SUPPORTING INFORMATION

Article: **Improving plant functional groups for dynamic models of biodiversity: at the crossroads between functional and community ecology.**

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Fig. S1 Evaluation of the optimal number of groups. The graphs show, for increasing numbers of groups (x-axis), four evaluation statistics, namely the Dunn index (Dunn), the R-squared, the Calinski & Harabasz index (CH) and the mean silhouette width (ASW). Each column corresponds to a dendrogram and the red circles to the chosen number of groups.

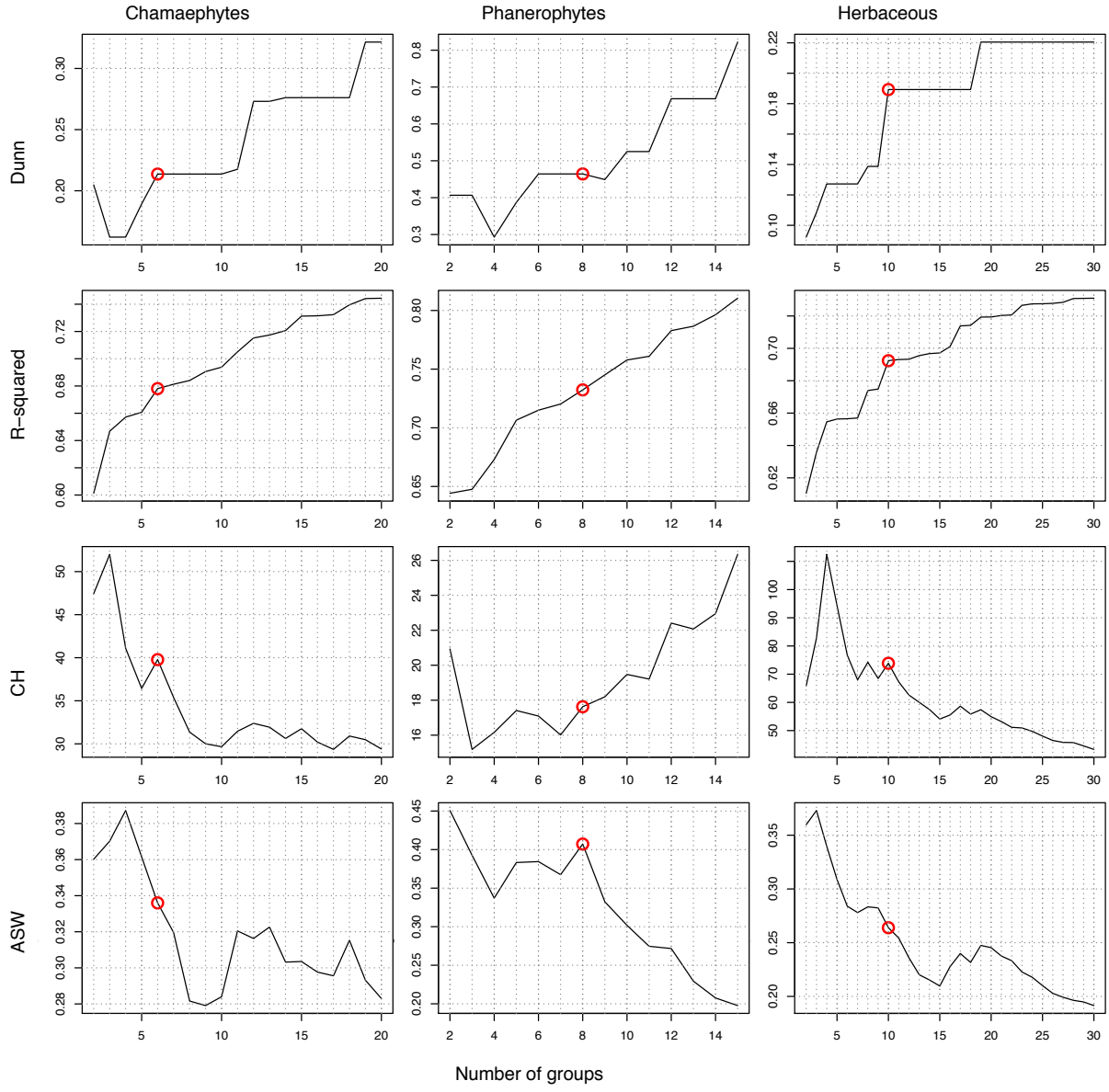


Fig. S2. Effect of removing outlier species. The following graphs represent the distance matrices, through a principal coordinate analysis, for (a) Herbaceous, (b) Chamaephytes and (c) Phanerophytes. On the left-hand side, graphs include all species positions. Dots show outlier species. On the right-hand side, we can see the effect of removing outliers on the spread of each group represented by dashed ellipses (all species) and solid line ellipses (core species). The ellipses include two-thirds of the species.

Fig. S2a

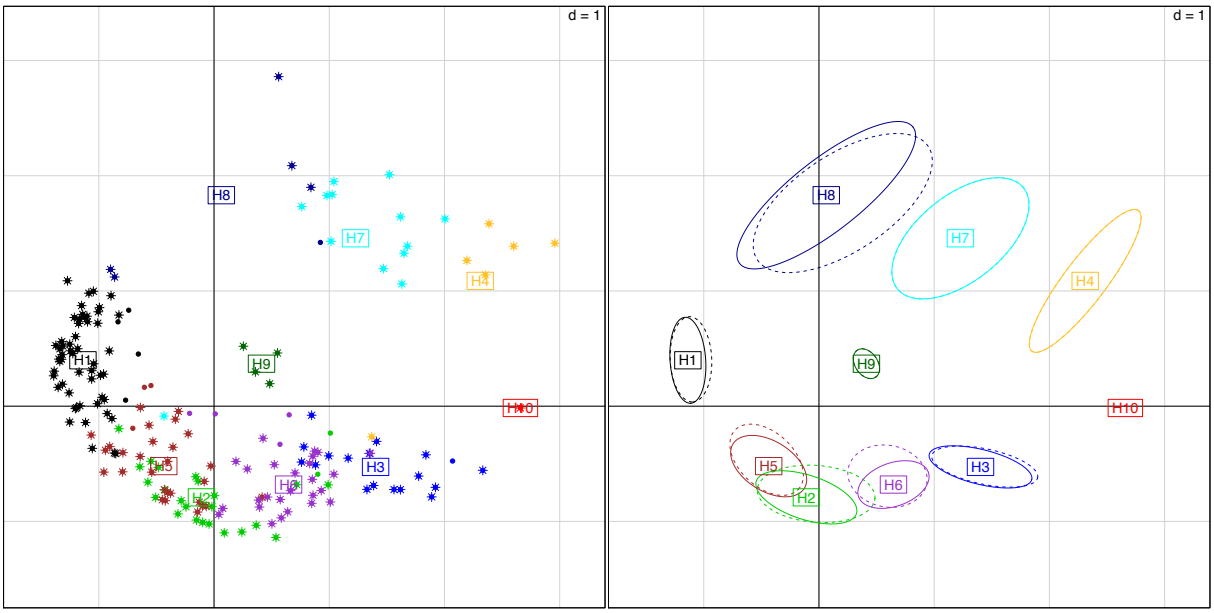


Fig. S2b

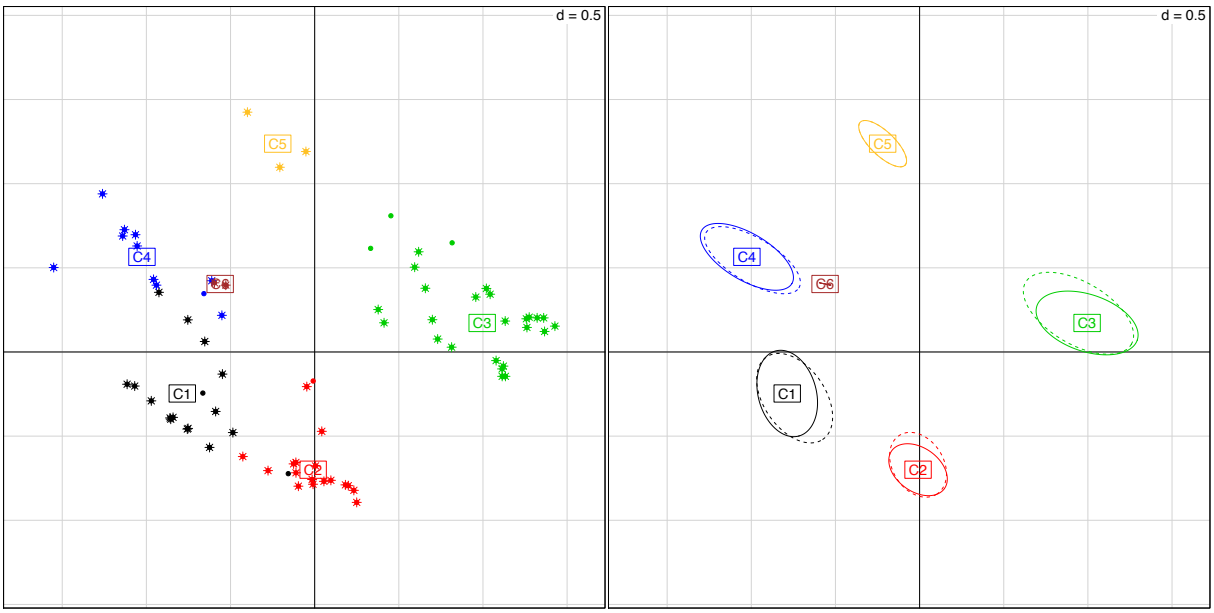
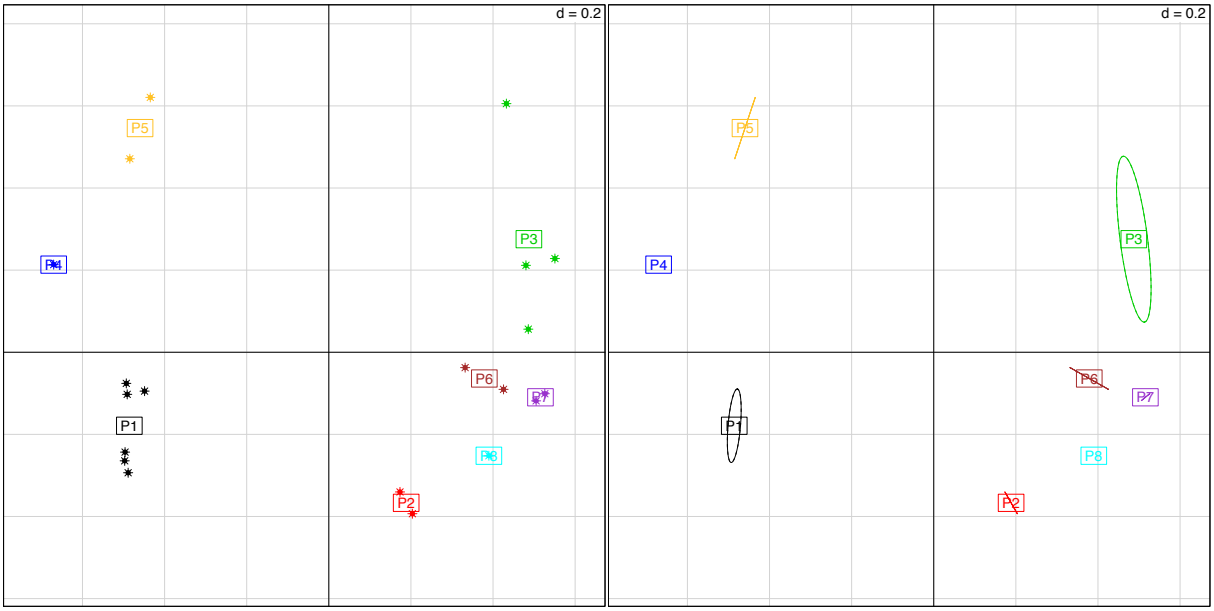


Fig. S2c


d = 0.2
P5
P3
P4
P1
P6
P7
P8
P2
d = 0.2
P5
P3
P4
P1
P6
P7
P8
P2

Tab. S1 Species in each group. The list of species is given for each group. Outlier species have been removed (i.e. with mean distances to other species of the group falling outside of the 95% left-handed confidence interval).

Group	Species list
H1	*Oxyria digyna, Polygonum viviparum, Ranunculus glacialis, Ranunculus kuepferi, Ranunculus montanus, Geum montanum, Geum reptans, Potentilla aurea, Potentilla erecta, Potentilla grandiflora, Saxifraga stellaris robusta, Linaria alpina alpina, Carex capillaris, Carex curvula, Carex foetida, Carex frigida, Carex nigra, Carex panicea, Carex rupestris, Eriophorum latifolium, Eriophorum polystachion, Eriophorum scheuchzeri, Kobresia myosuroides, Trichophorum cespitosum, Juncus alpinoarticulatus alpinoarticulatus, Juncus trifidus, Luzula alpinopilosa, Agrostis alpina, Agrostis rupestris, Alopecurus alpinus, Avenula versicolor versicolor, Festuca halleri halleri, Festuca quadriflora, Phleum alpinum, Poa alpina, Poa cenisia, Poa laxa, Doronicum grandiflorum, Trisetum distichophyllum, Athamanta cretensis, Hieracium glaciale, Leontodon montanus, Leontodon pyrenaicus helveticus, Taraxacum alpinum, Campanula cochleariifolia, Astragalus alpinus, Lotus alpinus, Trifolium alpinum, Trifolium pallescens, Achillea nana, Gentiana punctata, Arnica montana, Epilobium anagallidifolium, Plantago alpina.*
H2	*Rumex acetosa, Rumex pseudalpinus, Fragaria vesca, Galium aparine, Galium verum, Carex caryophyllea, Carex sempervirens, Agrostis capillaris, Agrostis stolonifera, Festuca nigrescens, Sesleria caerulea, Astrantia major, Leucanthemum vulgare, Carum carvi, Meum athamanticum, Chenopodium bonus-henricus, Lathyrus pratensis, Lotus corniculatus, Onobrychis montana, Trifolium montanum, Trifolium pratense, Geranium sylvaticum, Plantago media.*
H3	*Ranunculus acris, Trollius europaeus, Urtica dioica, Aegopodium podagraria, Anthoxanthum odoratum, Arrhenatherum elatius elatius, Dactylis glomerata, Deschampsia cespitosa, Festuca rubra, Crepis pyrenaica, Poa pratensis, Taraxacum officinale, Heracleum sphondylium, Pimpinella major, Trifolium repens, Vicia cracca, Plantago lanceolata.*
H4	*Aconitum lycoctonum vulparia, Aruncus dioicus, Dryopteris dilatata, Dryopteris filix-mas, Athyrium filix-femina, Prenanthes purpurea.*
H5	*Pulsatilla alpina, Ranunculus bulbosus, Anthericum liliago, Luzula sieberi, Achnatherum calamagrostis, Agrostis agrostiflora, Briza media, Bromus erectus, Deschampsia flexuosa, Festuca acuminata, Festuca flavescens, Festuca laevigata, Festuca marginata gallica, Koeleria vallesiana, Phleum alpinum rhaeticum, Stipa eriocaulis eriocaulis, Trisetum flavescens, Leontodon autumnalis, Leontodon hispidus, Tolpis staticifolia, Festuca melanopsis, Hugueninia tanacetifolia, Laserpitium halleri, Laserpitium siler, Silene flos-jovis, Hypericum maculatum, Salvia pratensis, Epilobium dodonaei fleischeri.*
H6	*Ranunculus aduncus, Cacalia alliariae, Saxifraga rotundifolia, Valeriana officinalis, Carex flacca, Cicerbita alpina, Luzula nivea, Avenula pubescens, Brachypodium rupestre, Calamagrostis varia, Festuca altissima, Melica nutans, Milium effusum, Molinia caerulea arundinacea, Poa nemoralis, Hieracium murorum, Hieracium prenanthoides, Senecio ovatus ovatus, Chaerophyllum aureum, Chaerophyllum villarsii, Cardamine pentaphyllos, Laserpitium latifolium, Knautia dipsacifolia, Mercurialis perennis, Gentiana lutea, Epilobium angustifolium.*
H7	*Cacalia alpina, Cryptogramma crispa, Asplenium ramosum, Asplenium septentrionale septentrionale, Asplenium trichomanes quadrivalens, Equisetum arvense, Cystopteris fragilis, Gymnocarpium robertianum, Woodsia alpina, Hieracium pilosella, Homogyne alpina, Petasites albus, Tussilago farfara.*
H8	*Cacalia leucophylla, Cirsium spinosissimum, Omalotheca supina, Murbeckiella pinnatifida pinnatifida, Gentiana alpina.*
H9	*Anthoxanthum odoratum nipponicum, Nardus stricta, Poa supina, Silene vulgaris prostrata.*
H10	*Heracleum sphondylium elegans.*
C1	*Rumex acetosella, Cotoneaster integerrimus, Potentilla neumanniana, Rubus idaeus, Rubus saxatilis, Valeriana montana, Lonicera caerulea, Helianthemum grandiflorum, Helianthemum nummularium, Anthyllis montana, Hippocrepis comosa, Achillea millefolium, Stachys recta, Teucrium chamaedrys, Thymus pulegioides.*
C2	*Rumex scutatus, Salix hastata, Saxifraga aizoides, Saxifraga oppositifolia, Helictotrichon sedenense sedenense, Leucanthemopsis alpina, Cerastium alpinum, Cerastium cerastoides, Cerastium latifolium, Cerastium pedunculatum, Cerastium uniflorum, Sempervivum arachnoideum, Vaccinium*

	uliginosum microphyllum, Antennaria dioica, Thymus polytrichus, Artemisia umbelliformis eriantha, Artemisia umbelliformis umbelliformis.
C3	*Androsace pubescens, Androsace vitaliana, Primula hirsuta, Primula latifolia, Dryas octopetala, Salix herbacea, Salix reticulata, Salix retusa, Saxifraga bryoides, Saxifraga exarata, Eritrichium nanum nanum, Noccaea rotundifolia, Pritzelago alpina alpina, Gypsophila repens, Sagina glabra, Sagina saginoides, Silene acaulis, Silene acaulis bryoides, Sedum album, Sedum alpestre, Sedum dasyphyllum, Empetrum nigrum hermaphroditum, Rhododendron ferrugineum, Globularia cordifolia.*
C4	*Amelanchier ovalis, Crataegus monogyna, Rosa pendulina, Salix laggeri, Juniperus communis, Alnus alnobetula, Lonicera xylosteum, Cornus sanguinea, Corylus avellana, Ribes petraeum.*
C5	*Arctostaphylos uva-ursi crassifolius, Calluna vulgaris, Hippocrepis emerus.*
C6	*Vaccinium myrtillus, Vaccinium vitis-idaea vitis-idaea.*
P1	*Prunus avium, Sorbus aria, Sorbus aucuparia, Sorbus mougeotii, Pinus cembra, Pinus sylvestris.*
P2	*Populus tremula, Salix daphnoides.*
P3	*Tilia platyphyllos, Acer pseudoplatanus Fraxinus excelsior.*
P4	*Larix decidua.*
P5	*Picea abies, Fagus sylvatica.*
P6	*Pinus uncinata, Betula pendula.*
P7	*Acer opalus, Acer campestre campestre.*
P8	*Betula alba.*

Tab. S2. The resulting PFGs and their classification trait values. Trait values were attributed to each group using the mean across species for continuous traits and the majority class for ordinal values, after removing outlier species (i.e. with mean distances to other species of the group falling outside of the 95% left-handed confidence interval). The three life forms classes are P=Phanerophytes, C=Chamaephytes, and H=Herbaceous. There are seven dispersal classes with increasing median distance (Short: 0.1-2m; Medium: 40-100m; Long: 400-500m). Light classes increase with decreasing shade tolerance. Plant height is given in cm. Palatability ranges from 0 (not grazed) to 3 (grazed, with high nutritional value). Habitat represents climatic niche in 4 categories. M=mountainous; MS=mountainous/subalpine; S=subalpine; SA=subalpine/alpine.

Group	Growth form	Dispersal distance	Light preference	Height (cm)	Palatability	Habitat
C1	C	Long (6)	Full light (7)	30	3	MS
C2	C	Medium (4)	Full light (8)	18	3	S
C3	C	Short (1)	Full light (8)	9	0	S
C4	C	Long (6)	Any (6)	208	2	MS
C5	C	Long (6)	Any(6)	63	0	MS
C6	C	Long (7)	Any(6)	18	2	S
H1	H	Short (3)	Full light (8)	18	3	SA
H2	H	Long (6)	Full light (7)	40	3	S
H3	H	Long (7)	Full light (7)	55	3	MS
H4	H	Short (3)	Shade (5)	80	0	MS
H5	H	Short (3)	Full light (7)	41	3	S
H6	H	Short (3)	Any(6)	73	3	MS
H7	H	Medium (5)	Any(6)	18	0	S
H8	H	Short (3)	Full light (8)	19	0	SA
H9	H	Long (7)	Full light (8)	18	3	SA
H10	H	Long (7)	Any(6)	100	3	S
P1	P	Long (6)	Any(6)	1117	2	MS
P2	P	Medium (5)	Any(6)	750	2	MS
P3	P	Medium (4)	Shade (4)	1875	2	MS
P4	P	Long (6)	Full light (7)	2500	0	S
P5	P	Long (6)	Shade (4)	2500	2	M
P6	P	Medium (4)	Full light (8)	1650	2	MS
P7	P	Medium (4)	Shade (5)	600	2	M
P8	P	Medium (4)	Full light (7)	800	2	S

Tab S3. BIOCLIM description of variables. We used 19 BIOCLIM variables to estimate species abiotic niches and to determine the abiotic niche plan where distributions were compared between two species. These variables are derived from the monthly temperature and rainfall values in order to generate more biologically meaningful variables. They represent annual trends (e.g. mean annual temperature, annual precipitation) seasonality (e.g., annual range in temperature and precipitation) and extreme or limiting environmental factors (e.g., temperature of the coldest and warmest month, and precipitation in the wet and dry quarters).

BIO1	Annual Mean Temperature
BIO2	Mean Diurnal Range (Mean of monthly (max temp - min temp))
BIO3	Isothermality (BIO2/BIO7) (* 100)
BIO4	Temperature Seasonality (standard deviation *100)
BIO5	Max Temperature of Warmest Month
BIO6	Min Temperature of Coldest Month
BIO7	Temperature Annual Range (BIO5-BIO6)
BIO8	Mean Temperature of Wettest Quarter
BIO9	Mean Temperature of Driest Quarter
BIO10	Mean Temperature of Warmest Quarter
BIO11	Mean Temperature of Coldest Quarter
BIO12	Annual Precipitation
BIO13	Precipitation of Wettest Month
BIO14	Precipitation of Driest Month
BIO15	Precipitation Seasonality (Coefficient of Variation)
BIO16	Precipitation of Wettest Quarter
BIO17	Precipitation of Driest Quarter
BIO18	Precipitation of Warmest Quarter
BIO19	Precipitation of Coldest Quarter

Tab S4. Databases used for species traits or characteristics. They all form the database ANDROSACE that compiles trait values from field measurements in the study area and other trait databases containing species from the study area.

Databases	**References**
Field measurements	Choler P (2005) Consistent shifts in Alpine plant traits along a mesotopographical gradient. Arctic, Antartic, and Alpine Research, 37, 444-453.
Field measurements	Albert CH, Thuiller W, Yoccoz NG, Soudant A, Boucher F, Saccone P, Lavorel S (2010) Intraspecific functional variability: extent, structure and sources of variation. Journal of Ecology, 98, 604-613.
Field measurements	Lavorel S, Grigulis K, Lamarque P *et al*. (2011) Using plant functional traits to understand the landscape distribution of multiple ecosystem services. Journal of Ecology, 99, 135-147.
VISTA	Garnier E, Lavorel S, Ansquer P *et al.* (2007) Assessing the effects of land-use change on plant traits, communities and ecosystem functioning in grasslands: A standardized methodology and lessons from an application to 11 European sites. Annals of Botany, 99, 967-985.
LEDA	Knevel IC, Bekker RM, Bakker JP, Kleyer M (2003) Life-history traits of the Northwest European flora: the LEDA database. Journal of Vegetation Science, 14, 611-614.
BiolFlor	Kühn I, Durka W, Klotz S (2004) BiolFlor: a new plant-trait database as a tool for plant invasion ecology. Diversity and Distributions, 10, 363-365.
Flora Indicativa	Landolt E, Bäumler B, Erhardt A *et al*. (2010) Flora indicativa. Ecological indicator values and biological attributes of the flora of Switzerland and the Alp, Berne, Haupt Verlag.