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VEGETATIVE KEY TO THE ALPINE VASCULAR PLANTS OF MOUNT KENYA

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INTRODUCTION

In recent years there has been an increasing interest in several aspects of plant biology in the alpine zone of Mount Kenya. To my knowledge, at least a dozen research projects were carried out between 1977 and 1984. Fortunately, the flora of the region has been the subject of a fine monograph by Hedberg (1957), and the currently available volumes of the Flora of Tropical East Africa (FTEA hereafter) contain a majority of the alpine species. Although reproductive individuals are generally more prevalent on the mountain throughout the year when compared to the drier lowlands, many species are only rarely found in the reproductive state (personal observations). As part of a comprehensive study of the vegetation of the upper Teleki Valley on Mount Kenya, we produced this key based on vegetative characters. It has since proven useful (in manuscript form) in studies by various other researchers. It is hoped that its publication will facilitate and encourage future biological research on Mount Kenya.

A lower elevational limit of 3500 meters was chosen to eliminate a number of forest species that occur sporadically above the timberline. Several species not listed by Hedberg are included. These represent either new records for Mount Kenya, such as *Helictotrichon umbrosum* and *Cystopteris diaphana*, or new altitudinal ranges discovered in our studies, such as *Kniphofia thomsonii* and *Asplenium E* (Agnew 1974). A separate paper will document the distribution, frequency, and ecology of the approximately 70 species found in the upper Teleki Valley.

As an additional aid to identification, three short reproductive keys for difficult groups are appended to the main vegetative key. The first of these covers three species of *Helichrysum*, the second covers herbs with opposite entire leaves, and the third covers the grasses. For three genera (*Poa*, *Colpodium*, and *Cerastium*) of two species each, no reliable vegetative distinguishing traits could be found. These genera are included in the reproductive keys.

One other genus deserves special mention. Hedberg (1957) and Clayton (1970) distinguished *Pentaschistis minor* and *P. borussica* by panicle shape. The former reportedly has a linear panicle, and the latter an open panicle. In addition, their altitudinal distributions on Mount Kenya were thought to be disjunct (Hedberg 1957). We have found that not only can *Pentaschistis* spp. be found at intermediate elevations, but that panicle shape in *P. minor* varies with plant age and air temperature (T.P.) Young, personal observations). In addition, Clayton (1970) reports the existence of intermediates between *P. minor* and *P. borussica*. We have found no consistent vegetative differences, and both key out here as *P. minor*.

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Hints to Using the Key

It is particularly helpful to use this key in conjunction with Hedberg (1957), Agnew (1974), and relevant volumes of the Flora of Tropical East Africa (cf. Clayton 1970), sections of whose keys we have used here. After reaching one or more possible species identities in the key, compare your specimen to the descriptions in these texts, paying attention also to habitat and elevation. Unfortunately, the first two of these references are difficult to obtain at this time in East Africa. One hopes that this will not always be the case.

This key is designed for use with living vegetative material. Dry material may differ, especially in color: Reproductive material is often very different from vegetative material; for example, several small rosette species produce long leafy stems at reproduction, and leaves on reproductive stems may differ from those on vegetative plants. As in any vegetative key, there is likely to be some confusion concerning seedlings and young plants. For example, very young shaded *Lobelia telekii* individuals look similar to mature *Limosella africana* plants. In this case the latex of the former is indicative, but in others it must be left to the reader's own development of a 'feel' for the species. In particular, young plants of woody or shrubby species often appear herbaceous. We have tried in this key to reduce such ambiguities, relying on invariable characters as much as possible.

In order to make this key accessible to as broad a readership as possible, we have tried to minimize the use of botanical jargon. Nonetheless, some specialized terminology is unavoidable, particularly for the grasses.

- 1) Plant a fern; leaves (fronds) thin, compound, glabrous (but may have scales); ultimate segments dentate; leaves arising from a rhizome; plant not a rosette 2
Plant not a fern; if leaves compound and glabrous, then ultimate segments entire or the vegetative plant a rosette 3
- 2) Leaves multipinnate; final frond segments (pinnae) fan-shaped; rachis with coppery scales *Asplenium* sp. E. (Agnew)
Leaves pinnate; pinnae lanceolate, rachis without scales *Cystopteris diaphana* (syn. *C. fragilis*)
- 3) Plant glabrous; erect stems densely covered by numerous single-veined leaves less than 2 cm long (a nonseed plant that often has sporangia in its leaf axils) *Lycopodium saururus*
Plant not as above – if leaves small, glabrous and entire, then not densely covering erect stems (Angiosperms) 4
- 4) Leaves with parallel venation, entire, simple, often grasslike, not succulent, >2 cm long; if <2 cm long, then with distinct ligules (Monocotyledons) 5
Leaf veins net-like; leaves entire to deeply lobed, simple or compound, if somewhat grasslike, then succulent or woody or with liguleless leaves <2 cm long (Dicotyledons) 32
- 5) An aquatic plant with long internodes and leaves >1 cm broad *Potamogeton schweinfurthii*
Plant terrestrial, or with narrow leaves and short internodes 6
- 6) Leaves >1.5 cm wide 7
Leaves <1.0 cm wide 9
- 7) Leaves often >3 cm wide, always narrowing near the base. *Disa stairsii*
Leaves 1.5 to 2.5 cm wide, linear 8
- 8) Leaves with a raised midvein on both upper and lower surfaces; leaf blades flat *Gladiolus watsonoides*
Leaves without a raised midvein, or only on the lower surface; Leaf blades often V-shaped *Kniphofia thomsonii*
- 9) Leaves triangular to rectangular in cross section, with notched corners (in cross section) *Romulea keniensis*
Leaves flat, folded, rolled, round, or V-shaped, not notched 10
- 10) Leaves >4 mm wide, tinged red and densely long hairy. *Luzula abyssinica*
Leaves < 4 mm wide, if greater, then not tinged red and densely long hairy 11
- 11) Leaves with a distinct ligule, either membranous or a fringe of hairs (Graminae) 14 (see also 134)
Ligule indistinct or absent (*Carex*) 12

- 12) Leaves (culms) round *Carex runssoroensis*
 Leaves flat to V-shaped 13
- 13) Leaves <4 mm wide, strongly V-shaped *Carex monostachya*
 Leaves >4 mm wide *Carex sp. (prob. bageartii)*
- 14) Ligule a fringe of hairs 15
 Ligule membranous 16
- 15) Backs of leaves with single raised midveins *Pentaschistis minor*
 Backs of leaves with a number of equal ribs *Andropogon amethystinus*
- 16) Leaf forming two right angles between the sheath and the blade *Koeleria capensis*
 Leaf forming a single acute angle at the ligule 17
- 17) Leaves flat or folded, not readily rolled between the fingers 18
 Leaves (tightly) rolled or subulate, readily rolled between the fingers 28
- 18) Leaves >20 cm long, >5 mm wide *Andropogon amethystinus* (incl. *A. longipes*)
 Leaves <20 cm long, if longer then <5 mm wide 19
- 19) Leaves flat 20
 Leaves folded; if open, then with a distinct crease. 23
- 20) At least some leaves >4 mm wide 21
 All leaves <3.5 mm wide 22
- 21) Leaves glabrous or (sparsely hairy) when crushed not having a distinct aromatic smell or taste *Colpodium spp. (see 139)*
 Leaves usually long hairy; when crushed smelling and tasting of coumarin
 *Anthoxanthum nivale*
- 22) Leaves sparsely pubescent; some hairs >2 mm long *Helictotrichon umbrosum*
 Leaves glabrous or with a few hairs <1.5 long *Agrostis quinqueseta*
- 23) Folded leaf >1.5 mm wide 24
 Folded leaf <1.5 mm wide 26
- 24) Stem with distinct internodes >2 cm long *Calamagrostis hedbergii*
 Plant tufted; internodes <1 cm long 25
- 25) Upper leaf sheath of two distinct parts—a membranous extension of the ligule inside, and a green leafy lip outside *Colpodium spp. (see 139)*
 Upper leaf sheath not of two distinct parts *Poa spp. (see 146)*
- 26) Ligule <1.5 mm long with dark glands at its base, especially in older leaves. *Festuca abyssinica*
 Ligule > 1.5 mm long, without dark glands at its base 27
- 27) Leaf bases, sheathes, or blades tinged red; blades flexuous *Deschampsia flexuosa*
 Plant not tinged red; leaf blades straight *Agrostis sclerophylla*
- 28) Leaves smooth or only slightly rough to the touch 29
 Leaves scabrous, distinctly rough to the touch 30
- 29) Culm bases white, not grey or brown or reddish *Agrostis gracifolia*
 Culm bases grey or brown or reddish 30
- 30) Ligules <1.5 mm long; culm bases often reddish *Festuca pilgeri*
 Ligules >1.5 mm long; culm bases not reddish 31
- 31) Leaves striate *Agrostis volkensisii*
 Leaves estriate *Agrostis trachyphylla*
- 32) Leaves producing a milky latex 33
 Leaves not producing a milky latex 35
- 33) Latex white; leaves never >4 cm long; leaves entire, often emarginate .. *Dianthoseris schimperi*
 Latex cream colored; leaves usually >4 cm long; leaves shallowly crenate, not emarginate
 (*Lobelia*) 34
- 34) Midvein glabrous in smaller plants; in larger plants, rosette
 retaining a reservoir of water *Lobelia deckenii* ssp *keniensis*
 Lower midvein pubescent on the underside, rosette not retaining a reservoir of water (note: hybrids
 between these two species occur rarely) *Lobelia telekii*
- 35) Leaves or stem armed with stout spines, not merely barbed 36
 Plant not armed with spines, although some leaves may have weak barbs 38

- 36) Only stems armed; plant a woody shrub *Helichrysum citrispinum*
 Leaves armed, plant a rosette (*Carduus*) 37
- 37) Leaves compound; undersides white with pubescence *Carduus keniensis*
 Leaves dentate, undersides green *Carduus chamaecephalus* (syn. *C. platyphyllus*) (note:
 hybrids occur rarely) 39
- 38) Leaves distinctly compound *and* plant herbaceous or woody only at the base 39
 Leaves simple, entire to deeply lobed; or if leaves compound, then plant distinctly shrubby (see 106)
 49
- 39) Leaves with three leaflets; leaflets entire or minutely toothed *Trifolium multinerve*
 Leaves with more than three leaflets, or if three then distinctly dentate 40
- 40) Leaflets ovate, with acuminate teeth *Cardamine obliqua*
 Leaflets dentate, lobed, entire, sometimes filiform; not ovate 41
- 41) Leaves <10 cm long and leaflets >5 mm wide (*Ranunculus*) 42
 Leaves >10 cm long; or if less, then leaflets <5 mm wide 44
- 42) Leaves multipinnate *Ranunculus oreophytus*
 Leaves trifoliate 43
- 43) Leaflets deeply lobed *Ranunculus keniensis*
 Leaflets merely dentate *Ranunculus aberdaricus*
- 44) Leaflets <2 mm wide, filiform (*Peucedanum*) 45
 Leaflets >3 mm wide, dentate 46
- 45) Leaf rachis glabrous *Peucedanum friestorum*
 Leaf rachis sparsely pubescent *Peucedanum kerstenii*
- 46) Leaves densely pubescent, white to silvery in appearance 47
 Leaves sparsely pubescent, greenish 48
- 47) Leaflets pinnately lobed or leaves bipinnate *Anthemis tigrensis*
 Leaflets entire to 1-2 lobed *Cotula abyssinica*
- 48) Leaflets <5 mm wide *Haplosciadium abyssinicum*
 Leaflets >7 mm wide *Heracleum inexpectatum* (syn. *Heracleum elgonense*)
- 49) Plant a rosette, internodes <5 mm long (although leafy stolons or reproductive shoots may be
 present) 50
 Vegetative plant with distinct internodes 73
- 50) Leaves entire 51
 Leaves dentate to deeply lobed 58
- 51) Leaves spatulate, >1.5 cm long 52
 Leaves not distinctly spatulate; if slightly so then <1.5 cm long 54
- 52) Leaves <5 mm wide, not purple tinged *Limosella aquatica* (syn. *Limosella africana*)
 Leaves >5 mm wide, or purple tinged (*Swertia*) 53
- 53) Plants producing stolons *Swertia crassiuscula*
 Plants not producing stolons *Swertia volkensis*
- 54) Leaves succulent *Subularia monticola*
 Leaves not succulent 55
- 55) Leaves glabrous 56
 Leaves pubescent 57
- 56) Leaves >3 mm wide *Dianthoseris schimperi*
 Leaves <3 mm wide *Sagina afroalpina*
- 57) Underside of leaf apex with a distinct gland; leaf hairs not glandular *Myosotis keniensis*
 Underside of leaf apex without a white gland; leaf hairs glandular *Cerastium* spp. (see 133)
- 58) Leaves dentate to lobed less than halfway to the midvein 59
 Leaves lobed more than halfway to the midvein 70
- 59) Leaves robust, thick (1 mm), with stout midveins and incurved margins, dentate 60
 Leaves thin, with thin margins, dentate or not 66

- 60) Leaves white woolly underneath 61
 Leaves green underneath, sometimes light green due to a thin layer of hairs 62
- 61) Upper leaf surfaces relatively smooth, plant becoming megaphytic *Senecio brassica*
 Upper leaf surfaces rugulose; plant a small flat rosette *Haplocarpha rueppellii*
- 62) Leaves <1 cm wide; plant not becoming megaphytic (see 121) 63
 Leaves >2 cm wide; plant becoming megaphytic 64
- 63) Plant glandular sticky *Senecio schweinfurthii*
 Plant not glandular sticky *Senecio keniohytum*
- 64) Leaves green beneath *Senecio keniodendron*
 Leaves greenish-white beneath, due to a thin layer of hairs 65
- 65) Megaphytic rosette plant growing to several meters; absent from the Teleki Valley, occurs along rocky courses elsewhere *Senecio battiscombei*
 Megaphytic rosette plant never reaching much taller than 1 m; only found along the ecotone between adjacent *Senecio brassica* and *Senecio keniodendron* populations, not uncommon in these situations *Senecio keniodendron* x *S. brassica* hybrid
- 66) Leaves lobed or crenate, >2 cm long 67
 Leaves toothed, <2 cm long 68
- 67) Leaves >5 cm long, often deeply lobed *Scabiosa columbaria*
 Leaves <5 cm long, crenate *Conyza subscaposa*
- 68) Hairs simple or leaves glabrous *Wahlenbergia pusilla*
 Hairs forked or stellate 69
- 69) Leaves densely covered by stellate hairs usually <.5mm long; (silique >.7 mm broad).
 *Arabis alpina*
 Leaves sparsely to moderately covered by stellate and simple hairs, some hairs at the bases of leaves up to 7 mm long; (silique <.7mm broad) *Arabidopsis thaliana*
- 70) Basal leaves usually thrice ternately lobed *Anemone thomsonii*
 Leaves pinnately, bipinnately, or palmately lobed 71
- 71) Leaves palmately lobed; not longer than wide; sometimes reddish (*Geranium*) 112
 Leaves pinnately to bipinnately lobed; longer than wide, not reddish. 72
- 72) Leaves >5 cm long *Scabiosa columbaria*
 Leaves <5 cm long *Oreophyton falcatum*
- 73) Leaves succulent 74
 Leaves not succulent 77
- 74) Plant woody at base *Sedum ruwenzoriense*
 Plant herbaceous 75
- 75) Leaves alternate *Sedum crassularia*
 Leaves opposite (*Crassula*) 76
- 76) Plant restricted to shallow soil on dry ledges; leaves distinctly succulent, nearly spherical.
 *Crassula alba*
 Plant of seasonal boggy flats; leaves weakly succulent *Crassula granvikii*
- 77) Leaves entire or with barbs or small acuminate teeth 78
 Leaves distinctly dentate to lobed to compound 104
- 78) Plant woody, at least at the base 79
 Plant herbaceous throughout 93
- 79) Leaves broader than 7 mm, never sticky 80
 Leaves narrower than 5 mm, or glandular sticky 81
- 80) Leaves opposite *Hypericum kenianse*
 Leaves alternate *Protea kilimandscharica*
- 81) Leaves clasping the stem (*Helichrysum*) 82
 Leaves petiolate, not clasping the stem 85
- 82) Leaves >8 mm wide, glandular sticky *Helichrysum formosissimum*
 Leaves <5 mm wide, not glandular sticky 83 (see also 125)
- 83) Stems usually >6 mm in diameter; upper and lower leaf surfaces distinctly different in color; plant a shrub to 2m *Helichrysum chionoides*
 Stems <5 mm in diameter; upper and lower leaf surfaces similar; plant >.5m high 84

- 106) Leaves bipinnate *Artemisia afra*
 Leaves trifoliolate or simple 107
- 107) Leaves bipinnate *Adenocarpus mannii*
 Leaves or leaflets dentate or serrate 108
- 108) Leaves densely pubescent, usually trifoliolate; stipule membranous, with undivided apex
 *Alchemilla argyrophylla*
 Leaves sparsely to moderately pubescent, simple; stipule foliaceous, with a dentate apex
 *Alchemilla johnstonii*
- 109) Leaves with stinging hairs *Urtica massaica*
 Leaves without stinging hairs 110
- 110) Stipules dentate; plant erect *Cineraria grandiflora*
 Stipules entire; plant spreading 111
- 111) Leaves sharply dentate *Alchemilla cyclophylla*
 Leaves without acute teeth (*Geranium*) 112
- 112) Leaf blades reniform (kidney shaped) *Geranium kilimandscharica*
 Leaf blades pentagonal *Geranium arabicum*
- 113) Leaves opposite, at least near the base 114
 Leaves alternate 120
- 114) Leaves more than twice as long as broad 115
 Leaves less than twice as long as broad 117
- 115) Leaves deeply lobed toward base, entire at apex *Valeriana kilimandscharica*
 Leaves crenate-dentate throughout (*Bartsia*) 116
- 116) Leaves usually <3 times long as broad, rarely rolled (flowers purple) *Bartsia abyssinica*
 Leaves usually >3 times long as broad, often rolled (flowers yellow).
 *Bartsia decurva* (syn. *Bartsia kilimandscharica*)
- 117) Leaves minty, stems hairy (*Satureja*) 118
 Leaves not minty, stems glabrous (*Veronica*) 119
- 118) Leaf bases cordate *Satureja kilimandscharica*
 Leaf bases cuneate to truncate *Satureja simensis*
- 119) All stems prostrate *Veronica gunae*
 Some stems ascending to erect *Veronica glandulosa*
- 120) Leaves glabrous *Hebenstretia angolensis* (see at 86)
 Leaves pubescent (*Senecio*, see Hedberg 1957, page 225) 121
- 121) Plant glandular sticky 122
 Plant not glandular sticky 123
- 122) Plant woody at the base *Senecio roseiflorus*
 Plant herbaceous *Senecio purtschelleri*
- 123) Plant woody, at least at the base *Senecio schweinfurthii*
 Plant herbaceous 124
- 124) Leaves petiolate, dentate *Senecio kentophytum*
 Leaves apetiolate, mostly entire *Senecio jacksonii*

SPECIAL REPRODUCTIVE KEYS TO DIFFICULT GROUPS

Unarmed *Helichrysum* spp.

- 125) Involucre bracts appressed, inconspicuous; capitula diameter <4mm ... *Helichrysum cymosum*
 Involucre bracts open, showy; capitula diameter >15mm 126
- 126) Heads 1-5 in each corymb, 2.5-3.0cm wide, white with faint reddish tinge in bud
 *Helichrysum brownei*
 Heads usually 5-10 or more in each corymb, 1.5-2.5cm wide, pure white or with a brownish tinge
 *Helichrysum chionoides*

Herbs with opposite, entire, glabrous leaves

- 127) Ovary of four separate carpels 128
 Carpels united 129
- 128) Flowers unisexual *Callitriche stagnalis*
 Flowers bisexual *Crassula granvikii*

- 129) Flowers irregular *Satureja biflora*
 Flowers regular 130
- 130) One style and stigma 131
 3-5 styles or stigmas 133
- 131) Petals small, <4mm long *Montia fontana*
 Petals longer than 6mm 132
- 132) Petals with indistinct nectaries without ciliation *Swertia subnivalis*
 Petals with distinct ciliate nectaries *Swertia kilimandscharica*
- 133) Petals often inconspicuous, with a narrow slit at apex; capsule teeth erect with reflexed margins
 *Cerastium octandrum*
 Petals emarginate at apex, capsule teeth backwards or spirally *Cerastium afromontanum*
- Gramineae**
- 134) Inflorescence [two to] several digitately arranged spikes *Andropogon amethystinus*
 Inflorescence an open or contracted panicle 135
- 135) Ligule a fringe of hairs *Pentaschistis minor*
 Ligule membranous 136
- 136) Spikelets with one floret 137
 Spikelets with more than one floret (sometimes only one fertile, but then with more than one awn
 per spikelet) 144
- 137) Floret with long hairs longer than the spikelet (sometimes deciduous upon drying)
 *Calamagrostis hedbergii*
 Floret without hairs or with only short hairs 138
- 138) Leaves >3mm wide; florets awnless (*Colpodium*) 139
 Leaves <3mm wide, if greater than florets awned (*Agrostis*) 140
- 139) Spikelets 4-6.5mm long; leaves to 12cm long *Colpodium chionogeiton*
 Spikelets 2.5-3.5mm long; leaves to 6.5cm long *Colpodium hedbergii*
- 140) Florets awnless *Agrostis sclerophylla*
 Florets awned 141
- 141) Leaves flat, >2mm wide *Agrostis quinqueseta*
 Leaves rolled, <2mm wide 142
- 142) Leaves smooth *Agrostis gracifolia*
 Leaves rough 143
- 143) Leaves striate *Agrostis volkensis*
 Leaves estriate *Agrostis trachyphylla*
- 144) Florets awnless 145
 Florets short to long awned 147
- 145) Glumes enclosing the florets *Koeleria capensis*
 At least the upper florets exserted (*Poa*) 146
- 146) Panicle contracted *Poa leptoclada*
 Panicle open *Poa schimperiana*
- 147) Upper florets distinctly exserted; lemma straight-awned from the tip (*Festuca*) 148
 Upper florets not distinctly exserted; awns dorsal or bent 149
- 148) Leaves rough *Festuca pilgeri*
 Leaves smooth *Festuca abyssinica*
- 149) Spikelets enclosed by the glumes, 2-8mm long *Deschampsia flexuosa*
 Spikelets exserted from the glumes, 8-16mm long 150
- 150) Leaves usually >4mm wide, smelling of cumarin *Anthoxanthum nivale*
 Leaves <4mm wide, without a distinctive smell *Helictotrichon umbrosum*

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