	.	.	.	3	4	17	.	.	11	36	.	.	.
<i>Thunbergia</i> spec. D of UKWF	.	.	.	.	.	.	.	.	.	7	35	.	.	.
<i>Stylosanthes fruticosa</i>	.	.	.	.	.	.	2	.	.	2	35	.	.	.
<i>Hyparrhenia dissoluta</i>	.	.	.	.	.	.	.	.	.	.	30	.	.	.
<i>Tephrosia pumila</i>	.	.	.	.	.	.	5	.	.	2	50	.	.	.
<i>Indigofera volkensii</i>	.	.	.	.	.	.	5	.	.	2	47	.	.	.
<i>Aristida diffusa</i>	.	.	.	.	.	.	4	10	.	7	9	40	.	.
<i>Themeda triandra</i>	.	.	.	.	.	.	.	.	.	.	42	.	.	.
<i>Eragrostis superba</i>	.	.	.	.	.	.	2	.	.	.	42	.	.	.
<i>Indigofera volkensensis</i>	.	.	.	.	.	.	9	.	.	2	43	.	.	.
<i>Eragrostis ciliaris</i>	.	.	.	.	.	.	3	.	.	.	38	.	.	.
<i>Bartsia grandicalyx</i>	.	.	.	.	.	.	.	.	.	.	32	.	.	.
<i>Sehima nervosum</i>	.	.	.	4	.	.	.	.	.	.	38	.	.	.
<i>Dyschoriste hildebrandtii</i>	.	.	.	12	.	.	.	.	.	2	36	.	.	.
<i>Cymbopogon caesius</i>	.	.	.	.	.	.	2	.	.	.	38	.	.	.
<i>Thesius schweinfurthii</i>	.	.	.	.	.	.	.	.	.	.	35	.	.	.
<i>Phyllanthus maderaspatensis</i>	.	.	.	4	.	.	.	.	.	36	.	.	.	.
Colline saltmarshes														
<i>Sporobolus spicatus</i>	.	.	.	.	.	.	.	.	.	85	.	.	.	.
<i>Cyperus laevigatus</i>	.	.	.	.	.	.	.	.	.	77	.	.	.	.
<i>Sporobolus kentrophylloides</i>	.	.	.	.	.	.	.	.	.	54	.	.	.	.
<i>Psilolemma jaegeri</i>	.	.	.	.	.	.	.	.	.	31	.	.	.	.
Alpine swamps and bogs														
<i>Ranunculus volkensi</i>	.	.	.	33	4	.	20	.	11	.	100	75	.	.
<i>Peucedanum kerstenii</i>	14	7	.	.	.	.	.	.	.	33	50	.	.	.
Alpine muddy streamsides														
<i>Subularia monticola</i>	.	.	.	.	.	.	.	.	.	100	.	.	.	.
<i>Ranunculus aquatilis</i>	.	.	.	.	.	.	.	.	.	97	.	.	.	.
<i>Cardamine spec. 4627</i>	.	.	.	.	7	.	4	.	6	67	.	.	.	.
<i>Anagallis serpens</i>	.	.	.	.	.	.	.	.	8	33	.	.	.	.
<i>Poa muhavurensis</i>	.	.	.	.	.	.	.	.	.	33	.	.	.	.
<i>Montia fontana</i>	.	.	.	.	.	.	.	.	.	33	.	.	.	.
(Sub-)alpine <i>Carex monostachya</i> bogs														
<i>Carex monostachya</i>	3	.	7	.	.	.	.	.	.	100	.	.	.	.
(Sub-)montane swamps														
<i>Acmena calirhiza</i>	.	.	.	.	.	19	31	4	29	3	85	.	34	.
<i>Commelinopsis diffusa</i>	.	.	.	.	4	.	7	.	6	6	30	28	.	.
<i>Cyperus niger</i> ssp. <i>elegans</i>	.	.	.	.	35	.	.	20	18	.	45	.	.	.
<i>Panicum hymenochilum</i>	.	.	.	.	4	3	.	.	6	.	50	.	.	.
<i>Trifolium pratense</i>	.	.	.	.	15	.	.	.	18	.	45	.	.	.
<i>Oxyurus murdannii</i>	.	.	.	.	.	.	.	.	.	.	40	.	.	.
<i>Ludwigia abyssinica</i>	.	.	.	.	.	.	.	.	.	.	45	.	.	.
<i>Polygonum salicifolium</i>	.	.	.	.	.	11	.	4	7	.	35	3	.	.
<i>Impatiens nana</i>	.	.	.	.	.	.	4	14	.	6	45	.	.	.
<i>Cyperus distans</i> coll.	.	.	.	.	.	4	3	.	18	13	30	19	.	.
Colline floating mats														
<i>Cyperus alopecuroides</i>	.	.	.	.	.	.	.	.	.	100	.	.	.	.
<i>Furcraea pubescens</i> var. <i>major</i>	.	.	.	.	.	.	.	.	.	100	.	.	.	
<i>Orasocephalum pteridifolium</i>	.	.	.	7	.	.	7	.	.	20	100	.	.	.
<i>Adenostemma californicum</i>	.	.	.	.	.	.	.	.	.	15	100	.	.	.
<i>Thelypteris confertus</i>	.	.	.	2	.	.	.	.	.	15	100	.	.	.
Colline swamps on lakeshores														
<i>Leersia hexandra</i>	.	.	.	.	.	.	.	.	6	.	20	59	.	.
<i>Cyperus denudatus</i> ssp. <i>denudatus</i>	.	.	.	.	.	.	.	.	.	47	.	.	.	.
<i>Panicum repens</i>	.	.	.	.	.	.	.	.	.	34	.	.	.	.
Tall herb vegetation on montane riversides														
<i>Impatiens volkensi</i>	.	.	.	2	.	4	.	3	.	22	37	29	7	.
<i>Deparia boryana</i>	.	.	.	32	.	3	.	.	.	.	10	.	.	.
<i>Adenostemma mauritanum</i>	.	.	.	.	23	.	.	.	.	.	100	4	.	.
Forest clearings														
<i>Peridium aquilinum</i>	.	43	.	.	.	8	11	14	2	.	42	21	25	25
<i>Thalictrum myrsinocarpum</i>	.	14	.	4	.	15	.	.	.	.	17	19	25	25
<i>Peucedanum linderi</i>	.	7	.	.	.	15	.	.	.	.	8	26	75	.
<i>Cyatula polycarpa</i>	.	.	.	.	8	3	2	.	.	25	.	17	31	50
<i>Pycnostachys meyeri</i>	.	.	.	.	.	.	.	.	.	.	17	19	37	25
Lower - upper montane forest clearings														
<i>Pedicularis sudetica</i>	.	.	.	.	4	.	7	.	7	18	.	5	.	.
<i>Stephania abyssinica</i>	.	.	.	.	.	18	7	2	.	.	31	53	25	.
<i>Momordica foetida</i>	.	.	.	.	4	.	.	.	.	.	12	33	.	.
<i>Hypocephalus sparsiflora</i>	.	.	.	.	12	.	.	.	.	.	17	46	63	.
<i>Rubus steudneri</i>	.	.	.	.	.	4	.	2	.	.	17	46	63	.
Lower montane forest clearings														
<i>Triumfetta brachyceras</i>	.	.	.	.	4	3	7	.	1	.	59	.	.	.
<i>Acyparis psilosachya</i>	.	.	.	.	11	4	7	.	.	5	54	.	.	.
<i>Basella alba</i>	.	.	.	.	.	11	4	7	.	.	33	5	.	.
<i>Impatiens digitata</i> ssp. <i>digitata</i>	.	.	.	.	8	.	.	.	.	.	38	5	.	.
<i>Ipomoea involucrata</i> ssp. <i>involuta</i>	.	.	.	.	.	.	.	.	.	.	27	11	.	.
Middle - upper montane forest clearings														
<i>Histiopteris incisa</i>	.	.	.	.	.	.	.	.	.	.	42	.	.	.
Forest clearings of the northern slope														
<i>Urtica massaica</i>	.	.	.	.	.	.	.	.	.	.	75	25	.	.
<i>Sparmannia ricinocarpa</i>	.	14	.	.	.	.	.	.	.	.	5	25	.	.
<i>Leucas massaiensis</i>	.	.	.	.	.	.	.	.	.	.	33	25	.	.
<i>Pavonia patens</i>	.	.	.	.	.	.	.	.	.	.	3	.	.	.
<i>Bothriocline longipes</i>	.	.	.	.	.	.	.	.	.	.	25	.	.	.
<i>Vernonia laspous</i>	.	.	.	.	.	4	2	.	2	.	25	.	.	.
Forest clearings in upper montane <i>Erica</i> forests														
<i>Dipsacus pinnatifidus</i>	.	43	.	.	.	15	100	82	100	38	63	65	87	53
<i>Nepeta azurea</i>	.	14	.	.	.	2	46	67	32	71	38	43	82	87
<i>Verbascum brevipedicellatum</i>	.	14	.	.	.	38	.	2	.	20	88	87	44	1
<i>Sida ternata</i>	.	.	.	.	23	46	17	7	12	17	59	27	13	29
Companions														
<i>Ageratum conyzoides</i>	.	.	.	11	.	15	100	82	100	38	63	65	87	53
<i>Conyza sumatrensis</i>	.	.	.	2	.	46	67	32	71	38	43	82	87	78
<i>Sporobolus africanus</i>	.	.	.	.	38	.	2	.	20	88	87	44	1	.
<i>Paspalum scrobiculatum</i>	.	.	.	.	12	.	.	39	65	53	27	2	30	3
<i>Commelinopsis</i> spec.	.	.	.	23	46	17	7	12	17	59	27	13	29	55
<i>Satureja bifolia</i>	7	7	14	57	13	.	4	.	9	6	31	4	.	4
<i>Selaria sphacelata</i>	.	.	.	9	.	31	19	29	2	2	33	2	6	11
<i>Desmodium repandum</i>	.	.	.	.	9	.	31	19	29	2	.	10	.	17
Species with low frequency were excluded.														

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