Supplementary Information for
The enigmatic tropical alpine flora on the African sky islands is young, disturbed, and unsaturated

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This PDF file includes:
- Supplementary text
- Figures S1 to S8
- Tables S1 to S9
- Legend for Appendix S2
- SI References

Other supplementary materials for this manuscript include the following:
- Appendix S2
Appendix 1. Supplementary Methods and Results

Methods

Material and DNA sequencing

We sampled 102 species that occur in montane and/or alpine areas of eastern Africa (Ethiopia, Kenya, Uganda, and Tanzania), limited to those with an upper altitudinal limit above 2500 m (Table S2). Seventy of these species occur above the tree line (> 3800 m). For this project, we sampled 92 species that were collected over the years (Table S1). We collected leaves on silica gel and pressed three individual plants from each population, deposited in the following herbaria: one in the National Herbarium of Ethiopia, Addis Ababa University, Ethiopia (ETH); one in the Natural History Museum, University of Oslo, Norway (O); and one in the country of collection: East African Herbarium, National Museum of Kenya, Nairobi, Kenya (EA); National Herbarium of Tanzania, Arusha, Tanzania (NHT); or Makerere University Herbarium, Kampala, Uganda (MHU).

In some cases, we pooled DNA of multiple individuals from a single population to obtain sufficient DNA for sequencing. We consider this to be unproblematic for species level analyses. We used FastQC (version 0.11.5; http://www.bioinformatics.babraham.ac.uk/projects/fastqc/) to determine the quality of the raw sequences. After sequencing, we removed adapters and low-quality reads using bbduk (bbmap version 38.79; 1) with standard settings (adapter trimming: ktrim=r, k=23, mink=11, hdist=1, tpe, tbo; low quality reads: qtrim=rl, trimq=10). To assemble nuclear ribosomal and plastid sequences we used GetOrganelle (version 1.6.2e; 2). Settings were adapted to plastid and nuclear ribosomal DNA, using the recommended ones (plastid: -R 7 -k 35,85,115; nuclear ribosomal: -R 15 -k 21,45,65,85,105).

Dating approach and methodology

To estimate ages of afroalpine lineages, we used datasets from previously published molecular dating analyses (3–16) whenever these were available through public archives or on request from the authors, instead of building new alignments. We could thereby leverage work by experts on the respective lineages, with sampling typically carefully chosen to be representative of the entire lineage, with carefully incorporated fossil calibrations, and often with comparison of results from different analysis settings; the sum of which has passed peer-review process. Most such datasets focused on individual seed plant clades; for comparison we also used an existing dataset spanning seed plants (17) which incorporates an alternative set of fossil calibrations.

We added new sequences to the existing alignments (3–17) using PhylUp (18). PhylUp is a python workflow for finding and adding sequences to a target alignment using blast+ (19) to search for similar sequences. To further increase sampling of the closest relatives of afroalpine taxa we used PhylUp to add 10 additional taxa from GenBank for each of our own new sequences, selecting those that were most similar (but not identical) and which represented species/subspecies not already included. We first split concatenated matrices into their constituent individual marker alignments. Where information about partitioning of the alignment was not available, we used blast searches to determine locus identities and start and end positions within the concatenated alignments. Alignment information is provided in Table S3.

We used different dating approaches. For individual seed plant clades, we used a Bayesian relaxed clock model (BEAST2; 20) and also a penalized likelihood method, treePL (21; Table S8). For the seed plant wide matrix, we used penalized likelihood only (following 17) because the matrix was too large to run successfully using BEAST2. It was not always possible or desirable to implement exactly the same analysis settings as used in the original publications. In two cases (Poaceae and Dipsacales) we combined alignments and molecular dating protocols from two different publications (4–6, 13). For Gentianaceae (11), we added a maximum age constraint for the root node following (22) to restrict overall age estimates to within plausible time frames. The node constraint reported for...
Cleistochloa in Poaceae (6) was omitted because the relevant node was not represented given the taxon sampling in the available alignment (13). Our BEAST2 analysis using the original Brassicaceae matrix did not converge; we achieved convergence after reducing the density of taxon sampling in the matrix.

For the treePL analyses, we first needed to reconstruct phylogenetic trees from the updated alignments using RAxML-NG (version 0.9.0) or RAxMLv8 on CIPRES (for the seed plant-wide phylogeny; 23–25). We then estimated chronograms using penalized likelihood (based on the RAxML trees) and uncorrelated lognormal relaxed clock models (estimating phylogeny and node ages at the same time). For treePL, we applied node calibrations as minimum and/or maximum age constraints, and for the BEAST2 analyses, we used the same prior distributions for node calibrations as implemented in the original publications (Table S8). For the analyses of individual seed plant clades, we used an existing script (https://github.com/tongjial/treepl_wrapper) for the treePL analysis that automatically runs the ‘prime’ step a hundred times to find the best optimization parameters and to choose the optimal cross validation (cv) parameters, before calculating an ultrametric phylogeny using the corresponding smoothing value. For the seed plant-wide analyses we followed the dating method as reported in the original analysis (17), incorporating the same set of node-defined calibration points and producing a comparable result by using their topology as a backbone constraint under RAxML. In order to compute confidence intervals for the age estimates, we calculated 50 bootstrap trees, dated them using treePL, and combined the dated trees using TreeAnnotator from the BEAST package (version 1.10).

For the BEAST2 analyses, when detailed settings were not provided in the original publications, we partitioned substitution models into pDNA and nrDNA markers, and linked trees and molecular clocks, without further assessment of model fit (Table S8). Convergence of BEAST2 analyses was assessed using Tracer version 1.7.1. Two independent BEAST2 analyses were combined using Logcombiner and TreeAnnotator (version 2.6.2) if the analyses converged and ESS values were above 200 (in a few cases only >100). Sometimes three independent but converging analyses were combined to ensure high ESS values.

To compare species ages with the age of the mountains we used the information from (26). Species were categorized as “local endemics” if they occur on a maximum of two different mountains; otherwise, either as “afrotropical endemics” (distribution limited to DR Congo, Rwanda, Tanzania, Ethiopia, Sudan, Zimbabwe, Kenya, Uganda, Burundi, Malawi, Zambia, Yemen) or as “widespread species” (also occurring in more distant temperate regions).

Species accumulation over time

We summarized the ages of species and clades (representing colonization and in situ diversification events) across phylogenies for all sampled species occurring in the afroalpine flora, excluding multiple accessions of monophyletic species, and compared the resulting node age distributions through time to expectations based on hypothetical models of diversification. Age estimates were pruned to two decimal positions for this approach.

1) We pooled node ages across all clades analyzed, ordered them by decreasing age, and summed the accumulating number of colonization/diversification events over time, equivalent to the approach of (27). In a few cases, where there was a discrepancy between phylogenies concerning the nodes within species complexes, we omitted these nodes.

2) We estimated a colonization/diversification rate given age intervals between consecutive ages by calculating the difference quotient, an approach similar to (28). The difference quotient is defined as f(b)-f(a)/(b-a), which in our case is (cumulative number of colonization/diversification events at age 2 - cumulative number of colonization/diversification events at age 1) / (age 2 - age 1).

3) We summarized the number of colonization/diversification events per time bin.

To account for phylogenetic uncertainty and uncertainty in the age estimates, we employed a
subsampling approach: We randomly selected 50% of the samples 200 times before recalculating the three estimates and overlaid the results. We compared our results to expectations assuming constant and exponential models, simulating colonization/diversification under these two models and comparing the fit of our data using the fit_curve method from scipy v. 1.5.4 (29), an optimization process to find an optimal set of parameters for a defined function that best fits a given set of observations. We calculated $R^2$ between our dating results and data of the fitted curve. We repeated the above analysis using diversification events only to test whether the pattern we see is driven by the older colonization events.

We modeled a constant colonization/diversification rate by sampling N colonization/diversification events from a uniform distribution between 0 and the maximum age inferred by the dating method. The corresponding linear function is $N(t)=a*t+b$, where a is the slope and b is the number of new species, in our case one. The exponential model was generated by drawing samples from an exponential distribution. The corresponding (probability density) function is $N(t)=N_0*\exp(-\lambda*t)$, where $N$ is the number of colonization/diversification events, t is the time point and lambda is $-\ln(N_0/N_{max})/t_{max}$.

Results

Data deposition

We deposited raw reads from shotgun sequencing in an NCBI sequence read archive: http://www.ncbi.nlm.nih.gov/bioproject/766027. Alignments (including newly added sequences, as below), phylogenetic trees and analysis settings as well as code used for this study are available via https://github.com/mkandziora/AfroalpineDating/, including reference to the respective original publications on which alignments and settings were based.

Phylogenetic relationships

All newly sampled sequences were represented in at least one of the datasets. However, nine species were only included in the seed plant-wide dating, either because of mismatch between available data and existing matrices (Table S2) or, in the case of Dipsacales and Apiaceae, because of persistent problems with convergence using BEAST2. For the analyses of individual seed plant clades, we included similar sequences from GenBank in addition to our newly sampled individuals to improve the resolution of species relationships of our afroalpine samples. This added nine afroalpine species and corresponding age estimates to the results of the individual seed plant clades only.

Of the genera that are represented by more than five species in the afroalpine flora (26), six were represented by more than one species in our analyses. We found that three of these six genera colonized the afroalpine region more than once: Lobelia and Swertia both colonized twice, and Ranunculus colonized at least four times (of which only two colonizations resulted in diversification into two or more afroalpine species). The two Silene species we sampled (out of three in the flora), S. flammulifolia and S. burchelli, belonged to separate clades, each including non-afroalpine Silene species. The genus Lychnis (in our dataset nested within Silene), represents a further independent origin in the afroalpine region.

Nineteen species were represented by more than one individual in our analyses (Table S4). Five of them were retrieved as clearly monophyletic (>0.9 PP; according to the BEAST2 analyses, which were better supported than the RAxML analyses), and seven were retrieved as para- or polyphyletic, potentially indicating unrecognized species diversity in the afroalpine flora (these cases did not represent additional immigration events). For the remaining seven species, support was too low to confirm or reject monophyly.

Molecular dating
Based on our three dating methods, we could summarize up to three different age estimates for each of 102 afroalpine species, with and without confidence intervals (Figure S3-S5, Table S2). For the analyses of individual seed plant clades, we used treePL (rate-smoothing a single ML tree to obtain point estimates for node ages) and BEAST2 (estimating the phylogeny and age estimates at the same time, including confidence intervals from posterior probability distributions). For the seed plant-wide analysis we used only treePL (using an ML tree with confidence intervals estimated from bootstrapping). As the two datasets represent different species (as represented in published data) with our newly added sequences, the two datasets delivered two somewhat different sets of results (91 and 93 age estimates from not fully overlapping species sampling).

More than 60% of the BEAST2/treePL median age estimates fell within the seed plant-wide confidence intervals, and >40% of the seed plant-wide median age estimates fell within the individual seed plant clade confidence intervals. Because fossil-calibrated molecular dating results should in principle be interpreted as minimum ages (and other means of rate calibration are subject to various sources of error), deviation between results based on different calibrations can be expected and needs to be assessed. The BEAST2 and treePL analyses resulted in only a few old (> 10 Ma) species, but the two methods identified different species (Table S6). The age estimates were very different for two species: Umbilicus botryoides (individual lineage analysis 0.98 Ma, seed plant-wide analysis 19.41 Ma) and Sebaea sp. (3.26 Ma and 18.25 Ma); the much younger ages inferred by the better sampled individual lineage analyses may be caused by using more informative, and thus more reliable, age constraints for these lineages. In the case of Umbilicus, it should be noted that the Crassulaceae is difficult to date as no fossils are available; the age estimate from the seed plant-wide dating, which is informed by (albeit more distant) fossil calibrations, might be more appropriate.

The inferred ages and resolution in our phylogenies of individual seed plant clades were very similar to those in the original publications (Table S9), except for Veronica, for which we estimated the crown age to 10.82 Ma (7.11-15.69 highest posterior density [HPD]) instead of 16.13 Ma (12.46-20.59 HPD, BEAST2 age estimates). We used the same node calibrations as in the original publication; the different results might be due to the use of both ITS and trnLF in the original publication whereas our analysis only included ITS, because our sampling for the trnLF alignment did not include the nodes needed for calibration.

Notably, our estimates for species stem ages from the treePL and BEAST2 analyses were young compared to the ages of the tropical African mountains, also when considering the maximum confidence intervals (Figures S2 and S3). The median age over all BEAST2 analyses was 2.44 Ma (0.7 - 4.85; median of all HPDs), the treePL median age was 2.57 Ma, and the seed plant-wide median age was 0.84 Ma (0.12 - 7.81; median of all HPDs). All three dating approaches estimated that the majority of species (73 of 102) were younger than 5 Ma. Eighty-four of the species were younger than 10 Ma according to their median age estimates (Figure S3, BEAST2 analyses, Table S7).

We found no correlation between age and altitudinal distribution (Pearson correlation: R = 0.11, p = 0.3) and no association between age and biogeographic subregion (Figure S6 and S7). Species older than 10 Ma were typically either widespread or only found in Ethiopia and mostly found in alpine habitats. The clades that diversified were often composed of species that occur both above and below the treeline. From our results, it was rarely possible to discern whether clades originated in alpine or montane habitats (Figure S7).

As might be expected from the young stem node ages, the crown nodes of the six afroalpine clades (i.e., in situ diversifications) that we recovered were also younger than most of potential alpine or montane habitats (Figure S1).

Accumulation of species over time did not change its main results when not including colonizations events (Figure S8).
Table S1. Voucher information. Abbreviations: HC – herbarium code.

| family    | genus     | species name (according to ncbi) | author          | collector | collection date | unique id | country     | locality          | elevation | latitude | longitud | HC       | accession sample_id |
|-----------|-----------|-----------------------------------|-----------------|-----------|-----------------|-----------|-------------|-------------------|-----------|----------|-----------|----------|-------------------|
| Apiaceae  | Pimpinella| Pimpinella oreophila var oreophila| Hook. f. (Hochst.) | AFROAL P II team | 2009-01-29 | 29 O-DP-36064 | Kenya       | Mt Elgon: S of Mt Koitobos | 3629      | 1.10067  | 34.6215   | SAMN21 599645 | KNO0314-2_Pimpinella_oreophila_var_oreophila |
| Apiaceae  | Pimpinella| Pimpinella pimpinelloides        | H.Wolff Sch.Bip | AFROAL P II team | 2007-10-30 | 30 O-DP-30849 | Ethiopia     | Simen Mts: Silki | 3760      | 13.3333  | 38.23333  | SAMN21 599646 | ET0415-2_Pimpinella_pimpinelloides ET1413-2_Cineraria_abysinica |
| Asteraceae| Cineraria  | Cineraria abyssinica              | A.Rich. Sch.Bip | AFROAL P II team | 2007-10-13 | 13 O-DP-33982 | Ethiopia     | Bale Mts: Habera | 3484      | 7.01867  | 39.72067  | SAMN21 599647 | ET0652-2_Cineraria_deltoides |
| Asteraceae| Cineraria  | Cineraria abyssinica              | A.Rich. Sch.Bip | AFROAL P II team | 2007-11-12 | 12 O-DP-31694 | Ethiopia     | Bale Mts: Sanetti Plateau | 4143      | 6.85502  | 39.87802  | SAMN21 599648 | ETO225-2_Cineraria_sebaldii |
| Asteraceae| Cineraria  | Cineraria sebaldii                | Cufod.          | AFROAL P II team | 2007-10-24 | 24 O-DP-44436 | Ethiopia     | Simen Mts: Dirni Gate | 3716      | 13.2879  | 38.11882  | SAMN21 599649 | UG2305-3_Dendrosenecio_adnivalis_var_adnivalis |
| Asteraceae| Dendroseccio| Dendrosenecio adnivalis var adnivalis | (Stapf) E.B.Kno (R.E.Fr. & T.C.E.F) | AFROAL P II team | 2008-08-10 | 10 O-DP-40704 | Uganda       | Rwenzori Mts: Upper Bigo Valley | 3561      | 0.38602  | 29.92632  | SAMN21 599650 | KNO0482-1_Dendrosenecio_battiscombei |
| Asteraceae| Dendroseccio| Dendrosenecio battiscombei       | E.B.Kno (R.E.Fr. & T.C.E.F) | AFROAL P II team | 2009-02-11 | 11 O-DP-27466 | Kenya        | Aberdare Mts: Mt Kinangop area | 3069      | 0.54265  | 36.71993  | SAMN21 599651 | KNO0516-4_Dendrosenecio_brassiciformis |
| Asteraceae| Dendroseccio| Dendrosenecio brassiciformis     | Mabb. (T.C.E. Fr.) | AFROAL P II team | 2009-02-12 | 12 O-DP-42217 | Kenya        | Aberdare Mts: Mt Satima area | 3865      | 0.30105  | 36.63192  | SAMN21 599652 | KNO0025-4_Dendrosenecio_elenonensis_ssp_kinangopensis_ssp_kinangopensis |
| Asteraceae| Dendroseccio| Dendrosenecio elgonensis ssp      | (T.C.E. Fr.) | AFROAL P II team | 2009-01-20 | 20 O-DP-34825 | Kenya        | Mts Elgon: S of Mt Koitobos | 3915      | 1.10567  | 34.60183  | SAMN21 599653 | KNO0314-2_Dendrosenecio_oreophila_var_oreophila |
**Dendroscenecio erici-rosenii**

- **Asteracea**
- Elgonensis
- E.B.Kno x (R.E.Fr. & T.C.E.F)

2008-07-22 O-DP-39500 Uganda

Virunga Mts: Mt Mghinga, summit 3457 1.38492 29.6449 O

**Dendrosenecio erici-rosenii ss erici-rosenii**

- **Asteracea**
- E.B.Kno & T.C.E.F

2009-07-04 O-DP-28618 Kenya

Kenya Mt Kenya: Sirimon Route 3652 0.06298 37.29625 O

**Dendrosenecio erici-rosenii f.**

- **Asteracea**
- Dendrosenecio
- Mabb. P II team

2009-07-04 O-DP-28581 Kenya

Kenya Mt Kilimanjaro Above Old Moses Camp 3696 0.06762 37.2978 O

**Dendrosenecio keniensis**

- **Asteracea**
- Dendrosenecio
- B.Nord. P II team

2009-07-22 O-DP-38340 Tanzania

Tanzania Horombo Hut, 4 km from 3288 -3.1508 37.4759 O

**Dendrosenecio kenioidendron**

- **Asteracea**
- Dendrosenecio
- E.B.Kno & T.C.E.F

2008-11-19 O-DP-38340 Tanzania

Tanzania Horombo 3288 -3.1508 37.4759 O

**Dendrosenecio kilimanjari ssp kilimanjari**

- **Asteracea**
- Dendrosenecio
- E.B.Kno x P II team

2008-11-20 O-DP-32764 Ethiopia

Ethiopia Bale Mts: Angaso Aberdare Mts: Mt Satima area 3986 6.88218 39.8883 O

**Euryops alpinus**

- **Asteracea**
- Euryops
- L. P II team

2007-11-20 O-DP-32764 Ethiopia

Ethiopia Bale Mts: Angaso Aberdare Mts: Mt Satima area 3986 6.88218 39.8883 O

**Euryops brownii**

- **Asteracea**
- Euryops
- S.Moor P II team

2009-02-14 O-DP-27951 Kenya

Kenya Mt Kilimanjaro: S of Mawenzi Peak 3605 0.33533 36.643 O

**Euryops dacrydioides**

- **Asteracea**
- Euryops
- Oliv. P II team

2008-11-15 O-DP-37892 Tanzania

Tanzania Mt Elgon: S of Mt 4109 3.10997 37.42112 O

**Euryops elgonensis**

- **Asteracea**
- Euryops
- Mattf. P II team

2009-01-20 O-DP-34779 Kenya

Kenya Mt Elgon: S of Mt 3915 1.10567 34.60183 O

**Euryops matti**

- **Asteracea**
- Euryops
- Mattf. P II team

2009-01-20 O-DP-34779 Kenya

Kenya Mt Elgon: S of Mt 3915 1.10567 34.60183 O

**Euryops sambucus**

- **Asteracea**
- Euryops
- Baker f. P II team

2009-07-04 O-DP-28581 Kenya

Kenya Mt Kenya: Sirimon Route 3696 0.06762 37.2978 O

**Euryops sambuculoides**

- **Asteracea**
- Euryops
- Baker f. P II team

2009-07-04 O-DP-28581 Kenya

Kenya Mt Kenya: Sirimon Route 3696 0.06762 37.2978 O

**Euphorbia keniensis**

- **Asteracea**
- Euphorbia
- L. P II team

2009-02-14 O-DP-27951 Kenya

Kenya Mt Kilimanjaro: S of Mawenzi Peak 3605 0.33533 36.643 O

**Euphorbia sambuculoides**

- **Asteracea**
- Euphorbia
- Mattf. P II team

2009-02-14 O-DP-27951 Kenya

Kenya Mt Kilimanjaro: S of Mawenzi Peak 3605 0.33533 36.643 O

**Euphorbia sambuculoides**

- **Asteracea**
- Euphorbia
- Mattf. P II team

2009-02-14 O-DP-27951 Kenya

Kenya Mt Kilimanjaro: S of Mawenzi Peak 3605 0.33533 36.643 O

**Euphorbia sambuculoides**

- **Asteracea**
- Euphorbia
- Mattf. P II team

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Kenya Mt Kilimanjaro: S of Mawenzi Peak 3605 0.33533 36.643 O

**Euphorbia sambuculoides**

- **Asteracea**
- Euphorbia
- Mattf. P II team

2009-02-14 O-DP-27951 Kenya

Kenya Mt Kilimanjaro: S of Mawenzi Peak 3605 0.33533 36.643 O

**Euphorbia sambuculoides**

- **Asteracea**
- Euphorbia
- Mattf. P II team

2009-02-14 O-DP-27951 Kenya

Kenya Mt Kilimanjaro: S of Mawenzi Peak 3605 0.33533 36.643 O
| Family       | Genus                  | Species                        | Collector        | Date     | Accession   | Country  | Location Description                  | Latitude | Longitude | O-DP- | Aircraft    | SAMN21  |
|--------------|------------------------|--------------------------------|------------------|----------|-------------|----------|---------------------------------------|----------|-----------|-------|-------------|---------|
| Asteraceae   | Euryops                | Euryops pinifolius             | A.Rich.          | 2008-10-08 | O-DP-33607  | Ethiopia | Mt Choke                              | 3960     | 10.642    | 37.83567 | ETH1330-2 | 599662  |
| Asteraceae   | Euryops                | Euryops prostratus             | B.Nord.          | 2007-11-21 | O-DP-32614  | Ethiopia | Bale Mts: Batu                        | 4116     | 6.85003   | 39.85317 | ET0889-2  | 599663  |
| Brassicaceae | Arabidopsis            | Arabidopsis thaliana          | (L.) Heynh.      | 2007-10-24 | O-DP-29948  | Ethiopia | Simen Mts: Dirni Gate Mt Meru: Saddle Hut | 3716     | 8         | 38.11882 | ET0177-3  | 599664  |
| Brassicaceae | Arabis                 | Arabis alpina                 | L.               | 2008-11-27 | O-DP-38474  | Tanzania | area                                   | 3594     | -3.217    | 36.769   | TZ0375-3  | 599665  |
| Brassicaceae | Erophila               | Erophila verna var macrosperma| Sebadl R.E.Fr. & | 2007-11-13 | O-DP-31710  | Ethiopia | BALE Mts: Sanetti                      | 4000     | NA        | NA      | ETH0671-2  | 599666  |
| Brassicaceae | Erophila               | Erophila verna var macrosperma| Sebadl R.E.Fr. & | 2007-11-13 | O-DP-31715  | Ethiopia | Bale Mts: Sanetti Mt Elgon: Near camp site at end of car road | 4050     | NA        | NA      | KN0394-1  | 599668  |
| Campanulaceae| Lobelia                | Lobelia aberdaronica          | T.C.E.F. r. (E.Wim m.) | 2009-01-29 | O-DP-27246  | Kenya     |                                        | 3557     | 1.09317   | 34.62367 | ET1503-3  | 599669  |
| Campanulaceae| Lobelia                | Lobelia acrochila             | E.B.Knox         | 2008-10-17 | O-DP-34377  | Ethiopia | Bale Mts: Dinsho Mt Kilimanjaro: Shira Plateau near Mt Simba: Betw. Goba and Sanetti, 4 | 3281     | 7.05815   | 39.7657  | TZ0025-2 | 599670  |
| Campanulaceae| Lobelia deckenii ssp  | Lobelia deckenii              | Hems. Engl.      | 2008-11-03 | O-DP-37017  | Tanzania |                                        | 3636     | 3.03425   | 37.243   | SAMN21     | 599671  |
| Campanulaceae| Lobelia                | Lobelia deckenii              | Hems. Engl.      | 2008-10-18 | O-DP-34150, 18 O-DP-34155 | Ethiopia |                                        | 2918     | 6.77312   | 39.72578 | SAMN21     | 599671  |
| Campanulaceae| Lobelia                | Lobelia Erlangeriana          | Hems. Engl.      | 2008-11-03 | O-DP-37017  | Tanzania |                                        | 3636     | 3.03425   | 37.243   | SAMN21     | 599671  |
| Campanulaceae | Lobelia lindblomii | Mildbr. | AFROAL P II team | 2009-02-12 | O-DP-27650 | Kenya | km from Goba | Aberdare Mts: Mt Satima area | 3806 0.30533 36.62483 O | SAMN21 4_Lobelia_lindblomii |
| Campanulaceae | Lobelia mildbraedii | Engl. | AFROAL P II team | 2009-02-17 | O-DP-28572 | Kenya | | Aberdare Mts: Near Wanderi Gate | 2571 0.32017 36.7685 O | SAMN21 2_Lobelia_mildbraedii |
| Campanulaceae | Lobelia rhynchopetalum | Hemsl. | AFROAL P II team | 2007-10-21 | O-DP-29729 | Ethiopia | Simen Mts: Saha | 3711 3 38.11077 O | SAMN21 2_Lobelia_rhynchopetalum |
| Campanulaceae | Lobelia schimperi | Hochst. ex A.Rich. | B. Gebremen & G. Tassew | 2013-03-26 | O-DP-54720 | Ethiopia | ETH: Simen Mts: Sherafi Virunga Mts: Mt Muhavura, along trail to summit | 2780 5 38.07445 O | BG52-1_Lobelia_schimperi |
| Campanulaceae | Lobelia stuhlmannii | Schwei nf. ex Stuhlmann | AFROAL P II team | 2008-07-26 | O-DP-43042 | Uganda | | Aberdare Mts: Mt Kinangop area, Gura River Virunga Mts: Mt Muhavura, summit | 3600 1.38272 29.67798 O | SAMN21 1_Lobelia_stuhlmannii |
| Campanulaceae | Lobelia telekii | Schwei nf. | AFROAL P II team | 2009-02-12 | O-DP-27438 | Kenya | NA NA NA O | SAMN21 3_Lobelia_telekii |
| Campanulaceae | Lobelia wollastonii | Baker f. | AFROAL P II team | 2008-07-28 | O-DP-40212 | Uganda | | | | SAMN21 3_Lobelia_wollastonii |
| Caryophylaceae | Lychnis abyssinica (=Silene abyssinica) | (Hochst AFROAL P II team | 2008-09-22 | O-DP-33225 | Ethiopia | | | | 2318 7.25575 39.1564 O | SAMN21 3_Lychnis_abyssinica |
| Caryophylaceae | Lychnis (Hochst AFROAL | 2007-10-28 | O-DP-44203 | Ethiopia | | | | | 3574 13.2666 38.10782 O | SAMN21 ET009-
| Family    | Genus     | Scientific Name                                      | Collector | Year       | Code       | Country     | Location     | Coordinates | Description                  |
|-----------|-----------|-----------------------------------------------------|-----------|------------|------------|-------------|--------------|-------------|-----------------------------|
| Caryophyllaceae | Lychnis | abyssinica (=Silene abyssinica)                    | Liden     | P II team  | 20         | Close to Gich Camp Site | Aberdare Mts: Mt Kinangop area | 3086°0.5425' 36.7175°O | X_Lychnis_abyssinica_LGS |
| Caryophyllaceae | Lychnis | crassifolia (=Silene kenyana)                      | (T.C.E. Fr.) | AFROAL  | 2009-02-01 | 11 O-DP-27504 | Kenya         |             | SAMN21 Lychnis_crassifolia   |
| Caryophyllaceae | Lychnis | kigesiensis subsp. ragazziana (=Silene kigesiensis subsp. ragazziana) | (Ousted) | AFROAL  | 2008-10-06 | 06 O-DP-41981 | Uganda        |             | SAMN21 Lychnis_kigesiensis_subsp_ragazziana |
| Caryophyllaceae | Lychnis | kiwuensis (=Silene kiwuensis)                      | (T.C.E. Fr.) | AFROAL  | 2008-10-01 | 01 O-DP-33528 | Ethiopia      |             | SAMN21 Lychnis_kiwueinsis     |
| Caryophyllaceae | Lychnis | rotundifolia (=Silene afromontana)                 | (Oliv.)   | AFROAL  | 2009-02-12 | 12 O-DP-27521 | Kenya         |             | SAMN21 Lychnis_rotundifolia   |
| Caryophyllaceae | Minuartia | filifolia                                        | (Forssk. AFROAL)  |  | 2007-10-25 | 25 O-DP-30277 | Ethiopia      |             | SAMN21 Minuartia_filifolia    |
| Caryophyllaceae | Minuartia | filifolia                                        | (Forssk. Mattf.) | P II team  | 2007-10-24 | 24 O-DP-29995 | Ethiopia      |             | SAMN21 Minuartia_filifolia    |
| Caryophyllaceae | Sagina   | afroalpina                                        | Hedberg   | AFROAL  | 2009-07-09 | 09 O-DP-29202 | Kenya         |             | SAMN21 Sagina_afroalpina      |
| Caryophyllaceae | Silene   | burchellii                                        | Oth ex AFROAL DC. P II team  | 2009-02-14 | 14 O-DP-27930 | Kenya         |             | SAMN21 Silene_burchellii_var_burchellii |
| Caryophyllaceae | Silene   | flammulifolia                                     | Steud. AFROAL ex P II team  | 2007-10-24 | 0 O-DP-30053 | Ethiopia      |             | SAMN21 Silene_flammulifolia   |

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**Legend:**
- **Family:*** Caryophyllaceae
- **Genus:**
- **Scientific Name:**
- **Collector:**
- **Year:**
- **Code:**
- **Country:**
- **Location:**
- **Coordinates:**
- **Description:**
| Family          | Genus       | Species                          | Authors                  | Collection Number | Country     | Location Details          | Coordinates   | Elevation (m) | Latitude  | Longitude  | Comment       |
|-----------------|-------------|----------------------------------|--------------------------|-------------------|-------------|---------------------------|---------------|--------------|-----------|------------|---------------|
| Caryophyllaceae | Silene      | Silene macrosolen                | A.Rich. ex A.Rich.       | AFROAL P II team  | Ethiopia    | Simen Mts: Bwahit Mt Kilimanjaro Horombo Bale Mts: Garba Guracha Virunga Mts: Mt Muhavura | 13.2513       | 4035         | 38.20225  | O          | 599690       |
| Dipsacales     | Scabiosa    | Scabiosa columbaria             | L.                       | AFROAL P II team  | Tanzania    | -                         | 3650          | 3.14215     | 37.44065  | O          | 599691       |
| Dipsacales     | Valerianella| Valerianella microcarpa         | Loisel.                  | AFROAL P II team  | Ethiopia    | -                         | 4101          | 6.87028     | 39.8678   | O          | 599692       |
| Gentianaceae   | Sebae       | Sebea sp                        |                         | AFROAL P II team  | Uganda      | -                         | 3800          | NA           | NA        | O          | 599693       |
| Gentianaceae   | Swertia     | Swertia adolfi-friderici        | Mildbr. & Gilg           | AFROAL P II team  | Tanzania    | Mbeya Mts Virunga Mts: Mt Mgahinga, near Mgahinga Camp Site | 2731          | 8.83633     | 33.37083  | O          | 599695       |
| Gentianaceae   | Swertia     | Swertia brownii                 | J.Shah                   | AFROAL P II team  | Uganda      | Mt Elgon: S of Mt Koitobos | 2340          | 1.35275     | 34.6215   | O          | 599696       |
| Gentianaceae   | Swertia     | Swertia crassiuscula ssp        | Gilg                     | AFROAL P II team  | Kenya       | Bale Mts: Sanetti Aberdare Mts: along the car road towards Satima | 3700          | 6.76667     | 39.75     | O          | 599698       |
| Gentianaceae   | Swertia     | Swertia crassiuscula ssp robusta| Sileshi                  | AFROAL P II team  | Ethiopia    | Bale Mts: along the car road towards Satima | 3697          | 0.33883     | 36.6515   | O          | 599699       |

**Notes:**
- **AFROAL P II team:** The group responsible for the expeditions and collections.
- **O-DP-XXXX:** The collection number, indicating the specific field and collection details.
- **ET0289-4 Silene macrosolen:** The specific collection documentation code and identifier.
- **SAMN21:** The repository or collection code, used for cataloging and referencing the specimens.
| Gentianaceae | Species | Synonyms | Collectors | Dates | Vouchers | Locality | Latitude | Longitude | Elevation | Coordinates |samn | ET | O-DP- | Country |
|-------------|---------|----------|------------|-------|---------|----------|----------|-----------|-----------|-------------|------|----|--------|---------|
| Swertia     | engleri | var. engleri | Gilg | AFROAL P II team | 2007-10-23 | O-DP-43467 | Ethiopia | Simen Mts: Saha | 13.2852 | 3718 5 38.11838 O | SAMN21 | ET0136-1_Swertia_engleri | 599700 |
| Swertia     | engleri | var. woodii | J. Shah, Sileshi | AFROAL P II team | 2008-10-14 | O-DP-34071 | Ethiopia | Bale Mts: Habera Virunga Mts: Mt Muhavura, along trail to 1st Hut | 3482 7.00733 29.70983 O | SAMN21 | ET1454-4_Swertia_engleri | 599701 |
| Swertia     | kilimandscharica | | Engl. | AFROAL P II team | 2008-07-29 | O-DP-40220 | Uganda | | 2900 NA NA O | SAMN21 | UG2175-1_Swertia_kilimandscharica | 599702 |
| Swertia     | macrosepala | ssp | Gilg | AFROAL P II team | 2008-07-22 | O-DP-39494 | Uganda | Virunga Mts: Mt Mgahinga | 3470 1.38427 29.64018 O | SAMN21 | ET0443-1_Swertia_macrosepala | 599703 |
| Swertia     | pumila | | Hochst. | AFROAL P II team | 2007-10-31 | O-DP-30948 | Ethiopia | Simen Mts: Silki Sidamo: Wendo Abela Giorgis Church | 13.3490 | 3912 7 38.2625 O | SAMN21 | ET1304-5_Swertia_pumila | 599704 |
| Swertia     | quartiniana | | A. Rich. (Hochst.) | AFROAL P II team | 2008-09-24 | O-DP-33260 | Ethiopia | Simen Mts: Near Gich Camp Site Mt Elgon: Mt Koitobos Addis Ababa: Kality Mt Elgon: Mt Koitobos | 1990 6.9158 38.50017 O | SAMN21 | ET0187-5_Swertia_quartiniana | 599705 |
| Swertia     | schimperi | | Griseb. | AFROAL P II team | 2007-10-25 | O-DP-44309 | Ethiopia | Simen Mts: NA | NA NA NA O | SAMN21 | KN0004-3_Swertia_schimperi | 599706 |
| Swertia     | subnivalis | r. | T.C.E.F r. | AFROAL P II team | 2009-01-19 | O-DP-34720 | Kenya | | 4224 1.1239 34.60198 O | SAMN21 | ET1294-3_Swertia_subnivalis | 599707 |
| Swertia     | tetandra | | Hochst. | AFROAL P II team | 2008-09-29 | O-DP-33195 | Ethiopia | NA | NA NA NA O | SAMN21 | KN0085-4_Swertia_tetandra | 599708 |
| Swertia     | uniflora | | Mildbr. & Gilg | AFROAL P II team | 2007-01-23 | O-DP-35048 | Kenya | O-DP-39276-O-DP-39278, 24 O-DP-48440 | 3953 1.124 34.59033 O | SAMN21 | TZ0711-4568_Swertia_uniflora | 599709 |
| Swertia     | usambarensis | | Engl. | AFROAL P II team | 2009-06-24 | O-DP-48440 | Tanzania Mbeya Mts | | 2616 8.83683 33.3725 O | SAMN21 | TZ0711-4568_Swertia_usambarensis | 599710 |
| Family      | Genus               | Species               | Author            | Collector          | Specimen Code | Location                  | Date     | Coordinates                  | Use Code | Accession Number | Other Accession Numbers                                           |
|-------------|---------------------|-----------------------|-------------------|-------------------|---------------|---------------------------|---------|-----------------------------|----------|------------------|---------------------------------------------------------------|
| Poaceae     | Gentiana            | Swertia               | Gilg              | AFROAL P II team | 2007-11-031750,13 O-DP-131751 | Ethiopia Sanetti | 4050 NA NA O | SAMN21 599711 ET0680-x23_Swertia_volkensii | ET0167-T_Aira_caryophyllea ET0495-5_Alopecurus_baptarrhenius |
| Poaceae     | Poaceae             | Aegea                 | Gilg              | AFROAL P II team | 2007-10-44263 | Ethiopia Dirni Gate        | 3716 8 38.11882 O | SAMN21 599712 |                       |                                |
| Poaceae     | Poaceae             | Alopecurus            | S.M. Phillips     | AFROAL P II team | 2007-11-31197 | Ethiopia Silki               | 3681 7 38.24297 O | SAMN21 599713 |                       |                                |
| Poaceae     | Poaceae             | Anthoxanthum         | Schumacher        | AFROAL P II team | 2008-11-37045 | Tanzania Shira Plateau     | 3406 2.98662 37.22327 O | SAMN21 599714 |                       |                                |
| Poaceae     | Poaceae             | Deschampsia          | Beauvoir          | AFROAL P II team | 2007-11-32350 | Ethiopia Konten            | 4019 6.85542 39.89647 O | SAMN21 599715 |                       |                                |
| Poaceae     | Poaceae             | Avenella             | Drejer            | AFROAL P II team | 2008-11-38285 | Tanzania Horombo           | 3710 -3.1375 37.43683 O | SAMN21 599716 |                       |                                |
| Poaceae     | Poaceae             | Koeleria             | Nees              | AFROAL P II team | 2007-10-29614 | Ethiopia Saha               | 3718 5 38.11838 O | SAMN21 599718 |                       |                                |
| Poaceae     | Poaceae             | Rytidosperma         | Cope              | AFROAL P II team | 2007-11-32749 | Ethiopia Angaso            | 3986 6.88218 39.8883 O | SAMN21 599719 |                       |                                |
| Plantaginaceae | Veronica         | anagallis-aquatica  | L.                | AFROAL P II team | 2007-11-31570 | Ethiopia Silki             | 3682 5 38.24247 O | SAMN21 599731 |                       |                                |
| Plantaginaceae | Veronica         | arvensis             | Hochst. ex        | AFROAL P II team | 2007-10-30129 | Ethiopia Dirni Gate        | 3716 8 38.11882 O | SAMN21 599732 |                       |                                |
| Plantaginaceae | Veronica         | glandulosa           | Hochst. ex        | AFROAL P II team | 2007-10-29615 | Ethiopia Saha             | 3718 13.2852 38.11838 O | SAMN21 599733 |                       |                                |
| Family         | Genus               | Species                          | Occurrence          | Location                  | Altitude | Coordinates       | Number     | Additional Information                        |
|---------------|---------------------|----------------------------------|---------------------|---------------------------|----------|-------------------|------------|-----------------------------------------------|
| Primulaceae   | Anagallis           | serpens subsp meyeri-johannis    | (Engl.)             | Benth.                    |          |                   |            | Et0090-3_Ananagallis_serpens_subsp_meyeri-johannis |
| Primulaceae   | Primula             | verticillata                     | Forssk.             | AFROAL P II team          | 2007-10- | O-DP-29581        | Ethiopia   | 13.2827 Simen Mts: Saha 3711 3 38.11077 O       |
| Ranunculaceae | Anemone             | thomsonii var friesiorum         | Ulbr.               | AFROAL P II team          | 2007-11- | O-DP-31586        | Ethiopia   | 13.3285 Simen Mts: Silki 3643 38.24092 O       |
| Ranunculaceae | Anemone             | thomsonii                       | Oliv.               | AFROAL P II team          | 2008-11- | O-DP-38990        | Tanzania   | 3.21783 36.754 O Mt Meru: Saddle Hut 3659       |
| Ranunculaceae | Ranunculus          | aberdaricus                      | Ulbr.               | AFROAL P II team          | 2007-11- | O-DP-31436        | Ethiopia   | 13.3285 Simen Mts: Silki 3643 38.24092 O       |
| Ranunculaceae | Ranunculus          | distrias                         | A, Rich. ex Hochst. | AFROAL P II team          | 2007-10- | O-DP-29766        | Ethiopia   | 13.2827 Simen Mts: Silki 3711 3 38.11077 O       |
| Ranunculaceae | Ranunculus          | oligocarpus                      | A, Rich. ex Hochst. | AFROAL P II team          | 2007-11- | O-DP-30977        | Ethiopia   | 13.3284 Simen Mts: Silki 3681 7 38.24297 O       |
| Ranunculaceae | Ranunculus          | oreophytus                       | Delile ex Hochst.   | AFROAL P II team          | 2008-11- | O-DP-38965        | Tanzania   | 3.22075 36.78395 O Mt Elgon: S of Mt Koitobos 3166|
| Ranunculaceae | Ranunculus          | stagnalis                        | A, Rich. ex Hochst. | AFROAL P II team          | 2009-01- | O-DP-27222        | Kenya      | 1.107 34.60317 O Mt Meru: Saddle Hut 3166       |
| Ranunculaceae | Ranunculus          | trichophyllus                    | Chaix               | AFROAL P II team          | 2007-11- | O-DP-31595        | Ethiopia   | 13.3285 Simen Mts: Silki 3643 38.24092 O       |
| Ranunculaceae | Ranunculus          | volkensii                        | Eng.                | AFROAL P II team          | 2008-11- | O-DP-37229        | Tanzania   | 3.0056 37.24155 O Mt Kilimanjaro: Shira 3536    |

**Note:** The table includes species names, occurrence data, location details, and additional information such as altitude, coordinates, and number identifiers. Each row represents a different species or variety, with details such as family, genus, species, and occurrence data. The table is organized with columns for Family, Genus, Species, Occurrence, Location, Altitude, Coordinates, Number, and Additional Information.
| Family       | Genus   | Species          | Authority | AFROAL | Team     | Year    | Location          | Latitude | Longitude | Elevation | Coordinates | Collection | Genus   | Species       | Authority | AFROAL | Team     | Year    | Location          | Latitude | Longitude | Elevation | Coordinates | Collection |
|--------------|---------|------------------|-----------|--------|----------|---------|------------|----------|-----------|------------|-------------|-----------|---------|--------------|-----------|--------|----------|---------|------------|------------|-----------|-----------|-----------|-------------|-----------|
| Violaceae    | Viola   | Viola abyssinica | Steud. ex Oliv. | AFROAL | P II team | 2008-07- | Plateau Virunga Mts: Muhavura, along trail to summit | 3700     | 1.3782    | 29.67333  | O          | SAMN21 599734 | UG2096-2_Viola_abyssinica |
| Violaceae    | Viola   | Viola eminii    | R.E.Fr.    | AFROAL | P II team | 2008-07- | Plateau Virunga Mts: Muhavura, along trail to summit | 3550     | 1.37628   | 29.67153  | O          | SAMN21 599735 | UG2035-1_Viola_eminii |
| Violaceae    | Viola   | Viola nannae    | R.E.Fr.    | AFROAL | P II team | 2008-08- | Plateau Virunga Mts: Muhavura, along trail to summit | 3425     | 0.38502   | 29.9273   | O          | SAMN21 599736 | UG2247-2_Viola_nannae |
| Crassulaceae | Umbilicus| Umbilicus botryoides | Hochst. ex A.Rich. | AFROAL | P II team | 2007-10- | Plateau Virunga Mts: Muhavura, along trail to summit | 3652     | 13.269    | 38.1058   | O          | SAMN2 1599737 | ET0230-2_Umbilicus_botryoides |
**Table S2.** Distribution and age of species. Distribution and elevation of sampled species according to the Flora of East Africa and the Flora of Eritrea. In some cases, information are adapted to more recent information (indicated). *Lychnis* information are also based on Ousted (1985) *A taxonomic revision of the genus Uebelinia* Hochst. (Caryophyllaceae). *Bulletin du Jardin botanique national de Belgique/Bulletin van de Nationale Plantentuin van Belgie*, pp. 421-459. *Cineraria* information based on Cron, G.V., Balkwill, K. and Knox, E.B., 2006. *A revision of the genus Cineraria* (Asteraceae, Senecioneae). *Kew Bulletin*, pp. 449-535. *Viola* information are solely based on information provided by “Conservatoire et Jardin botanique de Geneve” (http://www.ville-ge.ch/musinfo/bd/cjb/africa/details.php?langue=an&id=175422). Abbreviations: Ci: confidence interval; sA: strict Afroalpine (>3800m, according to Gehrke et al. (3)); obsA: occurs in the strict Afroalpine and below; obsA: occurs only below the strict Afroalpine (<3800m).

| family | genus | species name | BEAST2 individual clades | BEAST2 seed plant wide | treePL elevation in m | altitudinal coding | Distribution coding | Distribution | sample_id |
|--------|-------|--------------|--------------------------|------------------------|----------------------|-------------------|---------------------|-------------|-----------|
| Apiaceae | Pimpinella | oreophila | Apiaceae | 2.58 7.71 0.19 1.25 | 0.37 1.52 0.01 | 250 410 | endemicEA | Ethiopia, Kenya, Rep. South Sudan, Tanzania, Uganda, Cameroon, Gulf of Guinea Islands | ET0415-2_Pimpinella_oreophila

| Apiaceae | Pimpinella | pimpinelloides | Apiaceae | 2.58 7.71 0.19 1.25 | 0.37 1.52 0.01 | 250 410 | endemicEA | Ethiopia, Saudi Arabia, Yemen, Ethiopia, Kenya, Uganda, Tanzania, Rep. South Sudan, DR Congo, Rwanda, Malawi, Zambia, Zimbabwe, South Africa | ET0652-2_Cineraria_deltoidea

| Asteraceae | Cineraria | abyssinica | Asteraceae | 2.58 7.71 0.19 1.25 | 0.37 1.52 0.01 | 250 410 | endemicEA | Ethiopia, Kenya, Uganda, Tanzania, Rep. South Sudan, DR Congo, Rwanda, Malawi, Zambia, Zimbabwe, South Africa, Ugandan, DR Congo, Rwenzori Mtts | UG2305-3_Dendrosenecio

| Asteraceae | Cineraria | deltoidea | Asteraceae | 0.42 2.5 0.59 1.25 | 0.48 9.75 0.01 | 325 450 | endemic to Mt | Uganda, DR Congo, Rwenzori Mtts | UG2305-3_Dendrosenecio

| Asteraceae | Dendrosenecio | adnivalis | Asteraceae | 0.42 2.5 0.59 1.25 | 0.48 9.75 0.01 | 325 450 | endemic to Mt | Uganda, DR Congo, Rwenzori Mtts | UG2305-3_Dendrosenecio
| Family       | Genus            | Species               | Locality                                      | Locality Code |
|--------------|------------------|-----------------------|-----------------------------------------------|---------------|
| Asteraceae   | Dendrosenecio    | battiscombei          | 0.41 2.51 0.59 0.55 4.68 0.01 0 0 osA        | KN0482-1_Dendrosenecio_battiscombei |
|             | Dendrosenecio    | brassiciformis        | 0.42 2.5 0.59 0.46 5.52 0 0 0 osA             | KN0516-4_Dendrosenecio_brassiciformis |
|             | Dendrosenecio    | cheranganiensis      | 1 3.61 0.02 0.99 0 osA                       | KN025-4_Dendrosenecio_cheranganiensis |
|             | Dendrosenecio    | elgonensis           | 0.41 2.51 0.54 0.22 2.36 0.01 0 5 osA         | UG2207-5_Dendrosenecio_elgonensis_ssp_elgonensis |
|             | Dendrosenecio    | erici-rosenii        | 1.46 4.85 0.12 1.98 0.33 8.23 0.03 0 5 osA     | KN0792-3_Dendrosenecio_johnstonii |
|             | Dendrosenecio    | johnstonii           | 0.49 2.95 0.67 0 osA                          | KN0781-1_Dendrosenecio_johnstonii |
|             | Dendrosenecio    | keniensis            | 0.44 2.7 0.59 0.22 3.2 0.01 0 5 osA            | KN0781-1_Dendrosenecio_keniensis |
|             | Dendrosenecio    | keniodendron         | 0.44 2.7 0.54 0.46 2.54 0 0 0 osA              | TZ0343-3_Dendrosenecio_kenioidendron |
|             | Dendrosenecio    | kilimanjari          | 0.49 2.95 0.67 0.23 2.56 0 0 0 osA              | UG2207-5_Dendrosenecio_kilimanjari_ssp_kilimanjari |
|             | Dendrosenecio    | meruensis            | 2.79 8.75 0.13 1.34 0 osA                       | UG2207-5_Dendrosenecio_meruensis |

- **Dendrosenecio battiscombei**: endemic to Mt Kenya and Aberdare Mts.
- **Dendrosenecio brassiciformis**: endemic to Aberdare Mts and Cherangani Hills.
- **Dendrosenecio cheranganiensis**: endemic to Cherangani Hills.
- **Dendrosenecio elgonensis**: endemic to Mt Elgon.
- **Dendrosenecio erici-rosenii**: endemic to Mt Rwenzori, Virunga Mts, Mt Muh, Mt Kahuzi, Mt Rwenzori Mts, Virunga Mts.
- **Dendrosenecio johnstonii**: endemic to Mt Kilimanjaro.
- **Dendrosenecio keniensis**: endemic to Mt Kenya.
- **Dendrosenecio keniodendron**: endemic to Mt Kilimanjaro.
- **Dendrosenecio kilimanjari**: endemic to Mt Kilimanjaro.
- **Dendrosenecio meruensis**: endemic to Mt Meru.
| Family       | Genus     | Species                | Coordinates | Distribution                                                                 |
|-------------|-----------|------------------------|-------------|-------------------------------------------------------------------------------|
| Asteraceae  | Erigeron  | Erigeron alpinus      | 3.86 8.82 0.55 1.36 0.03 1.76 0 0 0 osA | Ethiopia and Kenya. Also Europe to N. Iran. Widespread                        |
| Asteraceae  | Euryops   | Euryops brownei       | 0.54 3.06 0 0.6 0.52 4.25 0 0 0 osA | Kenya, Tanzania endemicEA                                                    |
| Asteraceae  | Euryops   | Euryops dacydioides   | 2.5 7.07 0.07 2.2 0.3 6.2 0 0 0 osA | Tanzania; endemic to Mt Kilimanjaro MtKilimanjaro                             |
| Asteraceae  | Euryops   | Euryops elgonensis    | 0.54 3.06 0 0.6 0.52 4.47 0 0 0 osA | Kenya, Uganda; endemic to Mt Elgon MtElgon                                    |
| Asteraceae  | Euryops   | Euryops pinifolius    | 1.61 5.73 0.02 1.44 0.43 4.25 0 0 0 osA | Ethiopia; Simen Mts, Mt Choke Simen                                           |
| Asteraceae  | Euryops   | Euryops prostratus    | 1.61 5.73 0.02 1.75 0.3 4.5 0 0 0 osA | Ethiopia, endemic to Bale Mts, Bale                                          |
| Brassicaceae| Arabidopsis| Arabidopsis thaliana | 15.7 11.91 9.81 3.66 2.11 6.14 0.01 0 0 0 osA | Ethiopia, Kenya, Uganda, Tanzania. Also in Northern Africa, Macaronesia, Europe and much of Asia. Widespread |
| Brassicaceae| Arabis    | Arabis alpina         | 19.09 4 5 6.14 3.81 8.75 0.31 0 0 0 osA | Ethiopia, Kenya, Uganda, Tanzania, DR Congo. Also widespread in Europe, N. Asia, and N. America, extending within the Arctic Circle. Widespread |
| Brassicaceae| Erophila  | Erophila verna        | 9.77 14.4 5.26 2.74 1.02 7.93 0.12 390 450 osA | Ethiopia, Simen widespread                                                     |
Brassicaceae  

| Thlaspi alliaceum (=Mummenhoffia alliacea) | 18.9 | 15.8 | 390 | 462 | 

| Thlaspi verna var. Macrosperma | 2.0 | 0.0 | 0.0 | 0.0 | 

| 3 | 0 | 0 | 0 | 0 | 

Campanulaceae  

| Thlaspi alliaceum (=Mummenhoffia alliacea) | 12.7 | 3.0 | 7.01 | 4.41 | 1.57 | 9.0 | 0.35 | 0.0 | sA | 

| 2_Erophila_verna var. Macrosperma | 12.0 | 1.8 | 5.1 | 1.3 | 

| ET0671-2 | Thlaspi_alliaceum | 12.7 | 1.8 | 5.1 | 1.3 | 

| 3 | 0 | 0 | 0 | 0 | 

Campanulaceae  

| Lobelia alliaceum | 12.7 | 170 | 355 | 

| 2_Thlaspi_alliaceum | 12.0 | 1.8 | 5.1 | 1.3 | 

| KN0394-1 | Lobelia_alliaceum | 12.0 | 1.8 | 5.1 | 1.3 | 

| 3 | 0 | 0 | 0 | 0 | 

Campanulaceae  

| Lobelia aberdarica | 4.03 | 6.94 | 1.95 | 2 | 0.6 | 8.27 | 0.3 | 0 | obsA | 

| Kenya, Uganda | endemicEA | 

| ET1503-3 | Lobelia_aberdarica | 4.03 | 6.94 | 1.95 | 2 | 0.6 | 8.27 | 0.3 | 0 | obsA | 

| 3 | 0 | 0 | 0 | 0 | 

Campanulaceae  

| Lobelia acrochila | 0.72 | 2.17 | 0.04 | 5 | 0.17 | 8.59 | 0.06 | 0 | obsA | 

| Ethiopia; Mt Bale, Sidamo, Arsi, Harar Kenyan; endemic to Bale | 

| 2 | 0 | 0 | 0 | 0 | 

Campanulaceae  

| Lobelia bambuseti | 0.15 | 0.82 | 0.21 | 1.7 | 0.01 | 8.27 | 0.3 | 0 | obsA | 

| Mt Kenya and Aberdare Mts Uganda, DR Congo; endemic to Mt Rwenzori | 

| 2 | 0 | 0 | 0 | 0 | 

Campanulaceae  

| Lobelia deckenii subsp. bequaertii | 2.44 | 5.09 | 0.75 | 6.05 | 0 | 0 | osA | 

| Tanzania, Kenya, Uganda | endemicEA | 

| TZ0025-2 | Lobelia_deckenii ssp.deckenii | 2.44 | 5.09 | 0.75 | 6.05 | 0 | 0 | osA | 

| 3 | 0 | 0 | 0 | 0 | 

Campanulaceae  

| Lobelia giberroa | 0.57 | 2.14 | 0.15 | 1.57 | 0 | 0 | obsA | 

| Zambia, Zaire | endemicEA | 

| KN0743-1 | Lobelia_giberroa | 0.57 | 2.14 | 0.15 | 1.57 | 0 | 0 | obsA | 

| 3 | 0 | 0 | 0 | 0 | 

Campanulaceae  

| Lobelia granitica | 4.09 | 1.08 | 8.6 | 4.76 | 3.13 | 9.17 | 0 | 0 | obsA | 

| Tanzania | endemicEA | 

| 2 | 0 | 0 | 0 | 0 | 

Campanulaceae  

| Lobelia | 0.57 | 2.14 | 0.15 | 1.57 | 0.84 | 14.7 | 0.53 | 180 | 300 | obsA | 

| Burundi, Malawi, endemicEA | 

| 3 | 0 | 0 | 0 | 0 | 

Campanulaceae  

| Lobelia | 0.57 | 2.14 | 0.15 | 1.57 | 0.84 | 14.7 | 0.53 | 180 | 300 | obsA | 

| Burundi, Malawi, endemicEA | 

| 3 | 0 | 0 | 0 | 0 | 

Campanulaceae  

| Lobelia | 0.57 | 2.14 | 0.15 | 1.57 | 0.84 | 14.7 | 0.53 | 180 | 300 | obsA | 

| Burundi, Malawi, endemicEA | 

| 3 | 0 | 0 | 0 | 0 | 

Campanulaceae  

| Lobelia | 0.57 | 2.14 | 0.15 | 1.57 | 0.84 | 14.7 | 0.53 | 180 | 300 | obsA | 

| Burundi, Malawi, endemicEA | 

| 3 | 0 | 0 | 0 | 0 | 

Campanulaceae  

| Lobelia | 0.57 | 2.14 | 0.15 | 1.57 | 0.84 | 14.7 | 0.53 | 180 | 300 | obsA | 

| Burundi, Malawi, endemicEA | 

| 3 | 0 | 0 | 0 | 0 | 

Campanulaceae  

| Lobelia | 0.57 | 2.14 | 0.15 | 1.57 | 0.84 | 14.7 | 0.53 | 180 | 300 | obsA | 

| Burundi, Malawi, endemicEA | 

| 3 | 0 | 0 | 0 | 0 | 

Campanulaceae  

| Lobelia | 0.57 | 2.14 | 0.15 | 1.57 | 0.84 | 14.7 | 0.53 | 180 | 300 | obsA | 

| Burundi, Malawi, endemicEA | 

| 3 | 0 | 0 | 0 | 0 |
| Campanulaceae | Lobelia | Mildbraedii | 3 | 0 | 0 | Rwanda, Tanzania, Uganda, DR Congo, Burundi, Malawi, | 2_Lobelia_mildbraedii |
| Campanulaceae | Lobelia | Mildbraedii2 | 3.45 | 6.68 | 1.23 | 8.87 | 0 | 0 | obsA | Rwanda, Tanzania, Uganda, DR Congo endemicEA | Lobelia_mildbraedii |
| Campanulaceae | Lobelia | rhynchopetalum | 3.45 | 6.68 | 1.23 | 3 | 0.17 | 8.59 | 0.06 | 0 | 0 | osA | Ethiopia; Choke, Arsi, Harar, Burundi, Rwanda, Uganda, DR Congo | 2_Lobelia_rhynchopetalum |
| Campanulaceae | Lobelia | stuhlmannii | 1.25 | 2.94 | 0.3 | 3.67 | 0.5 | 7.81 | 0.24 | 0 | 0 | obsA | Kenya, Uganda; endemic to Mt. Rwenzori, Virunga Mts, Simen, Bale | 1_Lobelia_stuhlmannii |
| Campanulaceae | Lobelia | telekii | 5.18 | 8.59 | 2.66 | 2 | 0.79 | 7 | 0.12 | 0 | 0 | obsA | Mt. Elgon, Aberdare, Mt. Kenya endemicEA | 3_Lobelia_telekii |
| Campanulaceae | Lobelia | wollastonii | 2.44 | 5.09 | 0.75 | 6.05 | 0.5 | 7.81 | 0.24 | 0 | 0 | obsA | Ethiopia; Bale Mts, Arsi, Kenya, Uganda; endemic to Mt. Rwenzori, Virunga Mts, Simen, Bale | 3_Lobelia_wollastonii |
| Caryophyllaceae | Lychnis | abyssinica (=Silene abyssinica) | 1.98 | 3.25 | 1.03 | 0.98 | 1.37 | 14.3 | 0.47 | 135 | 400 | osA | Ethiopia; Kenya, widespread | 1_Lychnis_abyssinica |
| Family         | Genus         | Species Name                      | ET0098- X_Lychnis_abyssica | ET0098- X_Lychnis_abyssica1 | ET0098- X_Lychnis_abyssica2 | ET0098- X_Lychnis_abyssica3 | ET0098- X_Lychnis_abyssica4 |
|---------------|---------------|----------------------------------|-----------------------------|------------------------------|-----------------------------|-----------------------------|-----------------------------|
| Caryophyllace | Lychnis      | abyssinica                       | 4.67 6.81 2.85 2.57        | 2.4 1.15 0 0 osA             | 12.9 135 400                 | Ethio, Ken, Ru, UD Congo, Eritrea, Nig, Cameroon | widespread inica LGS |
| Caryophyllace | Lychnis      | cryssifolia                      | 2.45 4.14 1.26 1.53        | 2.11 10.2 0.68 0 0 osA       | 200 390                     | Kenya, Tan, endemicEA | folia |
| Caryophyllace | Lychnis      | kigesiensis                      | 1.98 3.25 1.03 0.98        | 1.37 11.3 0.47 0 0 obsA      | 150 300                     | Uganda, Rw, Eth, endemicEA | azzi |
| Caryophyllace | Lychnis      | kigesiensis subsp. ragazziana    | 2.45 4.14 1.26 1.53        | 2.11 10.2 0.68 0 0 obsA      | 180 380                     | Uganda, Ru, Bur, DR Congo, Ken, Tan, endemicEA | Kigesiensis subsp. ragazziana |
| Caryophyllace | Lychnis      | kiwensis                         | 3.9 5.81 2.36 2.88         | 1.98 8 0.68 0 0 osA          | 16.6 260 395                 | Uganda, Ken, Mt, Kilimanjaro, endemicEA | Kigeti |
| Caryophyllace | Lychnis      | scottii                          | 3.22 4.91 1.87 1.96        | 0 0 obsA                     | 270 330                     | Ethiopia, Tan, Eritrea, Rep. South, Sudan, Yemen, Eritrea, Rep. South, Sudan, Yemen, | Bale Uebelina scottii |
| Caryophyllace | Minuartia    | filifolia                        | 5.05 7.94 2.88 3           | 10.19 3 4.03 0 0 osA         | 13.9 27.1 180 405           | Somalia, endemicEA | ET0266- 1_Minuartia_filifolia |
| Caryophyllace | Sagina       | afroalpina                       | 2.87 4.8 1.29 2.78         | 1.44 16 1.15 315 460 osA     | 5.8 2.57 10.2 0.68 0 0 osA | E, Ken, endemicEA | KN0944- |
| Family               | Genus       | Species          | Country                          | Location          |
|---------------------|-------------|------------------|----------------------------------|-------------------|
| Caryophyllace       | Silene      | Silene burchellii | Uganda, DR Congo, Ethiopia, Kenya, Uganda, Tanzania, Eritrea, Rep. South Sudan, Somaliland, South Africa, Angola, Rwanda, DR Congo, Tropical Arabia | widespread        |
|                     |             |                  |                                  | KN0594-1_Silene_burchelli_var_burchellii | Eriobotrya                     |
| Caryophyllace       | Silene      | flammulifolia    | Ethiopia, Somalia, Yemen         | endemicEA flammulifolia | Eriobotrya                     |
| Caryophyllace       | Silene      | macrosolen       | Ethiopia, Kenya, Tanzania, Rep. South Sudan, | endemicEA macrosolen |
|                     |             |                  | Cameroon                         |                   |                                 |
| Crassulaceae        | Umbilicus   | botryoides       | Ethiopia, Kenya, Uganda, DR Congo, Djibouti, Eritrea, Rwanda, Somalia, Sudan, Cameroon | widespread botryoides |
|                     |             |                  |                                 |                   |                                 |
| Dipsacales          | Scabiosa    | columbaria       | Ethiopia, Kenya, Tanzania, also Cameron, South Africa and Europe | widespread mbaria |
|                     |             |                  | Ethiopia, Kenya, North Africa, Europe |                   |                                 |
| Dipsacales          | Valerianella| microcarpa       | 12.2 22.5 220 410                | Mediterranean region | widespread microcarpa |
| Gentianaceae        | Sebaea      | Sebaea sp        | 3.26 5.76 1.28 2.35 18.25 9.49 | obsA               |
| Gentianaceae        | Swertia1    | Swertia          | 5.17 8.43 2.24 4.8 0.58 3.11 0.1 150 335 | obsA               |
**Swertia abyssinica**

0 0

**Gentianaceae Swertia1**

Swertia brownii

| Country          | Observations |
|------------------|--------------|
| Uganda, Tanzania | 0 obsA       |
| Also in South Sudan, Malawi, Cameroon, Equatorial Guinea, Eritrea and Zambia | 3_Swertia_abyssinica |

| Gentianaceae Swertia1 | Swertia brownii | 6.47 9.85 3.46 4.8 0.45 4.1 0.07 750 0 obsA |
|-----------------------|-----------------|------------------------------------------------|
| DR Congo              | endemicEA       |
| Ethiopia, Kenya, Uganda, Tanzania, Burundi, Rwanda, Uganda, Tanzania | UG2008-1_Swertia_brownii |

**Swertia crassiuscula**

| Gentianaceae Swertia1 | Swertia crassiuscula | 17.3 |
|-----------------------|----------------------|------|
| Kenya, Tanzania, Uganda | 260 420 obsA |

**Gentianaceae Swertia1**

Swertia crassiuscula ssp robusta

| Gentianaceae Swertia1 | Swertia crassiuscula ssp robusta | 6.33 9.65 3.39 4.8 1.18 4.45 0.15 0 0 osA |
|-----------------------|----------------------------------|------------------------------------------|
| Ethiopia; endemic to Mt Bale | 360 405 |
| Bale                  |                                  |

**Gentianaceae Swertia1**

Swertia engleri var engleri

| Gentianaceae Swertia1 | Swertia engleri var engleri | 18.6 |
|-----------------------|-----------------------------|------|
| Ethiopia; Simen Mts and Wello | 335 450 |
| Simen                  |                              |

**Gentianaceae Swertia1**

Swertia engleri var woodii

| Gentianaceae Swertia1 | Swertia engleri var woodii | 13.99 3 9.82 9.87 0.82 4.79 0.13 0 0 osA |
|-----------------------|-----------------------------|------------------------------------------|
| Ethiopia; Yemen, Saudi Arabia | 245 335 |
| endemicEA              |                              |

**Gentianaceae Swertia1**

Swertia pumila

| Gentianaceae Swertia1 | Swertia pumila | 3.93 6.53 1.78 2.63 0.58 3.11 0.1 0 0 obsA |
|-----------------------|----------------|------------------------------------------|
| Ethiopia; Simen Mts, Bale Mts | 305 375 |
| Simen, Bale widely spread | 4_Swertia_engleri var woodii |

**Gentianaceae Swertia1**

Swertia quartiniana

| Gentianaceae Swertia1 | Swertia quartiniana | 5.17 8.43 2.24 4.8 0.9 4.19 0.19 900 285 obsA |
|-----------------------|---------------------|------------------------------------------|
| Ethiopia, Kenya, Uganda, Tanzania, DR Congo, Zambia, Malawi, Mozambique, Zimbabwe | 5_Swertia_quartiniana |

| Country          | Observations |
|------------------|--------------|
| Ethiopia; Yemen, Saudi Arabia | 0 |

| Gentianaceae Swertia1 | Swertia quartiniana | 5.17 8.43 2.24 4.8 0.9 4.19 0.19 900 285 obsA |
|-----------------------|---------------------|------------------------------------------|
| Ethiopia, Kenya, Uganda, Tanzania, DR Congo, Zambia, Malawi, Mozambique, Zimbabwe | 5_Swertia_quartiniana |
| Family       | Genus       | Species             | Cameroon, Nigeria | Ethiopia, Kenya, Uganda, Tanzania, Burundi, Rwanda, DR Congo, Zimbabwe, Mozambique, Malawi | widespread | Catalogue Number |
|--------------|-------------|---------------------|-------------------|------------------------------------------------------------------------------------------|-----------|------------------|
| Gentianaceae | Swertia     | usambarensis        | 6.33 9.65 3.39 5.8 | 0.45 5.89 0.07 0 0 obsA | Malawi    | TZ0711-4568_Swertia_usambarensis |
| Gentianaceae | Swertia     | adolfi-friderici    | 3.32 7.09 1.9 2.57 | 2.25 8 0.27 0 0 obsA | Uganda, Rwanda, DR Congo, Burundi, Rwanda, Ethiopia, Kenya, Uganda, Tanzania, Burundi, Rwanda, DR Congo, Malawi | endemicEA | TZ0710-5_Swertia_adolfi-friderici |
| Gentianaceae | Swertia     | klimandscharica     | 0.71 2.75 0 2.7   | 1.14 4 0.58 0 0 osA | Tanzania, Uganda, Rwanda, DR Congo, Ethiopia, Uganda, Tanzania, Malawi, South Sudan | endemicEA | UG2175-1_Swertia_kilimandscharica |
| Gentianaceae | Swertia     | macrosepala         | 0.22 1.08 0 0.35  | 3.33 9.79 0.27 0 0 osA | Ethiopia, Uganda, Tanzania, Malawi, DR Congo, Ethiopia, Kenya, Tanzania, Malawi, South Sudan | endemicEA | EG0085-3_Swertia_macrosepala |
| Gentianaceae | Swertia     | schimperi           | 4.09 7.09 1.9 2.57 | 1.14 4 0.58 0 0 osA | Kenya; endemic to Mt. Kenya. | MtKenya  | KN0004-3_Swertia_subnivalis |
| Gentianaceae | Swertia     | subnivalis          | 0.22 1.08 0 0.35  | 3.33 4 0.33 0 0 osA | Kenya, Uganda; endemic to Mt Elgon MtElgon | wide |
| Gentianaceae | Swertia     | uniflora            | 0.71 2.75 0 1.55  | 6.11 7 0.27 0 0 osA | Ethiopia, Kenya, Tanzania, widespread | | |
| Poaceae      | Aira        | caryophyllea        | 1.67 3.57 0.39 1.26 | 15.5 5.19 6 0.27 0 0 osA | Ethiopia, Kenya, Tanzania, widespread | ET0680-x23_Swertia_volkensii |

| Family       | Genus       | Species             | Tanzania, Uganda, Rwanda, DR Congo, Ethiopia, Uganda, Tanzania, Malawi, South Sudan, Kenya, Uganda; endemic to Mt Elgon MtElgon | Kenya, Uganda; endemic to Mt. Kenya. | MtKenya  | KN0095-4_Swertia_uniflora |
|--------------|-------------|---------------------|----------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------|-----------|-------------------------|
| Poaceae      | Aira        | caryophyllea        | 2.89 5.53 0.7 1.73 2.11 11.3 0.56 210 450 osA | 1 0 0 | Ethiopia, Kenya, Tanzania, widespread | ET0167-T_Aira_caryophyllea |

24
In South Africa, Northern Europe and Asia. Introduced to many other parts of the world.

| Poaceae        | Species                  | Numbers | Description                                      | Location                           | Code         |
|----------------|--------------------------|---------|--------------------------------------------------|------------------------------------|--------------|
| Alopecurus     | *baptarrhenius*          | 1.4     |                                                  | Ethiopia, Bale Mts, Kenya          | ET0495-5     |
| Anthoxanthum   | *nivale*                 | 2.1     |                                                  | Ethiopia, Kenya, Uganda, Tanzania  | TZ0031-2     |
| Avenella       | *flexuosa*               | 11.29   |                                                  | Ethiopia, Kenya, Uganda, Tanzania  | ET0831-3     |
| Deschampsia    | *cespitosa*              | 1.29    |                                                  | Ethiopia, Kenya, Uganda, Tanzania  | ET0831-3     |
| Helictotrichon | *elongatum*              | 1.43    |                                                  | Madagascar                       | TZ0097-1     |
| Koeleria       | *capensis*               | 1.15    |                                                  | Ethiopia, Kenya, Uganda, Tanzania, |              |

Also in South Africa, Northern Europe and Asia. Introduced to many other parts of the world.

| Numbers | Description | Location                           | Code         |
|---------|-------------|------------------------------------|--------------|
| 270     |             | Ethiopia, Bale Mts, Kenya          | ET0495-5     |
| 240     |             | Ethiopia, Kenya, Uganda, Tanzania  | TZ0031-2     |
| 260     |             | Ethiopia, Kenya, Uganda, Tanzania  | ET0831-3     |
| 290     |             | Ethiopia, Kenya, Uganda, Tanzania  | ET0831-3     |
| 180     |             | Madagascar                        | TZ0097-1     |

Also in Shewa Region.

Kenya, Uganda, DR Congo, Rwanda, Tanzania endemicEA

Kenya, Tanzania, DR Congo endemicEA

Ethiopia, Rwanda, Tanzania endemicEA

Kenya, Tanzania, DR Congo, Rwanda, Tanzania, Rep. South Sudan, Cameroonian endemicEA

Ethiopia, Kenya, Uganda, DR Congo, Tanzania endemicEA

Ethiopia, Kenya, Uganda, DR Congo, Tanzania, Rep. South Sudan, Cameroonian endemicEA

Ethiopia, Kenya, Uganda, Tanzania, Rep. South Sudan, Cameroonian endemicEA

Ethiopia, Kenya, Uganda, Tanzania, Rep. South Sudan, Cameroonian endemicEA

Ethiopia, Kenya, Uganda, Tanzania, Rep. South Sudan, Cameroonian endemicEA

Ethiopia, Kenya, Uganda, Tanzania, Rep. South Sudan, Cameroonian endemicEA

Also in Cameroon, widespread

Also in Madagascar, widespread

Also in Cameroon, widespread

Also in Cameroon, widespread
| Family            | Genus             | Species       | Latitude 1 | Latitude 2 | Latitude 3 | Latitude 4 | Latitude 5 | Latitude 6 | Latitude 7 | Latitude 8 | Latitude 9 | Latitude 10 | Latitude 11 |  
|-------------------|-------------------|---------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|------------|  
| Poaceae           | Rytidosperma      | subulata      | 1.43       | 2.61       | 0.28       | 0.75       | 0.77       | 2.97       | 0.07       | 300        | 430        |            |            |  
| Plantaginacea     | Veronica          | abyssinica    | 3.11       | 5.03       | 1.54       | 1.37       | 0          | 0          | osA        | 120        | 390        |            |            |  
| Plantaginacea     | Veronica          | anagallis-aquatica | 1.47       | 2.62       | 0.7        | 0.4        | 1.11       | 3.62       | 480        | 300        |            |            |            |  
| Plantaginacea     | Veronica          | glandulosa    | 6.79       | 1          | 4.35       | 2.65       | 0.74       | 7.87       | 0.2        | 200        | 410        |            |            |  
| Primulaceae       | Anagallis         | serpens       | 0.74       | 0.2        | 7.87       | 0          | osA        |            |            |            |            |            |            |  
| Primulaceae       | Primula           | verticillata  | 0.91       | 2.02       | 0.22       | 1.21       | 4.84       | 8.63       | 0.11       | 200        | 420        |            |            |  
| Ranunculaceae     | Anemone           | thomsonii     | 3.48       | 5          | 0.6        | 0          | osA        |            |            |            |            |            |            |  

Southern Africa
Ethiopia; Simen Mts, Bale Mts. Also in Northern Yemen. endemicEA

Ethiopia, Kenya, Uganda, Tanzania, Burundi, Cameroon, Malawi, Mozambique, Nigeria, Rwanda, Somalia, Rep. South Sudan, Zambia, DR Congo, Zimbabwe widespread

Ethiopia, Kenya, Uganda, Tanzania, also in Rwanda, Zambia, Zimbabwe and widespread in N America and Europe widespread

Ethiopia, Kenya, Uganda, DR Congo, Rwanda, Tanzania endemicEA

Uganda, Kenya, Tanzania, Rep. South Sudan, Zimbabwe, Somalia, Yemen endemicEA

Ethiopia, Kenya, Rep. South Sudan, Tanzania, Uganda, DR Congo
| Genus     | Species               | Obs 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 |
|-----------|-----------------------|--------|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|----|
| Ranunculaceae | Ranunculus_ noclade | 2.44   | 4.12 | 0.89| 6.76| 2.75| 9.01| 0  | 0  | 0  | 0  |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|            | distrias              |        |     |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Ranunculaceae | Ranunculus_ noclade | 3.74   | 5.93 | 1.86| 8.67| 3.75| 0.04| 0  | 0  | 0  | 0  |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|            | oreophytus            |        |     |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Ranunculaceae | Ranunculus_ noclade | 2.1    | 4.29 | 1.6 | 5.17| 0.56| 4.29| 0.11| 0  | 0  | 0  |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|            | trichophyllus        |        |     |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Ranunculaceae | Ranunculus_ noclade | 4.93   | 7.15 | 3.1 | 13.5| 2.68| 0.45| 0  | 0  | 0  | 0  |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|            | volkensii             |        |     |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Ranunculaceae | Ranunculus_ Ranunculus |    |      |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|            | aberdaricus           |        |     |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Ranunculaceae | Ranunculus_ Ranunculus |    |      |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|            | multifidus            |        |     |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Ranunculaceae | Ranunculus_ Ranunculus |    |      |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|            | cryptanthus           |        |     |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Ranunculaceae | Ranunculus_ Ranunculus |    |      |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
|            | oligocarpus           |        |     |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |
| Ranunculaceae | Ranunculus_ Ranunculus |    |      |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |    |

- *Ethiopia; Northern and central Ethiopia* Simen
- *Ethiopia, Kenya, Tanzania, Uganda,* Rwanda, Rep.
- *South Sudan, DR Congo*
- *Tanzania, Uganda, Rwanda, Rep.*
- *Drug Congo, Rwanda, Tanzania, Burundi*
- *Kenya, Uganda, Tanzania*
- *Ethiopia, Kenya, Uganda, Tanzania*
- *Tasmania, Europe to Asia, Australia and* Tasmanian
- *North America, through Europe to Asia, through* Australia and *Tasmania widespread*
- *Ethiopia, Kenya, Uganda, DR Congo, Rwanda, Tanzania, Burundi endemicEA*
- *Kenya, Uganda, Tanzania and widespread in tropical and south Africa, Madagascar and Arabia widespread*
- *Kenya, Uganda; endemic to Mt Elgon MtElgon*
- *Ethiopia, Kenya endemicEA*
- *Ethiopia, Kenya endemicEA*
- *Ethiopia, Kenya endemicEA*
- *Kenya, Uganda; endemic to Mt Elgon MtElgon*
- *Ethiopia, Simen endemicEA*
- *Ethiopia, Simen, Bale*

**ET0130-1** Ranunculus distrias
**TZ0472-5** Ranunculus oreophytus
**ET0609-2** Ranunculus trichophyllus
**TZ0069-1** Ranunculus volkensii
**ET0557-2** Ranunculus aberdaricus
**ET0449-2** Ranunculus oligocarpus

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27
| Family   | Genus     | Species           | Obs 1 | Obs 2 | Obs 3 | Obs 4 | Obs 5 | Obs 6 | Coordinates | Notes |
|----------|-----------|-------------------|-------|-------|-------|-------|-------|-------|-------------|-------|
| Ranunculacea | Ranunculus | simiensis        | 0     | 0     | 0     | 0     | 0     | 0     | Mts, Bale Mts, Arisi | simiensis |
|          | Ranunculus | stagnalis        | 0.44  | 1.43  | 0     | 0.79  | 0.63  | 8.91 | Ethiopia, Kenya, Uganda, Tanzania, | KN0386-2_Ranunculus_stagnalis |
|          | Ranunculus | stagnalis2       | 1.09  | 2.02  | 0.39  | 3.1   | 0.37  | 3.1  | Ethiopia, Kenya, Uganda, Tanzania, | endemicEA_Ranunculus_stagnalis |
|          | Ranunculus | tembensis        | 1.09  | 2.02  | 0.39  | 3.1   | 0.42  | 4.37 | Ethiopia, Kenya, Uganda, Tanzania, | endemicEA_Ranunculus_tembensis |
| Violaceae | Viola     | abyssinica       | 0.61  | 5.28  | 0.08  | 0     | 0     | 0     | Ethiopia, Kenya, Rwanda, Rep. South Sudan, Tanzania, Zambia, Zimbabwe, | widespreadViola_abyssinica |
| Violaceae | Viola     | eminii           | 0.32  | 4.96  | 0.04  | 0     | 0     | 0     | DR Congo | endemicEA_Viola_eminii |
| Violaceae | Viola     | nannae           | 0.32  | 4.96  | 0.04  | 0     | 0     | 0     | DR Congo | endemicEA_Viola_nannae |

28
| Alignment dataset | Locus       | No. of seq. in original dataset | No of seq. added from new material | No of seq. added from GenBank | Total no. of seq. | Total seq. length | Missing new samples |
|-------------------|-------------|----------------------------------|------------------------------------|-------------------------------|------------------|-------------------|---------------------|
| Seed plant wide   | *rbcL*      | 22399                            | 92                                 | 0                             | 27982            | 682               | 0                   |
|                   | *matK* (incl. *trnK*) | 27891                            | 92                                 | 0                             | 22489            | 4215              | 0                   |
|                   | concatenated |                                  |                                    |                               | 36197            | 4897              |                     |
| Asteraceae        | *trnLF*     | 29                               | 17                                 | 61                            | 107              | 890               | 0                   |
|                   | *rbcL*      | 29                               | 17                                 | 15                            | 55               | 1429              | 0                   |
|                   | *ndhF*      | 29                               | 17                                 | 20                            | 64               | 1718              | 0                   |
|                   | concatenated |                                  |                                    |                               | 90               | 4031              | 0                   |
| Brassicaceae      | *trnLF*     | 55                               | 4                                  | 37                            | 96               | 1064              | 0                   |
|                   | *rbcL*      | 26                               | 4                                  | 29                            | 59               | 1153              | 0                   |
|                   | *ndhF*      | 95                               | 4                                  | 22                            | 121              | 2068              | 0                   |
|                   | *nad4*      | 97                               | 0                                  | 0                             | 97               | 1481              | 4                   |
|                   | *matK*      | 58                               | 4                                  | 29                            | 91               | 1045              | 0                   |
|                   | ITS         | 211                              | 4                                  | 34                            | 249              | 819               | 0                   |
|                   | chl         | 26                               | 0                                  | 0                             | 26               | 999               | 4                   |
|                   | adh         | 14                               | 0                                  | 0                             | 14               | 1986              | 4                   |
|                   | concatenated |                                  |                                    |                               | 54               | 7270              |                     |
| Campanulaceae     | *trnLF*     | 76                               | 11                                 | 31                            | 119              | 1347              | 0                   |
|                   | *rbcL*      | 67                               | 11                                 | 27                            | 106              | 1400              | 0                   |
|                   | *ndhF*      | 31                               | 11                                 | 29                            | 72               | 1234              | 0                   |
|                   | concatenated |                                  |                                    |                               | 118              | 3776              |                     |
| Caryophyllaceae   | ITS         | 63                               | 10                                 | 58                            | 132              | 766               | 0                   |
| Crassulaceae      | *trnLF*     | 90                               | 1                                  | 9                             | 100              | 1168              | 0                   |
|                   | rps16       | 58                               | 1                                  | 9                             | 68               | 1052              | 0                   |
|                   | *matK*      | 89                               | 1                                  | 9                             | 99               | 1232              | 0                   |
|                   | ITS         | 322                              | 1                                  | 9                             | 332              | 1005              | 0                   |
|                   | concatenated |                                  |                                    |                               | 324              | 4440              |                     |
| Dipsacales        | ITS         | 120                              | 2                                  | 13                            | 122              | 743               | 0                   |
|                   | *matK*      | 126                              | 2                                  | 20                            | 128              | 1226              | 0                   |

*no chl, adh used for concatenation, samples with less than 4 loci were removed, alignment edited.*
| Family          | Accession | Length | GC content | A content | T content | C content | G content | N content |
|-----------------|-----------|--------|------------|-----------|-----------|-----------|-----------|-----------|
| Gentianaceae    | psbAH     | 109    | 2          | 4         | 111       | 459       | 0         |           |
|                 | trnL      | 123    | 2          | 16        | 125       | 1028      | 0         |           |
|                 | concatenated | 149 | 3448 | 0         |           |           |           |           |
|                 | trnLF     | 162    | 19         | 58        | 239       | 667       | 0         |           |
|                 | ITS       | 153    | 18         | 39        | 210       | 732       | 1         |           |
|                 | concatenated | 181 | 1384 |           |           |           |           |           |
| Poaceae (dataset A) | rbcL     | 250    | 8          | 28        | 286       | 1486      | 0         |           |
|                 | ndhF      | 250    | 8          | 30        | 288       | 2451      | 0         |           |
|                 | matK      | 250    | 8          | 27        | 285       | 3321      | 0         |           |
|                 | concatenated | 282 | 7442 |           |           |           |           |           |
| Plantaginaceae  | ITS – Plantago | 38 | 2    | 23        | 63        | 741       | 0         |           |
| Primulaceae     | trnLF     | 13     | 2          | 9         | 24        | 1070      | 0         |           |
|                 | rps16     | 11     | 2          | 9         | 22        | 879       | 0         |           |
|                 | rpl16     | 13     | 2          | 8         | 22        | 1099      | 0         |           |
|                 | rbcL      | 13     | 2          | 10        | 25        | 1396      | 0         |           |
|                 | ndhF      | 9      | 2          | 5         | 16        | 1938      | 0         |           |
|                 | matK      | 13     | 1          | 8         | 23        | 1573      | 1         |           |
|                 | concatenated | 20 | 7911 |           |           |           |           |           |
| Ranunculaceae   | trnL-matK | 237    | 7          | 42        | 286       | 2013      | 2         |           |
|                 | psbJ-petA | 225    | 7          | 24        | 256       | 762       | 2         |           |
|                 | ITS       | 238    | 6          | 39        | 283       | 656       | 3         |           |
|                 | concatenated | 249 | 3425 |           |           |           |           |           |
**Table S4.** Species represented by more than one individual in the phylogenies of individual seed plant clades generated using BEAST2 and retrieved as monophyletic or non-monophyletic. PP = posterior probability.

| Species retrieved as monophyletic | > 0.9 PP                                                                 | < 0.9 PP                                                                 |
|----------------------------------|--------------------------------------------------------------------------|--------------------------------------------------------------------------|
|                                  | *Arabidopsis thaliana, Arabis alpina, Minuartia filifolia, Lobelia deckenii* (excl. *L. d. bequaertii*, Silene burchellii) | *Lobelia telekii, Lobelia acrochila, Cineraria abyssinica*                 |

**Non-monophyletic**

| > 0.9 PP | Potentially paraphyletic species (nested species in parenthesis): *Veronica glandulosa* (*V. abyssinica*); *Lobelia aberdarica* (*L. bambuseti*); *Lobelia stuhlmannii* (*L. wollastonii*) |
|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|          | Potentially polyphyletic species: *
|          | Ranunculus stagnalis; Lychnis abyssinica; Lobelia mildbraedii, Lobelia deckenii* (*Lobelia deckenii* spp. *bequaertii* clade with *L. stuhlmannii*, *L. wollastonii*); Swertia crassiuscula (Ethiopian sample together with *S. engleri*, distantly related to other *S. crassiuscula*) |
| < 0.9 PP | *Ranunculus trichophyllus; Veronica anagallis-aquatica; Lobelia rhynchopetalum* (*L. acrochilua*); *Ranunculus volkensii* (*R. ficariifolius, R. cheirophyllus*) |

**Table S5.** BEAST2 age estimates of afroalpine clades containing min. two sampled species. Asterix indicates unsupported stem nodes.

| family     | clade         | number of species | crown age              | stem age              |
|------------|---------------|-------------------|------------------------|-----------------------|
| Asteraceae | *Dendrosenecio*  | 11                | 7.89 (2.07 - 16.77)    | 22.62 (15.18 - 30.73) |
| Asteraceae | *Cineraria*   | 2                 | 2.58 (7.71 - 0.19)     | 3.54 (0.55 - 8.28)   |
| Asteraceae | *Euryops*     | 6                 | 6.34 (1.93 - 13.03)    | 14.61 (7.4 - 22.87)  |
| Campanulaceae | Giant *Lobelia* | 14                | 9.49 (5.01 - 15.17)    | 15.79 (9.63 - 22.98) |
| Campanulaceae | Herbal *Lobelia* | 4                 | 12.23 (6.03 - 20.05)   | 18.7 (10.37 - 28.99) |
| Caryophyllaceae | Lychnis    | 7                 | 6.62 (4.33 - 9.4)      | 8.35 (9.4 - 5.56)    |
| Gentianaceae | Swertia clade 1 | 9                 | 13.99 (9.82 - 18.63)   | 19.02 (14.19 - 24.44) |
| Gentianaceae | Swertia clade 2 | 6                 | 4.09 (1.9 - 7.09)      | 10.49 (5.08 -  - |
| Plantaginaceae | Veronica | 7 | 3.93 (2.2 - 6.14) | 6.79 (4.35 - 10.01) |
| Ranunculaceae | *Ranunculus* clade 1 | 3 | 4 (2.06 - 6.13) | 5.53 (3.83 - 7.58) |
| Ranunculaceae | *Ranunculus* clade 2 | 4 | 2.2 (1.13 - 3.47) | 3.49 (2.31 - 4.8) |
Table S6. Lineages estimated to be older than 10 Ma in at least one of the analyses (Table S2). Differentiated into being part of an afroalpine clade or not. Sorted according to families and then sorted according to the dating method and then alphabetically. Bold indicates taxa having across all available dating methods age estimates > 10Ma.

| family            | genus             | taxon             | number of species | individual seed plant clades – BEAST2 | individual seed plant clades – treePL | seed plant-wide – treePL |
|-------------------|-------------------|-------------------|-------------------|--------------------------------------|------------------------------------|--------------------------|
| Asteraceae        | *Dendrosenecio*   | *Dendrosenecio*   | 11                | 22.62                                | 0.77                               |                          |
| Asteraceae        | *Euryops*         | *Euryops*         | 6                 | 14.61                                | 0.93                               |                          |
| **Campanulaceae** | *Lobelia2*        | *Lobelia 2*       | 4                 | 18.7                                 | 13.68                              |                          |
| Campanulaceae     | *Lobelia1*        | *Lobelia 1*       | 12                | 15.79                                | 1.42                               |                          |
| Caryophyllaceae   | *Lychnis*         | *Lychnis*         | 7                 | 8.35                                 | 3.35                               |                          |
| Gentianaceae      | *Swertia1*        | *Swertia 1*       | 11                | 19.02                                | 2.94                               |                          |
| Gentianaceae      | *Swertia2*        | *Swertia 2*       | 7                 | 10.49                                | 8.82                               |                          |
| Plantaginaceae    | *Veronica*        | *Veronica*        | 2                 | 6.79                                 |                                    |                          |
| Brassicaceae      | *Arabis*          | *Arabis alpina*   | 1                 | 19.09                                | 6.14                               | 3.81                     |
| Brassicaceae      | *Thlaspi*         | *Thlaspi alliaceum* | 1              | 12.7                                 | 4.41                               | 1.57                     |
| Brassicaceae      | *Arabidopsis*     | *Arabidopsis thaliana* | 1              | 11.91                                | 3.66                               | 2.11                     |
| Caryophyllaceae   | *Minuartia*       | *Minuartia filifolia* | 1              | 5.05                                 | 13.93                              | 10.19                    |
| Crassulaceae      | *Umbilicus*       | *Umbilicus botryoides* | 1              | 0.98                                 | 2.76                               | 19.41                    |
| **Dipsacales**    | *Valerianella*    | *Valerianella microcarpa* | 1              | 12.28                                | 10.23                              |                          |
| Gentianaceae      | *Sebaea*          | *Sebaea sp*       | 1                 | 3.26                                 | 2.35                               | 18.25                    |
| Poaceae           | *Avenella*        | *Avenella flexuosa* | 1              | 11.29                                | 11.49                              | 0.88                     |
Table S7. Statistics for the different dating methods (Table S2). Abbreviations: ci – confidence intervals.

|                      | individual seed plant clades – BEAST2 | individual seed plant clades – treePL | seed plant-wide – treePL |
|----------------------|----------------------------------------|----------------------------------------|---------------------------|
|                      | stem age | ci max | ci min | stem age | ci min | ci max | stem age | ci min | ci max |
| min                  | 0.15     | 0.82   | 0      | 0.33     | 0.03   | 0      | 0.03     | 0      | 0.20   |
| max                  | 19.09    | 25.14  | 13.05  | 14.02    | 19.41  | 7.87   | 65.78    |        |
| median               | 2.44     | 4.85   | 0.70   | 2.57     | 0.84   | 0.12   | 7.81     |        |
| mean                 | 3.37     | 6.00   | 1.68   | 3.81     | 2.12   | 0.53   | 10.28    |        |
| number of species    | 91       | 93     | 93     |          |        |        |          |        |
| <=5                  | 73       | 47     | 82     | 79       | 84     | 90     | 31       |        |
| < 10                 | 84       | 81     | 90     | 84       | 88     | 91     | 60       |        |
| >= 10                | 7        | 10     | 1      | 9        | 5      | 0      | 31       |        |
| >=15                 | 1        | 7      | 0      | 0        | 2      | 0      | 14       |        |
| Lineage              | Constraint | Linked substitution rates | Linked trees | Linked clocks | Starting tree | Substitution rate model | Prior settings | Min | Max |
|---------------------|------------|---------------------------|--------------|---------------|---------------|------------------------|----------------|-----|-----|
| Asteraceae          |            |                           |              |               |               |                        |                |     |     |
| Barnadesioideae     | incl. All samples | no                        | yes          | yes           | yes           | GTR+G+I               | uniform         | 73  | 101 |
| Barnadesia, Dasyphyllum, Acicarpa, Barnadesia, Boopis, Dasyphyllum, Famatinanthus, Schlechtendalia excl. Tropaeolum minus, Moringa oleifera, Carica papaya, Batis maritima, Reseda lutea, Capparis flexuosa, Cleome viscosa | Exponential | 1.5                       | Exponential  | 1.5           | 72.1          | 72.1                  | 100            |     |     |
| Campanulaceae       | excl.换 |                                        |              |               |               |                        |                |     |     |
| mrca                | incl. Brighamia insignis, Clermontia kakeana, Cyanea angustifolia, Cyanea koolauensis, Delissea undulata, Lobelia hypoleuca, Lobelia yuccoides, Trematolobelia macrostachys | no            | yes          | yes           | no             | GTR+G+I               | normal         | 89.5 | 87.9 |
| Campanula asperuloides, Campanula latifolia, Campanula trachelium, Legousia hybrida excl. Corrigiola andina, Corrigiola litoralis, Paronychia argentea, Paronychia lindheimeri, Gymnocarpos rotundifolius, Gymnocarpos decander, Herniaria glabra, Philippiella patagonica, Drymara cordata, Pycnophillum bryoides, Cerdia, Polycarpion tetraphyllum, Illecebrum verticillatum | Exponential | 5.33                      | Exponential  | 5.33          | 0             | 29.8                  | infinite       |     |     |
| Alsinoideae         | Cardionema ramosissimum, Loeflingia hispanica, Dichanethus plocamoides, Pteranthus dichotomus, Scopulophilia parryi, Sphaerocoma aucheri, Spargularia rubra, Telephium imperati | only 1         | only 1       | only 1        | no            | GTR+G+I               | lognormal      | 34  | 34  |
| Crassulaceae        | excl. Aphanopetalum, Glischlorcyon, Gonocarpus, Haloragis, Laurembergia, Meionectes, Myriophyllum, Penthorum, | yes           | yes          | yes           | no            | GTR+G+I               | normal         | 94  | 7.6 |
| mrca                | all         |                           |              |               |               |                        |                |     |     |
| Crassulaceae        |            |                           |              |               |               |                        |                |     |     |
| Family                  | Genus                        | Loci               | GenDist               | Model   | GenDist       | GenDist       | GenDist       | GenDist       | GenDist       |
|------------------------|------------------------------|--------------------|-----------------------|---------|---------------|---------------|---------------|---------------|---------------|
| **Dipsacales**^1^      | Macaronesia                  | incl. Aeonium, Greenovia, Monanthes | mrca      | all           | no   | yes | yes | yes | GTR+G+I          | uniform | 0  | 21 | set | 21 |
|                        |                              |                    |                       |         |               |               |               |               |               |
| **Gentianaceae**       | Gentianaceae                 |                    | all                   | no      | yes | yes | yes | GTR+G+I          | Normal | 7  | 3  | 40.4 | 68.8 |
|                        | Enmenopteris                 | sectGentiana       | incl. G.cruciata, G. decumbens |         |     |     |     | lognormal      | 1.0/1. | 45 | 0  | 45 | 65  |
|                        | Lisanthus                    | crownPoa           | incl. Lisanthus       |         |     |     |     | lognormal      | 1.0/1. | 1  | 5  | 5  | 25   |
|                        | Poampleae                    | excl. Anomochloa   | yes                   | yes     | yes | yes | yes | GTR+G+I          | uniform | 90 | y  | 90 | no set |
|                        | BEP+PA                       | excl. Anomochloa, Leptaspis, Pharus, Puelia, Streptochaeta |         |         |     |     |     | lognormal      | 1.0/1. | 55 | 0  | 55 | 75   |
|                        | Distichlis                   | incl. Bouteloua, Distichlis |         |         |     |     |     | lognormal      | 1.0/1. | 14 | 0  | 14 | 34   |
|                        | Aragoa                       | incl. Aragoa       | yes                   | yes     | yes | no  |     | GTR+G+I          | uniform | 0  | 3.3| 0  | 3.3  |
|                        | PlatArag                     | incl. Plantago and Aragoa |         |         |     |     |     | Exponential     | 1.0/1. | 39.9| 19.4| 19.4| 24   |
|                        | Primulaceae                  | mrca               | all                   | yes     | yes | yes | no  | GTR+G+I          | normal  | 9  | 11.49| 9  | 58.9 |
|                        |                              | ingroup            | excl. Androsace, Anagallis, Soldanella |         |     |     |     | lognormal      | 1.0/1. | 39.9| 7 | 18.9 | 39   |
|                        | Ranunculaceae                | excl. Anemone quinquefolia, Isopyrum |             | Only 1 | locus | Only 1 | locus | only no | GTR+G+I          | normal  | 46.6| 14.6 | 48.2  |
|                        |                              | excl. Anemone quinquefolia, Arcteranthis, Beckwithia andersonii, Callianthemoides semiverticillatus, Coptidium lapponicum, Coptidium pallasii, Cyrtorhynch ranunculina, Ficaria fascicularis, Ficaria verna, Halerpestes, Hamadryas Isopyrum, Oxygraphis polypetala, Myosurus Peltocalathos baurii |         |         |     |     |     | only no | GTR+G+I          | normal  | 0  | 0.914 | 0  | 2.56 |
|                        |                              | gen_dist           | incl. Ranunculus carpaticola, Ranunculus notabilis |         |     |     |     | Exponential     | 1.0/1. | 1  | 23 | 23 | not set |

^1^ Number of taxa: 1
| island incl. *R. caprarum, R. peduncularis* | uniform | not | set | 2 |
|------------------------------------------|---------|-----|-----|---|
|                                         | 0.1     | 2   | set | 2 |

\(^1\)based on Bell\&Donoghue 2012
Table S9. Comparison of our age estimates to previous Bayesian estimates. Abbreviations: CI – confidence intervals.

| lineage       | node                          | Individual clades – BEAST2 | compared to publication (references see main text) |
|---------------|-------------------------------|----------------------------|---------------------------------------------------|
|               |                               | median | min 95% CI | max 95% CI | median | min 95% CI | max 95% CI |
| Asteraceae    | Asteraceae crown              | 84.5   | 76.08      | 94.08      | 80.5   | 75.41      | 86.99      |
|               | Senecioneae crown             | 28.66  | 26.21      | 35.87      | 24.59  | 17.76      | 31.45      |
|               | Root - Moringaceae/Brassicace |                       |           |            |        |            |            |
| Brassicaceae  | ae split                      | 89.46  | 87.47      | 91.4       | 72     | 47.9       | 90.5       |
|               | Brassicaceae crown            | 47.19  | 35.82      | 58.35      | 37.6   | 24.2       | 49.4       |
| Campanulaceae | N2                            | 47.58  | 32.84      | 64.37      | 45.5   | 30.9       | 59.2       |
|               | N3                            | 42.78  | 30.07      | 57.59      | 39.7   | 27.4       | 53.1       |
|               | N4                            | 26.04  | 16.03      | 37.38      | 24.5   | 15.1       | 36.6       |
|               | N5                            | 19.53  | 12.44      | 27.65      | 20.8   | 12.4       | 30.5       |
|               | N7                            | 33.55  | 24.06      | 43.89      | 36.7   | 25.1       | 49.5       |
|               | N8                            | 31.3   | 19.96      | 39.75      | 32.8   | 22         | 45.4       |
|               | N9                            | 29.48  | 22.22      | 41.61      | 29.6   | 18.9       | 41.3       |
| Caryophyllaceae| Faccinia stem            | 10.37  | 6.77       | 14.38      | 9.41   | 5.02       | 13.93      |
|               | Faccinia crown              | 3.93   | 2.16       | 6.58       | 3.3    | 1.67       | 5.18       |
|               | Stellaria-Faccinia          | 27.01  | 21.36      | 32.22      | 25.46  |            |            |
| Crassulaceae  | root                         | 101.38 | 87         | 115.78     | 107.54 | 93.9       | 121.43     |
|               | excl. Crassula and          |        |            |            |        |            |            |
|               | Calanchoe                    | 60.16  | 46.32      | 74.82      | 65.92  | 53.39      | 79.53      |
| Gentianaceae  | Pirie et al. 2015 does not report ages incl. root constraint |
| Poaceae       | Poaceae crown               | 96.18  | 90         | 109.39     |        |            |            |
|               | BEP+PACCMAP                  | 61.79  | 55.15      | 72.16      | 57     | 51.75      |            |
|               | Danthonooideae              | 27.47  | 20.27      | 36.3       | 30     | 21.38      |            |
| Plantaginaceae| stem Veronica               | 14.69  | 9.81       | 20.99      | 19.91  | 15.47      | 25.09      |
|               | crown Veronica              | 10.82  | 7.11       | 15.69      | 16.13  | 12.46      | 20.59      |
| Primulaceae   | Primula crown               | 11.15  | 7.78       | 15.58      |        |            | results not shown |
| Ranunculaceae | Ranunculus stem             | 20     | 16.13      | 23.45      | 21.25  | 14.13      | 28.43      |
|               | Ranunculus crown            | 17.74  | 14.01      | 21.19      | 18.11  |            |            |
**Figure S1.** BEAST2 crown ages from the seed plant wide dating analysis indicating the start of lineage radiations. Numbers depict number of species sampled in clades.
Figure S2. Species accumulation over time in the afroalpine region based on historical lineage diversity estimates and relative branching times obtained from the time-calibrated phylogenies. These plots differ from standard lineage through time plots in that species accumulation in a region results from colonization events in addition to regional diversification. Row 1: Number of colonization/diversification events over time. The black dotted line marks a constant rate model and the black dashed line an exponential model. Row 2: Change in number of colonization/diversification events over time calculated as a difference quotient (see text). The red line shows the maximum difference of change in a constant model. Row 3: number of colonization/ diversification events per 0.5-million-year intervals.
Figure S3. Median age estimates of afroalpine species based on the three different dating approaches.
Figure S4. Individual seed plant clades stem age estimates (BEAST2) of all afroalpine species, ordered by median age.
Figure S5. treePL stem ages from the seed plant wide dating analysis, showing median and 95% confidence interval.
Figure S6. BEAST2 stem ages from the seed plant wide dating analysis and geographic distribution of species. Distribution of species has been assigned to subregions, species found in more than one subregion but being restricted to eastern Africa are coded as ‘afrotemperate endemic’ and if they occur beyond these limits as ‘widespread’. See text for details on distribution coding.
Figure S7. BEAST2 stem ages from the seed plant wide dating analysis. The species are categorized as ‘strictly afroalpine (lower altitudinal limit above 3800 m), ‘strictly afroalpine + below’ and ‘non-strictly afroalpine’ (upper altitudinal limit below 3800 m), median age estimates are 7.16 (n=2), 2.45 Ma (n=32) and 2.21 Ma (n=57) respectively.
Figure S8. Species diversification (excluding colonization events) over time in the afroalpine region based on historical lineage diversity estimates and relative branching times obtained from the time-calibrated phylogenies. These plots differ from standard lineage through time plots in that species accumulation in a region results from colonization events in addition to regional diversification. Row 1: Number of diversification events over time. The black dotted line marks a constant rate model and the black dashed line an exponential model. Row 2: Change in number of diversification events over time calculated as a difference quotient (see text). The red line shows the maximum difference of change in a constant model. Row 3: number of diversification events per 0.5-million-year intervals. A. Results for the three different dating methods are shown in A) and B). For A) age estimates were subsampled to 50% 200 times; B) shows the actual data.
Legends for further SI Appendices:
SI Appendix S2: Figures of dated phylogenies of individual seed-plant clades.
SI References

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Appendix 2 of The enigmatic tropical alpine flora on the African sky islands is young, disturbed, and unsaturated by M. Kandzia, B. Gehrke, M. Popp, A. Gizaw, C. Brochmann, M.D. Pirie

Asteraceae
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Campanulaceae

BEAST2 result
treePL result

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Caryophyllaceae
Crassulaceae

BEAST2 result

treePL result

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Gentinaceae

BEAST2 result

treePL result
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Poaceae

BEAST2 result

treePL result

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Primulaceae

BEAST2 result

treePL result
Ranunculaceae

BEAST2 result

treePL result

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