nature climate change

LETTERS

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Continent-wide response of mountain vegetation to climate change

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Climate impact studies have indicated ecological fingerprints of recent global warming across a wide range of habitats[1,2]. Although these studies have shown responses from various local case studies, a coherent large-scale account on temperature-driven changes of biotic communities has been lacking[3,4]. Here we use 867 vegetation samples above the treeline from 60 summit sites in all major European mountain systems to show that ongoing climate change gradually transforms mountain plant communities. We provide evidence that the more cold-adapted species decline and the more warm-adapted species increase, a process described here as thermophilization. At the scale of individual mountains this general trend may not be apparent, but at the larger, continental scale we observed a significantly higher abundance of thermophilic species in 2008, compared with 2001. Thermophilization of mountain plant communities mirrors the degree of recent warming and is more pronounced in areas where the temperature increase has been higher. In view of the projected climate change[5,6] the observed transformation suggests a progressive decline of cold mountain habitats and their biota.

The decade 2000–2009 was the warmest since the beginning of global climate measurements[7], surpassing the 1990s, which unveiled ecological responses of many animals and plants[8]. Several of these previous studies were made in mountain areas where an increase in plant species richness has been shown[9–13], and which coincide with projections of distribution models suggesting warming-induced upward range shifts[14–16]. These field studies, however, have been based on incidental historical data from a limited number of sites.

Based on a standardized and multiple-scale dataset for European mountain systems (GLORIA; ref. 17), we test the hypothesis of a synchronous change of plant communities towards a composition and structure that indicates a warming effect. In 2001, at 60 summit sites of different elevations distributed over 17 major European mountain regions, 1 × 1 m permanent plots, arranged in clusters of four quadrats (plot clusters), were established in each cardinal direction (Fig. 1c; ref. 17). In 2001 and 2008, data on species occurrences and cover were collected in the same standardized way. Our dataset comprised 764 vascular plant species (see Supplementary Information).

For detection of a warming effect, here termed thermophilization, we used the indicative value of the species found in a plot. The ecological indicator concept[18] relies on the realized position of a species along an environmental gradient, in our case altitude, which resembles a thermal gradient[19] (Fig. 1a). For some species their optimum performance is found in the treeline ecotone, whereas for others it is in the alpine zone, and in some cases close to the limits of plant life (nival zone; ref. 20; Fig. 1b). According to standard floras, an altitudinal rank was assigned to all recorded species (for details on ranking and effects of misclassifications see Supplementary Section S1 and Methods). For each plot, a composite score (that is, a weighted average[21]) in the following thermic vegetation indicator S was then calculated as

$$S = (\Sigma \text{rank}(\text{species}_i) \times \text{cover}(\text{species}_i)) / \Sigma \text{cover}(\text{species}_i) \qquad (1)$$

To justify the use of S as thermic indicator, we tested its correlation with habitat temperature, expressed by the average June daily minimum temperature ($T_{\min}$), measured in the soil over the years 2001–2007 (Fig. 1d and Supplementary Section S2).

Differences of the thermic vegetation indicator S between 2001 and 2008 were used to quantify transformations of the plant communities, and termed thermophilization indicator D hereafter ($D = S_{2008} - S_{2001}$).

This transformation is driven by species cover changes within the plot and by immigration or disappearance of species. Positive differences (thermophilization) may result from increased cover and/or immigration of species with a higher rank (that is, of lower elevational ranges (thermophilic)) and/or the decline or loss of species of lower ranks (that is, higher elevational ranges (cryophilic)). Alpine plants are long-lived[22] and internal processes in alpine plant communities work at a slow rate[23], thus it can be assumed that species cover does not vary much from year to year but shows a clear trend with increasing time intervals. Applying mixed-effects models, differences D were calculated at the continental scale as well as for each region and each summit. To interpret D in terms of climate change we used $T_{\min}$ in June from gridded European temperature data at a resolution of 0.25° (E-OBS data[24]). As the climatic conditions during the preceding years of a survey (termed here as prior periods) are expected to

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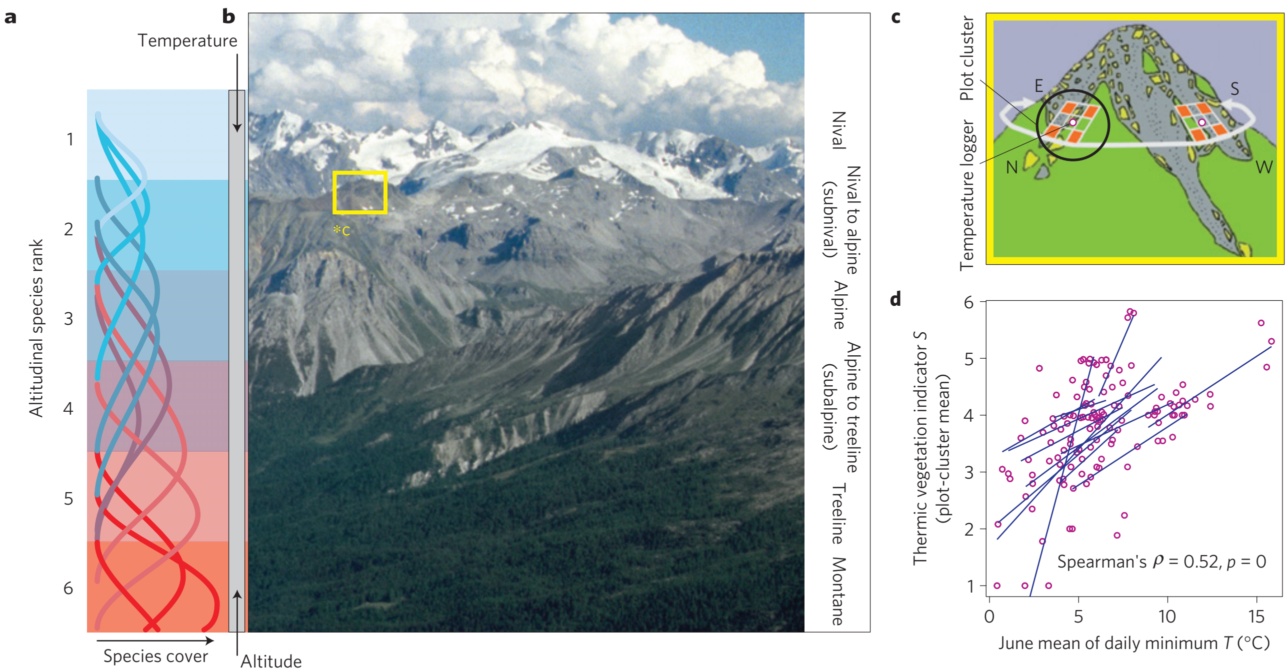

Figure 1 | Plant species distribution and vegetation patterns in mountains. **a**, Mountain plant species (symbolized as curves) are distributed along altitudinal gradients. The amplitudes of the curves reflect varying species abundances, which generally decrease towards higher elevations. To each studied species, an altitudinal indicator value was assigned using six ranks (1–6, blue to red). **b**, Species constitute vegetation patterns that form bioclimatic belts; example from the European Alps. In each of these belts, monitoring plots were installed in a hierarchical scheme: in 17 European mountain regions, four summits (one of them exemplified by the yellow rectangle in **b**) spanning the gradient from the region's treeline to its altitudinal limit were selected. **c**, On each summit's four cardinal directions (east, south, west and north), a cluster of four 1 × 1 m monitoring plots was installed. For each plot, a vegetation score *S* was calculated as the average of the altitudinal ranks of the contributing species, weighted by their respective cover (see equation (1)). Soil temperature was measured hourly in the centre of each plot-cluster over the years 2001–2007. **d**, The vegetation score *S*, calculated for 2008 and averaged for each cardinal direction's plot cluster, is correlated with soil temperature. It is therefore coined as the thermic vegetation indicator *S*. Circles, pooled data of plot clusters from several mountain regions. Blue lines, linear regressions of *S* from particular mountain regions on June mean of daily minimum temperature.

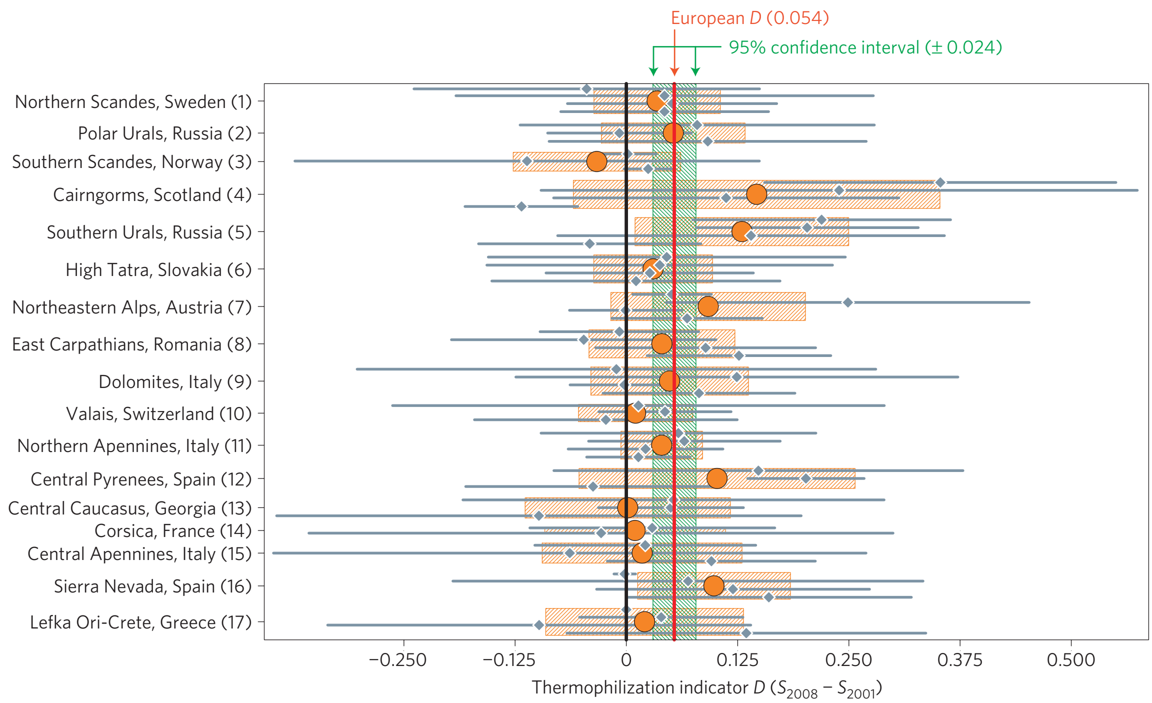

Figure 2 | The thermophilization indicator *D* is significantly positive on the European level. Diamonds and horizontal lines, *D* and 95% confidence intervals for the summits. Orange dots and horizontal bars, *D* and 95% confidence intervals for the mountain regions. The bar thickness refers to the number of summits in each mountain region (mostly four; three in Polar Urals, Southern Scandes, Valais, Central Pyrenees, Central Caucasus, Central Apennines; two in Corsica). Red line and green shading, European *D* and its 95% confidence interval. Black line, reference line at $D = 0$. Mountain regions are ordered from north to south (top to bottom), summits within regions from highest to lowest summit.

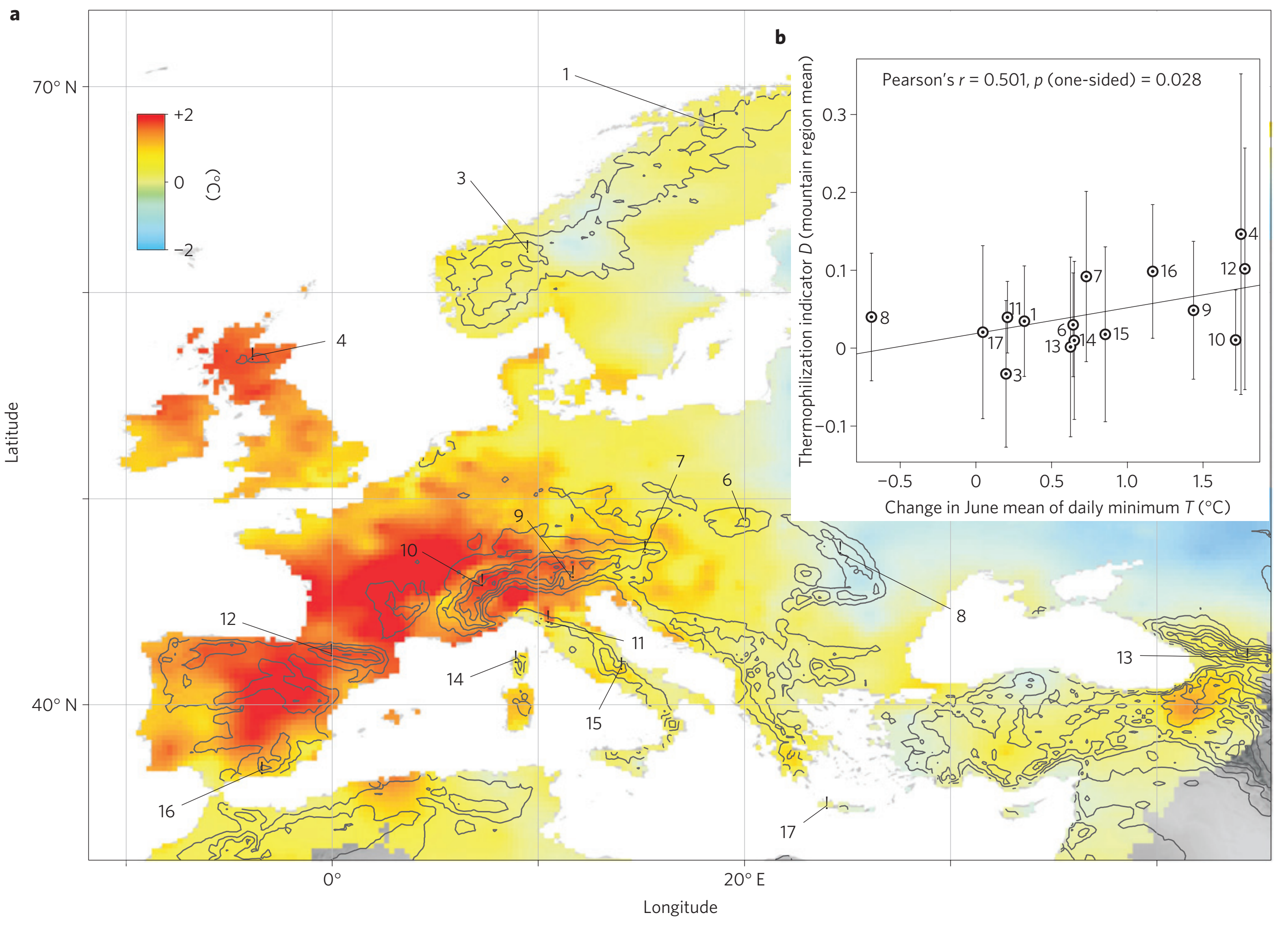

Figure 3 | The thermophilization indicator *D* of mountain regions is correlated with temperature change. a, Change in June mean of daily minimum temperature (map prepared from data provided by E-OBS; ref. 24, resolution 0.25°), calculated as the difference of the averages of two time periods that precede plant data recording: prior 2008 (2003–2007)–prior 2001 (1996–2000). The numbers indicate the mountain regions and are referenced in Fig. 2. No temperature data are available for the Polar Urals and Southern Urals (2 and 5 in Fig. 2). **b**, Correlation of *D* with the change in June mean of daily minimum temperature (prior 2008–prior 2001) in the study regions (data derived from the map in **a**), using a one-sided test following the null hypothesis of no positive correlation. Vertical lines are 95% confidence intervals of *D* for the mountain regions and a linear regression line is shown.

have long-lasting effects, we applied average values for the period 1996–2000 (prior 2001) and the period 2003–2007 (prior 2008). The usefulness of T_{min} in June and the choice of time spans of the prior periods were tested with our data and found acceptable (Supplementary Sections S2 and S5).

At the continental scale, the thermophilization indicator D was highly significantly positive ($D = 0.054$, $p < 0.0001$; Fig. 2). Sixteen of the 17 regions and 42 of the 60 summits had a positive D. The total variance in D resulted primarily from the among-plot differences (75%) and less so from nesting at larger spatial levels: 19% from cardinal directions, 6% from summits, and only 0.002% of the variance of D derived from differences between the mountain regions (for details see Methods and Supplementary Section S3). D was quite insensitive to possible misclassifications in the species' altitudinal ranks; the European D remained significantly positive up to a simulated misclassification rate of around 40% of the originally applied ranks. Neither the latitude of regions nor the elevation of summits had a significant effect on D (Supplementary Section S3).

The magnitude of D of the mountain regions reflects the pattern of the regional European climate development in the past decade and a half, that is, between prior 2001 and prior 2008. With an overall warming trend on the continental level[7] and an average increase of 0.76 °C in our study regions, June T_{min} changed differently in different mountain regions (Fig. 3a). The thermophilization indicator D was significantly correlated with these regional climatic trends (Fig. 3b).

The transformation of plant communities on a continental scale within less than a decade can be considered a rapid ecosystem response to ongoing climate warming. Although the signal is not statistically significant for single mountain regions, it is clearly significant when data throughout Europe are pooled. This signal is expected to have a number of important implications. Biotic interactions were suggested to shift along abiotic stress gradients from mutualistic interactions under physically harsh conditions to more competitive interactions under less harsh conditions[25]. Thus, climate warming exposes short-stature, light-demanding and slow-growing cold-adapted alpine plant species to enhanced competition. A temperature-governed change of plant communities may lead to declines or even local disappearance of alpine plant species. In fact, declines of extreme high-altitude species at their lower range margins have recently been observed in the Alps[12].

For Europe, approximately 2,500 vascular plant species (or approximately 20% of the continent's native vascular flora) were estimated to be centred in the alpine zone from the treeline ecotone to the highest mountain summits[26]. This zone comprises only 3% of the terrestrial area of Europe and, hence, limited space would be available for future alpine habitats in warmer climates. A thermophilization of $D = 1$ would relate to a shift in the magnitude of one vegetation belt (see Supplementary Section S1) according to our altitudinal rank definitions. This would theoretically imply that, for example, habitats of open and scattered subnival plant communities would be colonized by species of alpine grasslands. On the European level, we observed a transformation in the magnitude of about 5% of one vegetation belt after only seven years. Although a strong heterogeneity in microclimatic patterns[27] and a large vertical extension of mountains may provide local refugia[14,28], our results indicate a progressive shrinking of the low-temperature, high-elevation habitats, including parts of the Alps and Mediterranean mountains, where many locally restricted species live[29,30].

Methods

Field recording. Species percentage cover was visually estimated as a percentage of the permanent plot with the aid of transparent templates. In each plot cluster, a temperature logger (Onset Stowaway Tidbit) was buried at 10 cm substrate depth. A total of 131 loggers yielded complete temperature series (2001–2007) and was entered for the analysis shown in Fig. 1d.

Mixed-effects models. To calculate D at the European level we applied a mixed-effects model with an intercept as fixed effect and plots, grouped in clusters arranged in the cardinal directions (further grouped into summits and mountain regions), as random effects using restricted maximum likelihood estimation. D on lower nesting levels was calculated by fitting separate models with a similar but lower nesting structure. As fitting routine we used lme() from S-PLUS (TIBCO Spotfire S+ 8.1 for Windows). The function intervals() was applied to calculate confidence intervals for D (Supplementary Section S3).

Sensitivities to errors in species rank classification and cover estimation. To assess the sensitivity of D to the applied altitudinal classification scheme of the species, we randomly perturbed the originally assigned ranks with normally distributed errors with increasing standard deviation and rounded the perturbed ranks to the nearest integer on our scale. For each standard deviation, we simulated 1,000 sets of perturbed ranks and computed the effect on D as well as the misclassification rate, averaged over the sets (Supplementary Section S1).

Visual cover estimation includes two error components: a systematic error that varies between different observers; and a random error that an observer makes from one estimate to the next. The random component is dealt with appropriately by our model. Using a pilot study we estimated the influence of the systematic error to account for only approximately 4% of the total error in cover estimation and therefore decided not to model this negligible variance component (Supplementary Section S4).

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Author contributions

G.G., H.P. and M.G. coordinated the monitoring program, performed field work and wrote the text. M.G. and H.P. conceived the study and compiled data, and M.G. and A.F. performed the statistical analyses. All other authors organized and performed field work as well as data compilation, and edited the manuscript.

Additional information

The authors declare no competing financial interests. Supplementary information accompanies this paper on www.nature.com/natureclimatechange. Reprints and permissions information is available online at http://www.nature.com/reprints. Correspondence and requests for materials should be addressed to H.P.

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SUPPLEMENTARY INFORMATION

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SECTION 1 Altitudinal species ranks

1A Nomenclature

Species names follow Flora Europaea[31].

1B Ranking procedure

For each species, its lower and upper distribution margin and its distribution centre were derived from standard floras (Supplementary Table 1; this table provides also abbreviations for mountain regions as used in this Supplementary Information).
These altitudinal profiles were defined using the classical central European concept of vegetation belts (colline, montane, subalpine or treeline, alpine, nival) for the altitudinal distribution of life zones (see ref. 18 in the main text). They were then transformed into 6 altitudinal ranks (Supplementary Table 2) as follows:
Rank 1: species with nival distribution centre;
Rank 2: alpine to nival species that do not descend to the treeline;
Rank 3: alpine centred species which do not descend to the montane belt;
Rank 4: alpine centred species that descend to the montane belt; and species indifferently distributed from the treeline to the alpine; additionally, few treeline/indifferent/nival species from Caucasus, where the upper limit as stated in the literature appeared to be overestimated according to the authors' expert judgement;
Rank 5: species centred in the treeline ecotone or indifferently distributed from the montane to the alpine belts;
Rank 6: species which are montane-centered or indifferently distributed from the montane belt to the treeline.

764 species were classified in this manner before running the analysis. They are listed, together with their altitudinal profiles and ranks, in Appendix I.

Supplementary Table 1 | Abbreviations for mountain systems and references to standard floras used for the altitudinal species ranking.

Mountain system	Abbreviation in Supplementary Information	Number in Figure 2 and 3 of the main text	Reference to standard flora
Northern Scandes/Sweden	SELAT	1	32
Polar Urals/Russia	RUPUR	2	33,34
Southern Scandes/Norway	NODOV	3	32
Cairngorms/Scotland	UKCAI	4	32
Southern Urals/Russia	RUSUR	5	33,34
High Tatra/Slovakia	SKCTA	6	35
Northeastern Alps/Austria	ATHSW	7	36,37
E. Carpathians/Romania	ROCRO	8	38
Dolomites/Italy	ITADO	9	36,37
Valais/Switzerland	CHVAL	10	36,37
Northern Apennines/Italy	ITNAP	11	39,40
Central Pyrenees/Spain	ESCPY	12	41
Central Caucasus/Georgia	GECAK	13	42
Corsica/France	FRCRI	14	43,44
Central Apennines/Italy	ITCAM	15	40,45
Sierra Nevada/Spain	ESSNE	16	46,47
Lefka Ori-Crete/Greece	GRLEO	17	48

Supplementary Table 2 | Altitudinal profiles and assigned altitudinal species ranks.

Altitudinal distribution (lower margin / centre / upper margin)	n of species	Altitudinal species rank	Name of rank; total species in rank
nival / nival / nival	1	1	nival; 17
alpine / nival / nival	16	1	
alpine / alpine / nival	56	2	alpine to nival; 57
alpine / indifferent / nival	1	2	
alpine / alpine / alpine	60	3	alpine; 178
treeline / alpine / nival	25	3	
treeline / alpine / alpine	93	3	
montane / alpine / nival	13	4	treeline to alpine; 216
montane / alpine / alpine	40	4	
treeline / indifferent / nival	7	4	
treeline / indifferent / alpine	156	4	
treeline / treeline / nival	2	5	treeline; 205
treeline / treeline / alpine	58	5	
treeline / treeline / treeline	5	5	
montane / treeline / nival	1	5	
montane / treeline / alpine	56	5	
montane / indifferent / alpine	73	5	
montane / treeline / treeline	10	5	
montane / montane / alpine	24	6	montane; 91
montane / indifferent / treeline	32	6	
montane / montane / treeline	30	6	
montane / montane / montane	5	6	

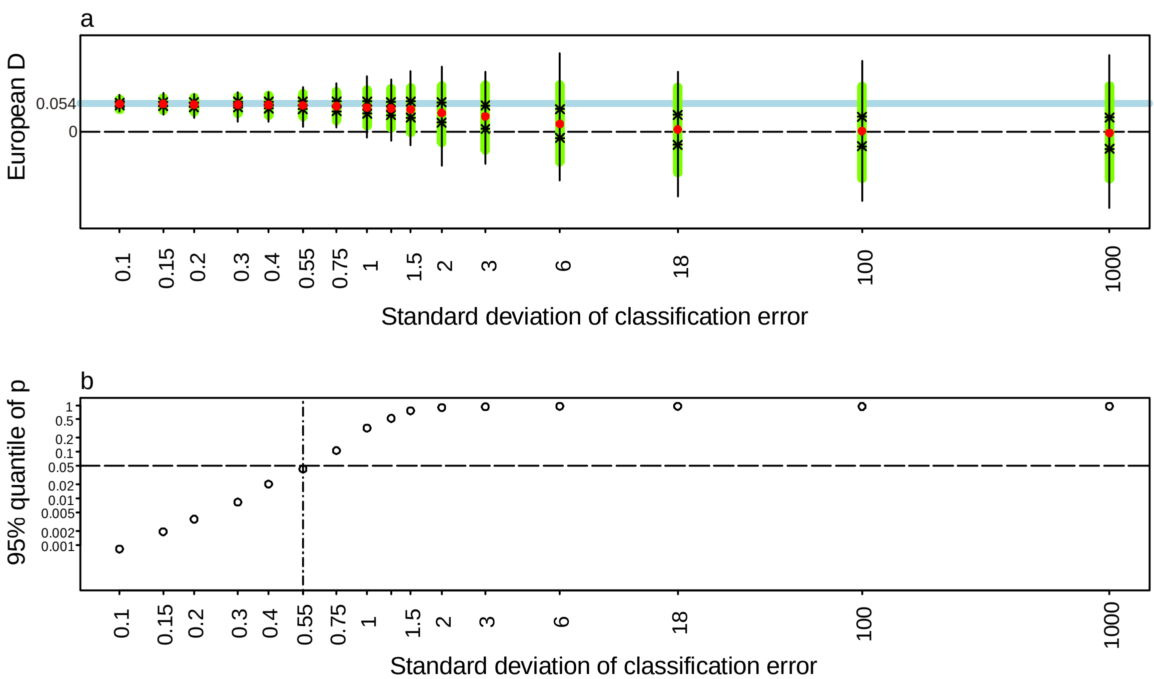
1C Sensitivity of *D* to the applied altitudinal classification scheme

A closer look at the thermic vegetation indicator *S* reveals that the influence of any given species on the indicator depends on its altitudinal rank. As shown in Supplementary Table 2, this rank provides us with a range position along the altitudinal gradient at which a given plant species has its ecological optimum. Since an incorrect rank may have been assigned to some of the species, it is of interest to investigate the influence of such an incorrect assignment on *D*, i.e., the change in the thermic vegetation indicator *S*. As an example, suppose that the thermic vegetation indicator *S* of a plot changes from 3.2 to 3.5 between two recording times. Suppose furthermore that this has been mostly caused by a species with altitudinal rank 4 whose cover increased considerably over time. If the rank for this species has been chosen inappropriately and the true rank should be 3, the vegetation indicator should actually have decreased instead of increased between the recording times. If on the other hand the true rank were 5, an even larger increase in *S* would have been observed. Thus our results would not be very robust, if the observed changes in scores were supported only by few species on few summits. On the other hand, the more summits and species support the changes, the more stable the results should be.

To further investigate the amount of robustness of our thermic vegetation indicator *S* (and its change *D*) with respect to misspecified altitudinal ranks, we consider the following probabilistic model: Consider a (possibly unknown) abundance density that gives the relative abundance of a species at different altitudes. To obtain the altitudinal rank, the researcher tries to identify the altitudinal range where this density attains its mode, i.e. its highest value. By mistake, an incorrect value for the mode may be chosen which in turn may lead to an incorrect altitudinal rank *r*. The mode assumed by the investigator is modeled by assigning a uniformly distributed mode position $m = r + U$ within the range $[r - 1/2, r + 1/2]$ implied by the altitudinal rank. To this position m, we add a normally $N(0, \sigma^2)$ distributed disturbance Z representing the distance between the true and the assumed mode of the abundance density. For the resulting disturbed position $m + Z$, a disturbed altitudinal rank $r(m + Z)$ is computed by rounding to the nearest rank. Subsequently the thermic vegetation indicator S is recomputed based on the disturbed ranks. As the true disturbances are unknown, the computations are repeated many times to get an estimate of the variability induced by using inaccurate altitudinal ranks. The robustness of our results can now be explored by considering several error variances σ^2 and checking up to which variance the results remains stable. Our particular interest is in finding out how inaccurate the altitudinal ranks can be, for the changes in S between the observational periods (i.e., D) to remain statistically significant. Simulations according to the above described probabilistic model gave the following results:

Starting at the original result of 0.054, D approaches zero with increasing disturbance variance (Supplementary Fig. 1a). Up to an amount of classification errors introduced by disturbances with a standard deviation $\sigma = 0.55$ ranks, 95% of the p-values (of 1000 permutation runs per data point in Supplementary Fig. 1b) remain below 0.05. This level of disturbance corresponds to the following average percentages (averaged over 1000 runs) of misclassified species: -3 | 0.13%; -2 | 0.67%; -1 | 20.1%; 0 | 60.6%; 1 | 18.2%; 2 | 0.48%; 3 | 0.13% (notation: distance to original rank | % of misclassified species within the 764 considered species). In other words, D has a 95% chance to remain significantly positive, even if the correct altitudinal rank has been assigned to only c. 60% of the species.

The focus of this sensitivity analysis has been on the misclassification of species within our proposed classification scheme and the originally applied altitudinal species ranks with the majority of species assigned to the middle ranks. Notice that we did not investigate the influence of considerably different classification schemes on our results, such as a scheme, where the species are distributed equally among the altitudinal ranks.

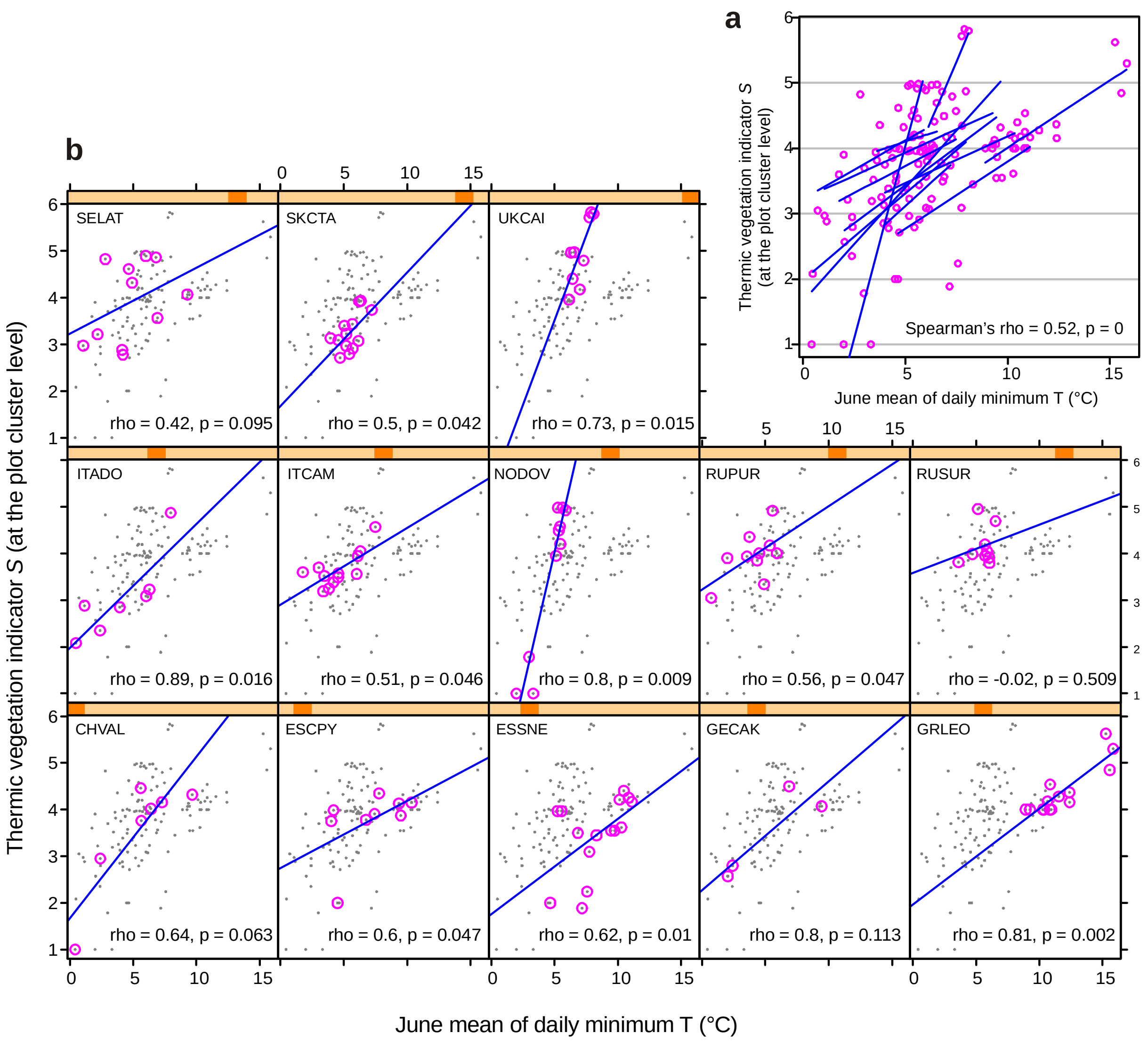


Supplementary Figure 1 | Sensitivity of the European *D* to the applied altitudinal rank classification scheme. **a**, European *D* at increasing simulated rates of misclassification. Points, median, stars, 1st and 3rd quartile, green bars, 95%-range, black lines, full range of *D* simulated in 1000 runs per step on the abscissa. **b**, distribution of p for *D* in the respective 1000 runs. See also the Methods Summary of the main text.

SECTION 2 Correlation of the thermic vegetation indicator *S* with locally measured temperatures

2A Correlation in particular mountain systems

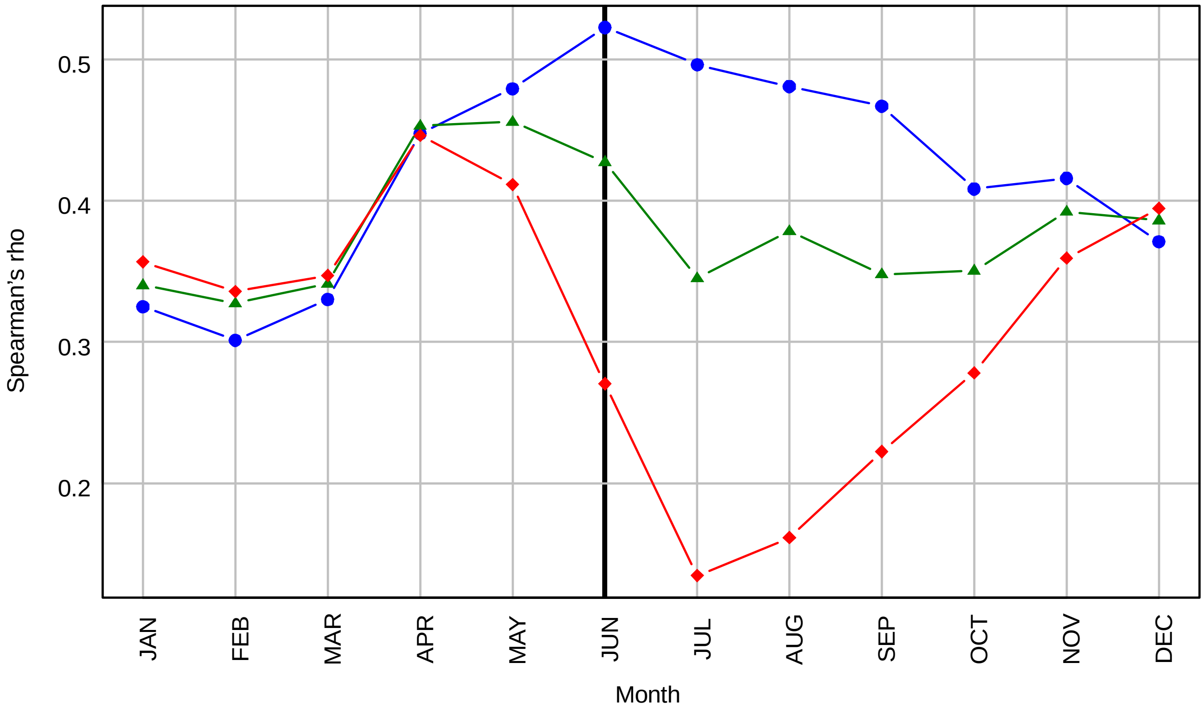
The relationships between the thermic vegetation indicator S and the measured soil T in the analysed European mountain regions are similar but not the same. *S* is indeed related to temperature in all regions but with different slopes, intercepts and strengths of correlation. There are, however, only two regions (UKCAI, NODOV) with regression slopes which are strongly different from the others (Supplementary Fig. 2). Only temperature loggers which did not fail in any June between 2001 and 2007 are included here (n = 131).



Supplementary Figure 2 | Correlation of the thermic vegetation indicator *S* with habitat temperature in particular mountain regions. a, All mountain regions pooled (redrawn from main text, for comparison to b). **b**, Particular mountain regions. Circles, values from the respective region. Grey points, pooled values of all regions. Lines, linear regressions. Spearman's correlation rho and the one-sided p are shown (we test the null hypothesis of no positive correlation). Four of the 17 regions in the dataset are not included here because the number of valid data points was too low due to failure of temperature loggers. For abbreviations of regions' names see Supplementary Tab. 1.

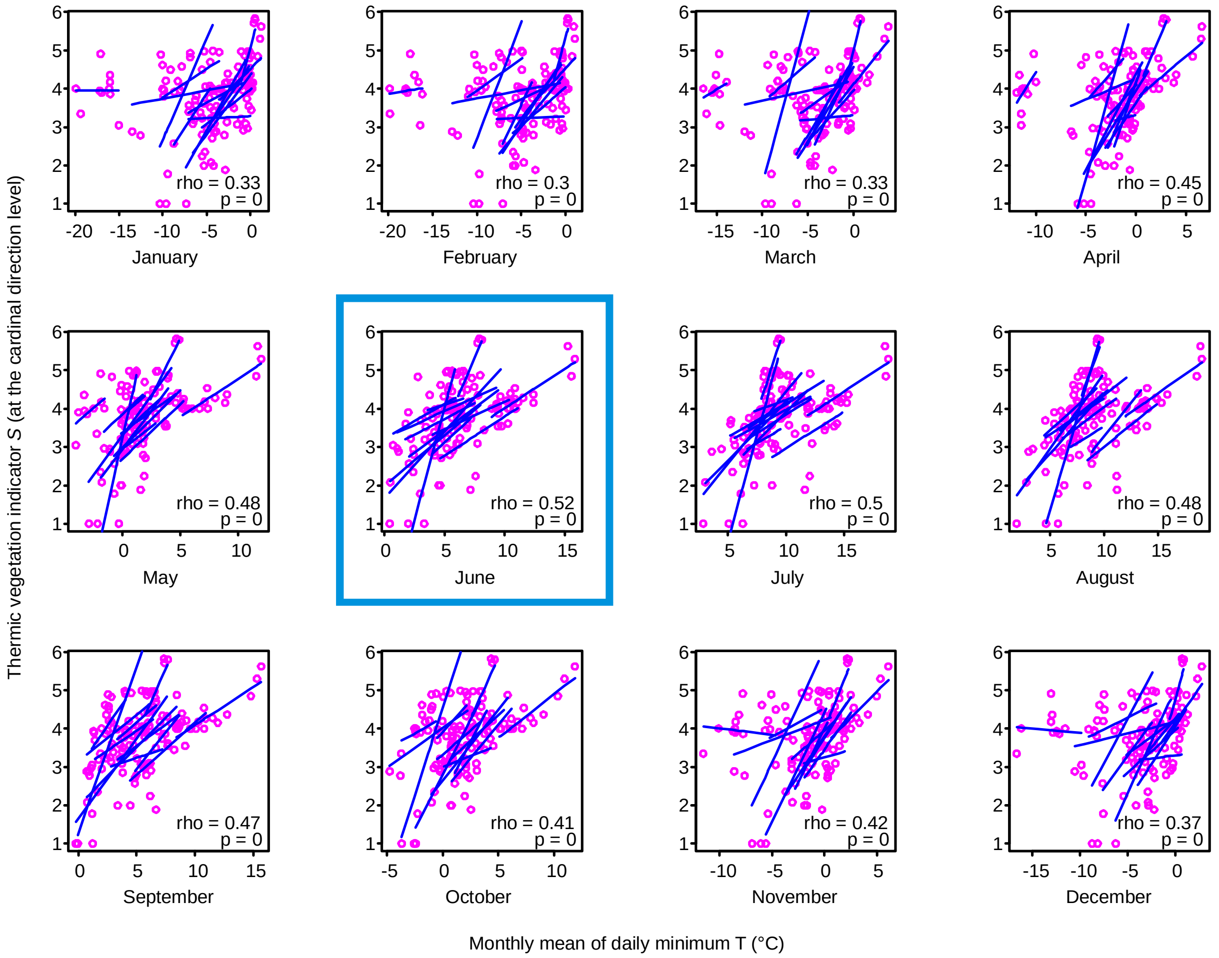
2B Why June minimum temperatures?

We tested, using our field vegetation and temperature data, the correlation of S_{2008} and temperature (T), averaged over 2001-2007, for each month of the year, and for mean of daily minimum (T_{min}), maximum (T_{max}), and mean temperature (T_{mean}) as well. The results are summarized in Supplementary Fig. 3. Using T_{min} of June showed the best correlation. We interpret this as follows: i) It is the temperature in the first part of the growing period which is most decisive for plant growth[49, and see ref. 23 (p.221-226), in the main text]. ii) Though temperature was measured in 10cm soil depth, these measurements still include some error due to insolation during daytime, whereas they are buffered against insolation effects at night. Note that the values for T_{min}, T_{mean} and T_{max} are quite similar from November to May. Under snow protection there is only little diurnal oscillation of T, therefore, daily maxima and minima are not much different.



Supplemetary Figure 3 | Correlation of *S_{2008}* with temperature (mean 2001-2007) using different climate predictors. Temperatures were calculated as mean of each month by using daily minima (T_{min}, blue circles), means (T_{mean}, green triangles), or maxima (T_{max}, red diamonds).

Further, we inspected the patterns of the pooled data (compare Figure 1d in the main text and Supplementary Fig. 2a), using T_{min} but calculated for each month of the year (Supplementary Fig. 4). In June the pattern is most consistent as compared to all other months. We are aware that it is certainly not exactly the time span of the calendar month June which is the crucial environmental factor in all the European mountain systems, from the Subarctic to the Mediterranean. Rather it is the temperature regime in the first part of the growing season; this period may differ somewhat from region to region. We derived from the T data measured in field, however, that June was the first month in almost all years where all studied plots were free of snow (data not shown). We conclude from the literature and from the evidence in our data as shown in Supplementary Figs. 3 and 4 that using June minimum temperatures is the best choice for a joint analysis throughout these mountain systems.



Supplemetary Figure 4 | Correlation of *S* with T_{min} for each month of the year. Circles, pooled data of plot-clusters from several mountain regions. Blue lines, linear regressions of *S* from particular mountain regions on temperature T_{min}. Spearman's correlation rho and the one-sided p is drawn (we test the null hypothesis of no positive correlation); $p < 0.001$ in all months. June T_{min} shows the most consistent pattern.

SECTION 3 Models for *D*

3A Final model for *D*

We fit a hierarchical linear mixed effects model for the changes *D* in the thermic vegetation indicator *S* (see Eq. 1 and 2 in the main text). To set up the model, consider *n* mountain regions. Mountain region *i* consists of n_i summits, numbered $1 \leq j \leq n_i$. Usually $n_i = 4$. Any summit can be split into four cardinal directions $1 \leq k \leq 4$, and there are four recording plots $1 \leq l \leq 4$ for each cardinal direction. Together this leads to D_{ijkl} for the *S* difference of plot *l* within cardinal direction *k* which is on summit *j* within mountain region *i*.

Our model is

$$D_{ijkl} = \alpha + \beta_i + \gamma_{ij} + \delta_{ijk} + \varepsilon_{ijkl}. \qquad \text{(Supplementary Eq. 1)}$$

The most important quantity in our model is the coefficient α since it measures the overall average change in the plot *S*. The other terms are for the random effects and errors: Indeed, β_i indicates the target region specific random deviation from the overall average α. Furthermore the coefficients γ_{ij} represent the summit specific fluctuations within the target regions, while δ_{ijk} are for the cardinal direction specific fluctuation. Finally ε_{ijkl} includes both random fluctuation and measurement error within a local aspect. The variances of the random effects and the error terms ε_{ijkl} are of interest, since the variance terms tell us how much fluctuation there is at the respective levels of hierarchy. We used the S-Plus procedure lme to estimate the model and obtained the following estimates: $\hat{\alpha} = 0.054$. The standard deviation of the β_i was estimated to be $\hat{\sigma}_\beta = 0.00092$. That of the γ_{ij} has been $\hat{\sigma}_\gamma = 0.0564$, and that of the δ_{ijk} has been $\hat{\sigma}_\delta = 0.1037$. The largest component of variance has been the residual standard deviation $\sigma_\varepsilon = 0.2045$.

3B Other effects on *D*

We now investigate whether the changes in *S* (measured by the differences *D*) depend on the altitude of the summit and the latitude of the target region. For this, we added fixed effects for the latitude and the altitude and estimated the following mixed model:

$$D_{ijkl} = \alpha + \beta_i + \gamma_{ij} + \delta_{ijk} + \eta \mathrm{LAT}_i + \nu \mathrm{ALT}_{ij} + \varepsilon_{ijkl}. \qquad \text{(Supplementary Eq. 2)}$$

Here η is the fixed effect of the latitude LAT_i of target region *i* and ν the fixed effect of the altitude ALT_{ij} of summit *j* within target region *i*. The other notation is as in Suppl. Eq. 1. It turns out that neither the latitude (p-value 0.827) nor the altitude (0.649) contributes significantly to the explanation of *D*. The picture remains the same, if the altitude in meters is replaced by dummy variables that indicate whether a summit is highest, second highest (and so on) within its target region. None of the three dummy variables needed to code the relative position of a summit led to a significant p-value (the p-values were 0.149, 0.26, 0.143 respectively.). Further, an ANOVA between the models with and without altitude and latitude led to no significant difference (at alpha = 0.05) in explanatory power. Finally, the model selection criteria AIC and BIC showed better values for the model without the additional variables.

SECTION 4 Observer errors in visual cover estimates

In this section, we investigate the influence of observer errors on our scores *S*. We want to point out that our score *S* will remain unchanged, if an observer over- or underestimates cover by the same relative amount for all recorded species. We call such a type of error a *systematic observer error*. Besides systematic observer errors, there are *random observer errors*, fluctuating from measurement to measurement. In Section 4A, we explore further the issue of systematic observer errors. There, we transform the cover estimates from a pilot study such that the estimation errors become close to normally distributed. Within this normal model, we provide a decomposition of the observer errors into a random and a systematic component, and it turns out that random observer errors dominate.

4A Systematic and random observer errors

For a more detailed analysis of the relative contributions of random and systematic observer errors to the measurements of species cover, we rely on a pilot study carried out in the two target regions ATHSW and SKCTA. In this investigation, 1x1 m plots have been parallel recorded independently by usually 14 different observers, and with the same recording method as for the study presented in the main text. The goal has been to split the observer errors into two components: a) *random observer error;* this is the error an observer makes, randomly, from one estimate to the next; b) and *systematic observer error;* this is the error component which is systematic, i.e., invariant within an observer but varies between observers, e.g., if a given observer notoriously over-, or under-estimates species cover.

For this purpose, we checked that the variation due to observer errors of the complementary log-log transformed cover log(−log(cover)) can be modelled by a normal distribution. Let

$$Y_{lmo} = \log(-\log(\text{cover}_{lmo})) \qquad \text{(Supplementary Eq. 3)}$$

denote the transformed cover estimate in plot l for species m by observer o. We set

$$Y_{lmo} = \mu_{lm} + \gamma_o + \varepsilon_{lmo}, \qquad \text{(Supplementary Eq. 4)}$$

where μ_{lm} denotes the true log−log cover for species m in plot l, γ_o denotes the systematic error for observer o, and ε_{lmo} denotes random independent identically distributed observer errors. We used a linear mixed model to estimate the variances of γ_o and ε_{lmo} and it turned out that the estimate s_o^2 for Var(ε_{lmo}) is much larger (96%) than that of Var(γ_o) (4%). We thus decided to neglect systematic observer errors in our analyses as presented in the main text.

4B Observer error component in the residual variance at the plot-cluster level

We then focused on the Europe-wide analysis that we present here and used the information obtained from the pilot study to investigate how much of the residual variation at the plot-cluster (i.e., cardinal direction) level can be attributed to observer errors. Our results are therefore based on the assumption that the distribution of observer errors in the pilot study provides a good proxy for the subsequent investigation. In more detail, we simulated random observer errors for the complementary log-log covers of all species occurring within a plot according to a normal $N(0, s_o^2)$ distribution with s_o^2 being the random observer variance estimated from our pilot study. These errors were added to the actually observed covers and a new plot score $S_{ijkl}^{*(yr)}$ was computed using the randomly disturbed covers. Here (yr) denotes the observation year, i the target region, j the summit, k the plot-cluster, and l the plot within its cluster. The differences

$$u_{ijkl}^{(yr)} := S_{ijkl}^{*(yr)} - S_{ijkl}^{(yr)} \qquad \text{(Supplementary Eq. 5)}$$

provide the effect of the observer errors on the plot scores. We next remove the residual fluctuation at the plot-cluster level by computing the average plot scores over the four quadrats of each cluster

$$\bar{S}_{ijk}^{(yr)} = \frac{1}{4}\sum_{l=1}^{4} S_{ijkl}^{(yr)}. \qquad \text{(Supplementary Eq. 6)}$$

Simulated plot scores that include only random observer errors but no further residual fluctuation, can then be obtained as

$$S_{ijkl}^{**(yr)} = \bar{S}_{ijk}^{(yr)} + u_{ijkl}^{(yr)}. \qquad \text{(Supplementary Eq. 7)}$$

We now estimate a mixed model for the change in the plot scores that is based on the simulated differences

$$D_{ijkl}^{**} = S_{ijkl}^{**(yr1)} - S_{ijkl}^{**(yr0)} \qquad \text{(Supplementary Eq. 8)}$$

and obtain the residual variance $(s_e^{**})^2$. We repeat this process over 1000 independent simulation runs and obtain the average residual variance

$$\overline{s_e^{**}}^2 := \frac{1}{1000}\sum_{j=1}^{1000}(s_e^{**})_j^2.$$

(Supplementary Eq. 9)

We then compare $\overline{s_e^{**}}^2$ which is obtained under a model where observer errors are the only source of residual fluctuation with the residual variance s_e^2 from the model based on the actually observed score differences

$$D_{ijkl} = S_{ijkl}^{(yr1)} - S_{ijkl}^{(yr0)}.$$

(Supplementary Eq. 10)

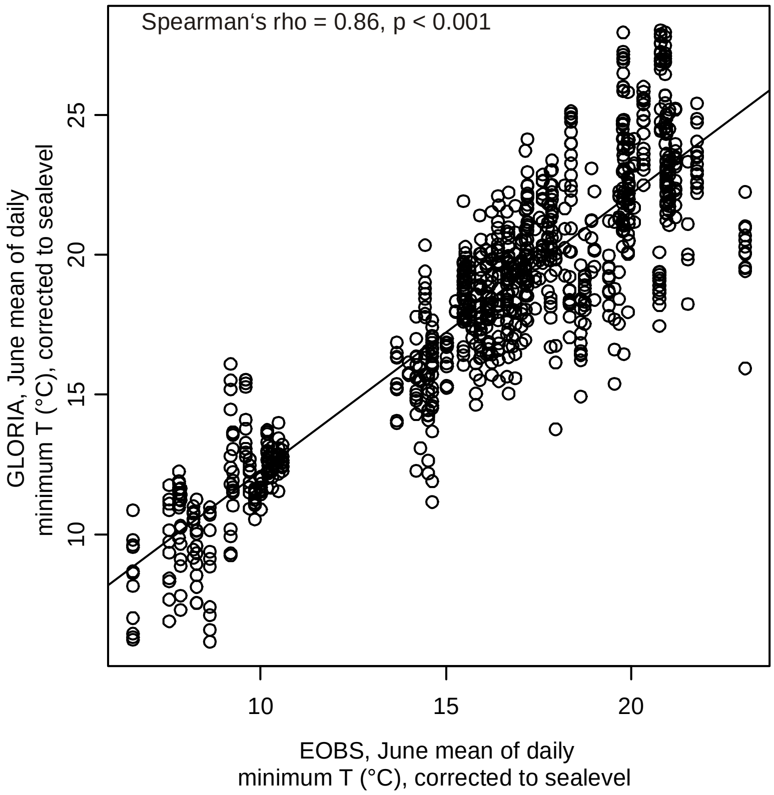
It turns out that the ratio $\overline{s_e^{**}}^2 / s_e^2 \approx 0.92$ suggesting that about 92% of the residual fluctuation can be attributed to random observer errors. This does not leave much space for sources of local environmental fluctuation. Notice however that both random observer errors and environmental fluctuation are dealt with appropriately by our linear mixed model. As discussed in Section 4A, the influence of systematic observer errors should be very small.

SECTION 5 European climate data set (E-OBS data)

E-OBS data were downloaded from http://eca.knmi.nl/download/ensembles/ensembles.php. This data set provides, among others, the climate elements T_{min}, T_{mean}, T_{max} on a daily basis from 1950 onwards and on a raster of 0.25x0.25 geographical degrees. For each mountain region, we defined the grid cell which covered the central point between its recorded summits. In almost all cases, all four summits were located within one cell. Daily information from these cells was used as follows: For each year between 1994 and 2007 we averaged the daily temperature of the three elements for each month. For the Ural Mountains (RUPUR and RUSUR), gaps existed in the E-OBS data in the considered period and, therefore, these two regions were not included in the calculations using E-OBS data (see Figure 3 in the main text).

5A Correlation of gridded E-OBS data with GLORIA temperature data measured in the field

First we investigated whether the E-OBS data can represent the local climate development at our recorded summits. For this purpose, we used all available temperature logger data recorded by our GLORIA field measurements for June between 2001 and 2007. If a time series for June of a certain year (due to logger failure) had a gap, this particular series has been excluded. For the remaining instances (n = 936), we computed the average daily minimum T in June, both from the GLORIA time series as well as from the E-OBS data. We calculated and tested the Spearman correlation of the GLORIA data and the respective E-OBS data (Supplementary Fig. 5). As both the GLORIA data (from different summits) and the E-OBS data (from different study regions) were measured at different altitudes, we corrected all temperatures to sealevel beforehand by assuming a lapse rate of -5.5 K / km [ref. 50]. This lapse rate is a global rule of thumb and the (unknown) regional lapse rates may deviate. Varying the lapse rate between -4.5 and -8.5 K / km had only marginal effects on the correlation, however. We found a significant correlation between the E-OBS data and our field measurements. This allowed us to adopt prior-2008, prior-2001 -differences in E-OBS temperatures (see Supplementary Section 5B) as surrogate for differences in temperatures at our observed habitats (see Figure 3 in the main text).



Supplementary Figure 5 | Correlation of gridded European E-OBS data and GLORIA field measurements of temperature T_{min}. Temperatures were measured at different summit altitudes as well as E-OBS cell altitudes but are here corrected to sealevel assuming a lapse rate of -5.5K / km.

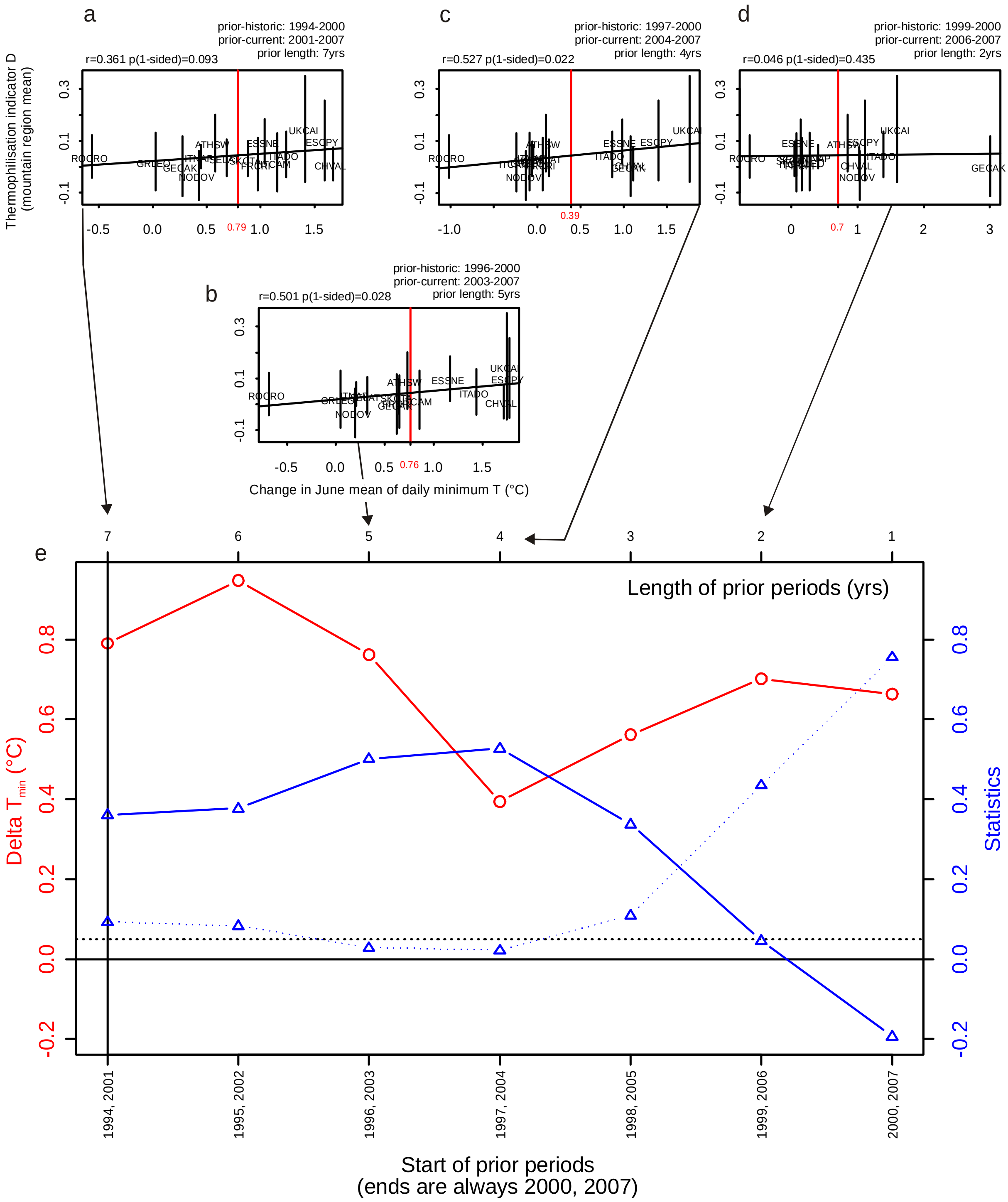
5B The prior-period concept

High mountain plants are long-lived. It is therefore unlikely that the climatic conditions short before a recording of plant properties (e.g., their presence and cover) can explain these properties sufficiently. We hypothesize that the climatic conditions of not only one year but of a number of years that preceded the year of plant data sampling influence the plants' status at the sampling time. We term this period as *prior-period* and distinguish a historic (*prior-2001*) from a current (*prior-2008*) period. We hypothesize further that this 'climatic memory' of plants is limited, however. Taking both these effects into account, there should exist a 'best' prior-periods' length representing a trade-off between both effects. Responses of plants to the preceding climatic development should be most visible when using this length of periods.

We tested the correlation between the thermophilisation indicator *D* on the level of mountain regions and temperature changes for increasing lengths of the prior-periods. We started with prior-periods of only one year, i.e., we correlated *D* with the temperature differences between June 2007 and June 2000 (the years preceding the two recording campaigns). We did not use June 2008 because in a few regions the re-recording started already in June 2008. Then we stepwise increased the length of the prior-periods, i.e., prior-2008 was running from 2006 to 2007 and prior-2001 from 1999 to 2000, and so on. The longest prior-periods were 2001 to 2007 (prior-2008) and 1994 to 2000 (prior-2001). This is a natural limit in our data since the first recording campaign took place in 2001.

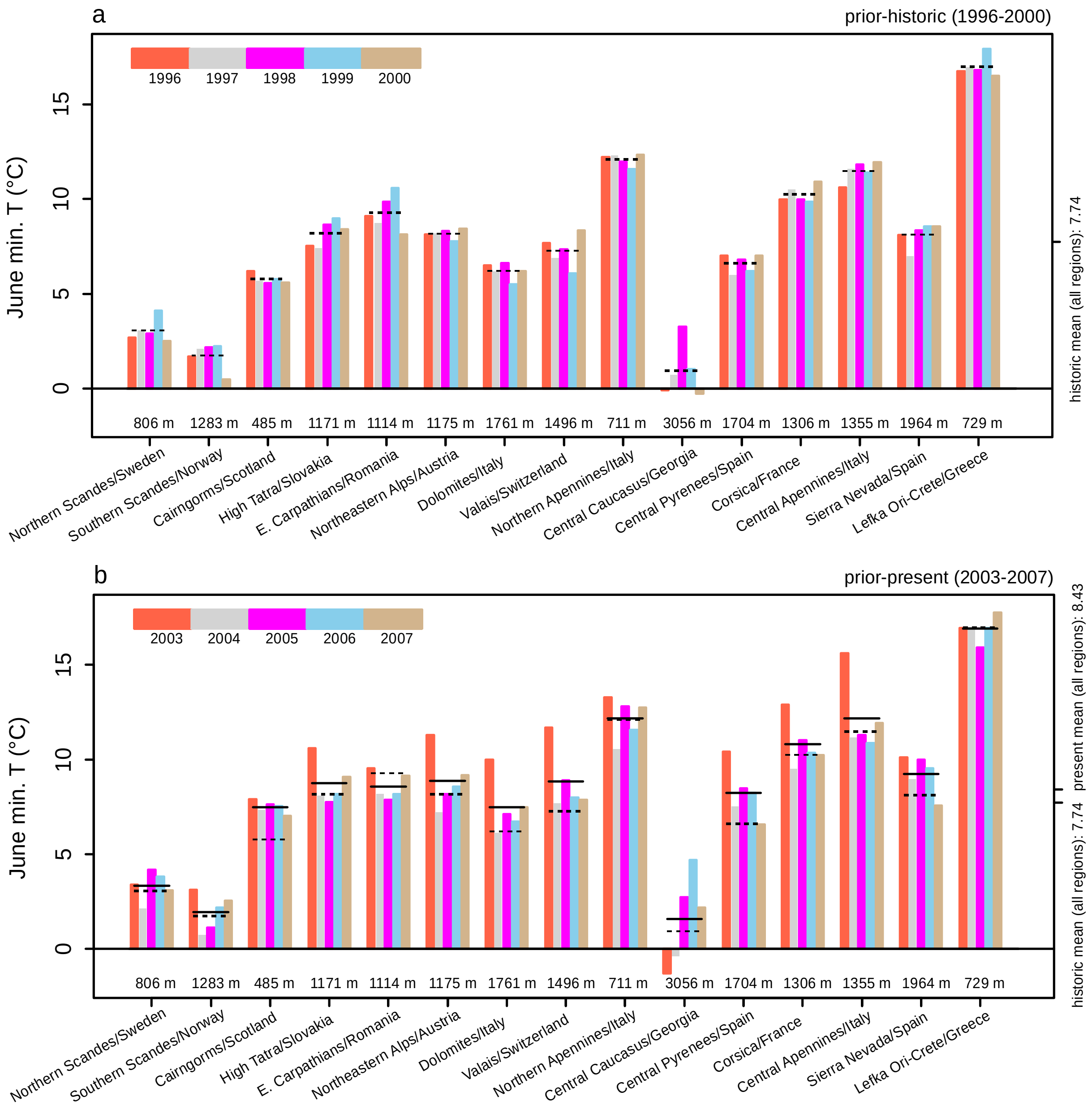
For each pair of prior-periods, we calculated and tested the Pearson's correlation between *D* and the temperature difference between prior-2008 and prior-2001 (Supplementary Fig. 6, and compare Figure 3b in the main text). As hypothesised, the amount of correlation peaked somewhere between the shortest and the longest compared prior-periods; it peaked at a prior-period length of four to five years;

moreover, the correlations were significant (at alpha=0.05) at only these two lengths of the prior-periods. We are aware that this is a data-driven best-estimate for a certain climatic period and other results may be obtained if such an analysis is repeated in the coming decades. As the year 2003 brought a remarkable heat wave in most of Europe, we decided to include this year in the prior-periods which were finally selected for the main analysis (see Figure 3 of the main text). The year 2003 (included in the 5-year prior-period) was, however, obviously not extraordinarily influential for *D* since the correlation for the 4-year prior-periods was almost equal (formally even slightly better).



Supplementary Figure 6 (on previous page) **| Comparison of different lengths of prior-periods according the correlation of *D* and temperature change. a-d**, Four selected prior-periods of different length. Data in **b** are the same as in Figure 3b of the main text. The average delta T_{min} between prior-2008 (prior-current) and prior-2001 (prior-historic) is indicated as red line together with its value. Pearson's r and one-sided p (we test the null hypothesis of no positive correlation) is indicated. **e**, Comparison of all tested prior-period lenghts (on abscissa). Left ordinate and red points, delta T_{min} (averaged over all mountain regions) between prior-2008 and prior-2001 (starting years of these periods are indicated on the abscissa). Right ordinate: Blue points connected with solid lines, Pearson's r of the correlation of *D* with delta T_{min}; blue points connected with dotted lines, one-sided p of the correlation.

Supplementary Fig. 7 (on next page) provides the June T_{min} for each mountain region in all years of the prior periods (excluding the Polar Urals and Southern Urals where no E-OBS data are available). It is important to note that the T values in each region refer to the reference altitude of the respective E-OBS grid cell in which a region is embedded. Therefore, temperatures cannot be directly compared between regions but only their delta T. It turns out that in the majority of mountain regions (8 of 15) four of the five years in the used prior-2008 period (2003-2007) were warmer than the average T in the prior-2001 period and that the year 2003 contributes much to this (Supplementary Fig. 7b). If we would, however, consider prior-periods of only four years (compare Supplementary Fig. 6d and e), in an even higher number of regions (9 of 15) three of the four years of the prior-2008 period were warmer than the average over the prior-2001 period in the respective mountain region. This again relativises the role of the 2003-heat wave.



Supplementary Figure 7 | T_{min} in all mountain regions and all years of the prior-periods. a, The historic, and **b**, the present prior-period. The differing reference altitudes of the relevant E-OBS cells are indicated at the ordinates. Horizontal lines, mountain regions' mean T_{min} in the prior-historic (dashed) and the prior-present (solid) period. No data available for Polar Urals and Southern Urals.

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Appendix I | Species names and assigned altitudinal profiles and ranks. Distributions: ni, nival; al, alpine; tr, treeline; mo, montane; id, centre indifferent. Ranks: 1, nival; 2, alpine to nival; 3, alpine; 4, treeline to alpine; 5, treeline; 6, montane.

Species name	Lower margin	Centre	Upper margin	Altitudinal rank	Mountain region
Acer sempervirens L.	mo	mo	tl	6	GRLEO
Achillea atrata L. subsp. atrata	al	al	al	3	ATHSW
Achillea clavennae L.	tl	id	al	4	ITADO
Achillea collina Becker ex Rchb.	mo	mo	al	6	ITNAP
Achillea erba-rotta All. subsp. moschata (Wulfen) I.Richardson	al	al	al	3	CHVAL
Achillea millefolium L.	mo	mo	tl	6	ESCPY
Achillea oxyloba (DC.) Sch.Bip. subsp. oxyloba	al	al	al	3	ITADO
Acinos alpinus (L.) Moench subsp. alpinus	mo	id	al	5	ATHSW, ITNAP
Acinos alpinus (L.) Moench subsp. meridionalis (Nyman) P.W.Ball	mo	id	al	5	ESSNE
Aethionema saxatile (L.) R.Br. subsp. creticum (Boiss. & Heldr.) I.A.Andersson et al.	mo	id	al	5	GRLEO
Aethionema saxatile (L.) R.Br. subsp. ovalifolium (DC.) Nyman	mo	tl	al	5	ESSNE
Agrostis alpina Scop.	tl	al	al	3	ATHSW, CHVAL, ITADO
Agrostis capillaris L.	mo	mo	tl	6	ATHSW, ESCPY, GECAK
Agrostis mertensii Trin.	tl	al	al	3	SELAT
Agrostis planifolia C. Koch	tl	tl	al	5	GECAK
Agrostis rupestris All.	tl	al	al	3	ATHSW, CHVAL, ESCPY, FRCRI, ITNAP, ROCRO
Agrostis rupestris All. subsp. pyrenaica (Pourr.) Dost.	al	al	ni	2	SKCTA
Agrostis vinealis Schreb.	mo	mo	al	6	ITNAP
Ajuga pyramidalis L.	mo	tl	tl	5	CHVAL
Alchemilla alpina L.	mo	tl	al	5	ESCPY, ITNAP
Alchemilla anisiaca Wettst.	mo	tl	al	5	ATHSW
Alchemilla caucasica Bus.	al	al	ni	2	GECAK
Alchemilla chlorosericea (Bus.) Juz.	ni	ni	ni	1	GECAK
Alchemilla cinerea Buser	tl	al	al	3	ITNAP
Alchemilla flabellata Buser	mo	tl	al	5	ITNAP
Alchemilla lapeyrousii Buser	mo	al	al	4	ESCPY
Alchemilla retinervis Bus.	tl	al	al	3	GECAK
Alchemilla rigida Buser	tl	tl	al	5	GECAK
Alchemilla saxatilis Buser	tl	id	al	4	ITNAP
Alchemilla sericata Rchb. ex Buser	tl	tl	al	5	GECAK
Alchemilla tephroserica (Bus.) Juz.	tl	tl	al	5	GECAK
Alchemilla vulgaris agg.	mo	id	al	5	ATHSW
Alopecurus alpinus Sm. subsp. glaucus (Less.) Hultén	mo	tl	al	5	RUSUR
Alyssum cuneifolium Ten. subsp. cuneifolium	tl	al	al	3	ITCAM
Alyssum fragillimum (Bald.) Rech.f.	tl	id	al	4	GRLEO
Alyssum purpureum Lag. & Rodr.	al	ni	ni	1	ESSNE
Alyssum sphacioticum Boiss. & Heldr.	tl	id	al	4	GRLEO
Alyssum spinosum L.	mo	al	ni	4	ESSNE
Androsace chamaejasme Wulfen	tl	al	al	3	ATHSW, RUPUR
Androsace lactea L.	tl	id	al	4	ATHSW
Androsace obtusifolia All.	tl	al	al	3	ATHSW, CHVAL
Androsace pubescens DC.	tl	al	al	3	CHVAL
Androsace villosa L.	tl	id	al	4	ESCPY, GECAK
Androsace villosa L. subsp. villosa	tl	id	al	4	ITCAM
Andryala agardhii Haens. ex DC.	mo	tl	al	5	ESSNE
Anemonastrum fasciculatum (L.) Holub	tl	id	al	4	GECAK
Anemone baldensis L.	al	al	al	3	ITADO

Anemone narcissifolia L. subsp. biarmiensis (Juz.) Jalas	mo	tl	al	5	RUSUR
Anemone narcissifolia L. subsp. narcissifolia	tl	tl	al	5	ATHSW
Anemone nemorosa L.	mo	mo	tl	6	ITNAP
Antennaria alpina (L.) Gaertn.	tl	al	ni	3	SELAT
Antennaria carpatica (Wahlenb.) Bluff & Fingerh.	tl	al	al	3	ITADO
Antennaria caucasica Boriss.	tl	al	al	3	GECAK
Antennaria dioica (L.) Gaertn.	mo	tl	al	5	CHVAL, ESCPY, ITNAP, NODOV, SELAT
Anthemis iberica Bieb.	tl	tl	tl	5	GECAK
Anthoxanthum odoratum L.	mo	tl	tl	5	GECAK
Anthoxanthum odoratum L. subsp. alpinum (Á. & D. Löve) Jones & Melderis	tl	id	al	4	ATHSW, CHVAL, GECAK, ITADO, ITNAP, NODOV, SELAT, SKCTA
Anthyllis variegata Boiss. ex Grossh.	tl	id	al	4	GECAK
Anthyllis vulneraria L.	mo	id	al	5	ITNAP
Anthyllis vulneraria L. subsp. atlantis Emb. & Maire	tl	al	al	3	ESSNE
Anthyllis vulneraria subsp. L. alpestris (Hegetschw.) Asch. & Graebn.	mo	id	al	5	ATHSW, ESCPY, ITADO
Anthyllis vulneraria subsp. pulchella (Vis.) Bornm.	tl	tl	al	5	ITCAM
Aquilegia alpina L.	tl	id	al	4	ITNAP
Arabis alpina L. subsp. alpina	mo	al	al	4	ATHSW, GRLEO, ITADO
Arabis caerulea (All.) Haenke	al	al	ni	2	ITADO
Arabis cretica Boiss. & Heldr.	mo	tl	al	5	GRLEO
Arabis pumila Jacq.	tl	id	al	4	ATHSW, ITADO
Arabis pumila Jacq. subsp. stellulata (Bertol.) Nyman	tl	id	al	4	ITADO
Arctagrostis latifolia (R.Br.) Griseb.	tl	al	al	3	RUPUR
Arctostaphylos alpinus (L.) Spreng.	mo	al	al	4	ATHSW, ITADO, NODOV, RUPUR, RUSUR, SELAT
Arctostaphylos uva-ursi (L.) Spreng.	mo	id	al	5	NODOV, UKCAI
Arenaria armerina Bory	mo	al	ni	4	ESSNE
Arenaria ciliata L. subsp. ciliata	al	al	ni	2	ATHSW, ITADO
Arenaria ciliata L. subsp. moehringioides (Murr) Braun-Blanq.	al	al	al	3	ESCPY
Arenaria cretica Spreng.	tl	id	al	4	GRLEO
Arenaria grandiflora L.	tl	id	al	4	ESCPY
Arenaria grandiflora L. subsp. grandiflora	tl	id	al	4	ITCAM
Arenaria moehringioides Murr	al	al	al	3	ITNAP
Arenaria pungens Clemente ex Lag.	tl	al	al	3	ESSNE
Arenaria purpurascens Ramond ex DC.	mo	al	ni	4	ESCPY
Arenaria tetraquetra L. subsp. amabilis (Bory) H.Lindb.	tl	al	ni	3	ESSNE
Armeria canescens (Host) Boiss. subsp. canescens	tl	tl	al	5	ITCAM
Armeria marginata (Levier) Bianchini	tl	id	al	4	ITNAP
Armeria maritima (Mill.) Willd. subsp. alpina (Willd.) P.Silva	tl	id	al	4	ATHSW
Arnica montana L. subsp. montana	mo	tl	al	5	CHVAL
Artemisia genipi Weber	al	al	ni	2	ITADO
Asperula aristata L.f. subsp. scabra (J.Presl & C.Presl) Nyman	mo	mo	al	6	ESSNE
Asperula aristata subsp. oreophila (Briq.) Hayek	mo	al	al	4	ITNAP
Asperula idaea Halácsy	mo	tl	al	5	GRLEO
Aster alpinus L.	mo	al	al	4	ESCPY, ITCAM
Aster bellidiastrum (L.) Scop.	mo	tl	al	5	ATHSW, ITADO, ITNAP
Astragalus alpinus L. subsp. alpinus	tl	id	al	4	NODOV
Astragalus alpinus L. subsp. arcticus Lindm.	mo	al	al	4	SELAT
Astragalus angustifolius Lam. subsp. angustifolius	tl	id	al	4	GRLEO
Astragalus frigidus (L.) A.Gray subsp. frigidus	mo	tl	al	5	NODOV
Athamanta cretensis L.	mo	tl	al	5	ITADO

Aubrieta deltoidea (L.) DC.	mo	id	al	5	GRLEO
Avenula cycladum (Rech.f. & J.Scheff.) Greuter	mo	mo	tl	6	GRLEO
Avenula versicolor (Vill.) M.Laínz	tl	id	al	4	CHVAL, ITADO, ROCRO
Avenula versicolor (Vill.) M.Laínz subsp. versicolor	tl	id	al	4	SKCTA
Avenula versicolor subsp. pretutiana (Parl. ex Arcang.) Holub	tl	id	al	4	ITCAM, ITNAP
Bartsia alpina L.	tl	id	al	4	ATHSW, ITADO, NODOV, SELAT
Bellardiochloa violacea (Bellardi) Chiov.	tl	al	al	3	ITNAP
Bellium bellidioides L.	mo	mo	tl	6	FRCRI
Berberis cretica L.	mo	id	al	5	GRLEO
Betonica macrantha K. Koch	tl	tl	al	5	GECAK
Betula humilis Schrank	tl	tl	al	5	RUSUR
Betula litwinowii Doluch.	tl	tl	tl	5	GECAK
Betula nana L.	mo	tl	al	5	NODOV, RUPUR, SELAT
Betula nana L. x pubescens Ehrh. subsp. tortuosa (Ledeb.) Nyman	mo	tl	tl	5	NODOV
Betula pubescens Ehrh. subsp. tortuosa (Ledeb.) Nyman	mo	mo	tl	6	RUPUR, RUSUR, SELAT
Biscutella glacialis (Boiss. & Reut.) Jord.	mo	al	al	4	ESSNE
Biscutella laevigata L. subsp. laevigata	mo	id	al	5	ITADO
Borderea pyrenaica Miégeville	mo	tl	al	5	ESCPY
Botrychium lunaria (L.) Sw.	mo	id	al	5	ATHSW, ESCPY, ITADO, ITNAP
Brachypodium genuense (DC.) Roemer & Schultes	tl	id	al	4	ITNAP
Bromopsis variegata (Bieb.) Holub	tl	tl	al	5	GECAK
Bromus tectorum L.	mo	mo	tl	6	GRLEO
Bufonia stricta (Sm.) Gürke in K.Richter subsp. stricta	mo	tl	al	5	GRLEO
Bupleurum ranunculoides L.	tl	id	al	4	ESCPY
Bupleurum ranunculoides L. subsp. ranunculoides	tl	id	al	4	ITNAP
Bupleurum trichopodum Boiss. & Spruner	mo	mo	tl	6	GRLEO
Calamagrostis lapponica (Wahlenb.) Hartm.	mo	al	al	4	SELAT
Calamagrostis purpurea (Trin.) Trin. subsp. langsdorfii (Link) Tzvelev	mo	mo	tl	6	RUPUR, RUSUR
Calamagrostis varia (Schrad.) Host	mo	id	tl	6	ITADO
Calluna vulgaris (L.) Hull	mo	mo	al	6	ESCPY, ITNAP, UKCAI
Campanula alpina Jacq. subsp. alpina	tl	id	al	4	ATHSW, ROCRO, SKCTA
Campanula barbata L.	tl	tl	al	5	CHVAL, ITADO
Campanula bellidifolia Adam	tl	tl	al	5	GECAK
Campanula biebersteiniana Schult.	tl	al	ni	3	GECAK
Campanula cochlearifolia Lam.	mo	id	al	5	ATHSW
Campanula collina M. Bieb.	tl	tl	al	5	GECAK
Campanula hohenackeri Fisch.& Mey.	tl	tl	al	5	GECAK
Campanula pulla L.	tl	id	al	4	ATHSW
Campanula rotundifolia L.	mo	mo	al	6	NODOV, RUPUR, RUSUR, SELAT
Campanula scheuchzeri Vill.	mo	al	al	4	ATHSW, CHVAL, ESCPY, ITADO, ITNAP
Campanula uniflora L.	al	al	al	3	SELAT
Campanula willkommii Witasek	tl	al	al	3	ESSNE
Cardamine bellidifolia L. subsp. bellidifolia	al	al	ni	2	SELAT
Cardamine resedifolia L.	al	al	ni	2	CHVAL
Carduus carlinifolius Lam.	mo	tl	al	5	ITNAP
Carduus carlinoides Gouan subsp. carlinoides	mo	al	al	4	ESCPY
Carduus carlinoides Gouan subsp. hispanicus (Kazmi) Franco	tl	al	al	3	ESSNE
Carduus defloratus L.	mo	id	al	5	ITADO
Carduus defloratus L. subsp. defloratus	mo	id	al	5	ATHSW

Carex atrata L. subsp. atrata	tl	id	al	4	ATHSW, ITADO, SELAT
Carex bigelowii Torr. ex Schwein.	al	al	ni	2	SELAT, UKCAI
Carex bigelowii Torr. ex Schwein. subsp. arctisibirica (Jurtzev) Á.Löve & D.Löve	tl	al	al	3	RUPUR
Carex bigelowii Torr. ex Schwein. subsp. ensifolia (Turcz. ex Gorodkov) Holub	tl	al	al	3	RUSUR
Carex bigelowii Torr. ex Schwein. subsp. rigida W.Schultze-Motel	al	al	ni	2	NODOV
Carex capillaris L.	tl	id	al	4	ATHSW, ITADO, SELAT
Carex curvula All. subsp. curvula	al	al	al	3	CHVAL, ROCRO
Carex digitata L.	mo	mo	mo	6	CHVAL
Carex ericetorum Pollich	mo	id	al	5	ESCPY
Carex firma Host	tl	id	al	4	ATHSW, ITADO
Carex fuliginosa Schkuhr	tl	al	al	3	ATHSW
Carex humilis Leyss.	mo	mo	al	6	ITCAM
Carex kitaibeliana Degen ex Bech.	mo	id	al	5	ITCAM
Carex medwedewii Leskov	al	al	ni	2	GECAK
Carex meinshauseniana V. Krecz.	tl	tl	al	5	GECAK
Carex montana L. subsp. montana	mo	id	tl	6	ITADO
Carex ornithopoda Willd. subsp. ornithopoda	mo	id	tl	6	CHVAL, ESCPY, ITADO
Carex ornithopoda Willd. subsp. ornithopodioides (Hausm.) Nyman	tl	id	al	4	ITADO
Carex parviflora Host	tl	al	al	3	ATHSW, CHVAL, ITADO
Carex rupestris All.	tl	al	al	3	ESCPY, ITADO, RUPUR, RUSUR, SELAT
Carex sempervirens Vill.	tl	id	al	4	ATHSW, CHVAL, ITADO, ITNAP, SKCTA
Carex tristis Bieb.	al	al	ni	2	GECAK
Carex vaginata Tausch	mo	tl	al	5	SELAT
Carex vaginata Tausch subsp. quasivaginata (C.B.Clarke) Malyschev	tl	tl	al	5	RUSUR
Carlina acaulis L.	mo	id	tl	6	ITADO, ITNAP
Carum alpinum (Bieb.) Benth.& Hook fil.	tl	al	ni	3	GECAK
Carum carvi L.	mo	mo	tl	6	ESCPY, GECAK
Carum caucasicum (Bieb.) Boiss.	tl	al	ni	3	GECAK
Cassiope hypnoides (L.) D.Don	al	al	ni	2	SELAT
Cassiope tetragona (L.) D.Don	mo	al	al	4	SELAT
Centaurea cheiranthifolia Willd.	tl	tl	al	5	GECAK
Centaurea idaea Boiss. & Heldr.	mo	id	al	5	GRLEO
Centaurea raphanina Sibth. & Sm. subsp. raphanina	mo	id	al	5	GRLEO
Centaurea uniflora Turra subsp. nervosa (Willd.) Bonnier & Layens	tl	al	al	3	ITNAP
Cephalaria gigantea (Ledeb.) Bobrov	tl	tl	tl	5	GECAK
Cerastium arvense L.	tl	tl	al	5	ESCPY, GECAK
Cerastium arvense L. subsp. strictum Gaudin	tl	id	al	4	ATHSW
Cerastium arvense L. subsp. suffruticosum (L.) Hegi	mo	tl	al	5	ITNAP
Cerastium cerastoides (L.) Britton	tl	al	al	3	GECAK
Cerastium fontanum Baumg. subsp. fontanum	tl	id	al	4	ITADO
Cerastium glabratum Hartm.	mo	al	al	4	SELAT
Cerastium gorodkovianum Schischk.	al	al	al	3	RUSUR
Cerastium holeostoides Fries subsp. triviale (Link) Möschl	mo	mo	al	6	ITNAP
Cerastium krylovii Schischk. et Gorczak.	tl	al	al	3	RUSUR
Cerastium multiflorum C.A. Mey.	al	al	ni	2	GECAK
Cerastium purpurascens Adam	tl	al	ni	3	GECAK
Cerastium ramosissimum Boiss.	mo	al	ni	4	ESSNE
Cerastium semidecandrum L.	mo	id	tl	6	GRLEO

Cerastium soleirolii Ser. ex Duby	mo	tl	al	5	FRCRI
Cerastium thomasii Ten.	tl	al	al	3	ITCAM
Cerastium tomentosum L.	mo	tl	al	5	ITCAM
Cerastium uniflorum Clairv.	al	ni	ni	1	ITADO
Chaenorhinum glareosum (Boiss.) Willk.	al	al	ni	2	ESSNE
Chaerophyllum aureum L.	mo	mo	mo	6	GECAK
Chamorchis alpina (L.) Rich.	tl	id	al	4	ITADO
Cicer incisum (Willd.) K.Maly	tl	id	al	4	GRLEO
Cicerbita racemosa (Willd.) Beauverd	tl	id	al	4	GECAK
Cirsium acaule Scop. subsp. acaule	mo	mo	tl	6	ESCPY
Cirsium obvallatum (M. Bieb.) Fisch.	tl	id	al	4	GECAK
Clematis alpina (L.) Mill. subsp. alpina	mo	tl	tl	5	ITADO
Coeloglossum viride (L.) Hartm.	mo	tl	al	5	GECAK, ITADO, ITNAP
Conioselinum tataricum Hoffm.	mo	id	al	5	RUSUR
Crepis aurea (L.) Cass. subsp. aurea	mo	tl	al	5	ATHSW
Crepis aurea (L.) Cass. subsp. glabrescens (Caruel) Arcang.	tl	id	al	4	ITNAP
Crepis chrysantha (Ledeb.) Turcz.	al	al	al	3	RUSUR
Crepis jacquinii Tausch subsp. kerneri (Rech.f.) Merxm.	tl	id	al	4	ITADO
Crepis oporinoides Boiss. ex Froel.	al	al	al	3	ESSNE
Crepis pygmaea L. subsp. pygmaea	mo	al	ni	4	ESCPY
Crepis sibthorpiana Boiss. & Heldr.	mo	al	al	4	GRLEO
Crepis terglouensis (Hacq.) A.Kern.	al	al	al	3	ATHSW
Crocus nudiflorus Sm.	mo	id	tl	6	ESCPY
Crocus vernus (L.) Hill subsp. albiflorus (Kit.) Asch. & Graebn.	mo	id	al	5	ITADO
Crocus vernus (L.) Hill subsp. vernus	mo	mo	al	6	ITNAP
Cruciata glabra (L.) Ehrend.	mo	mo	al	6	GECAK
Cuscuta atrans Feinbrun	tl	tl	al	5	GRLEO
Cuscuta epithymum (L.) L. subsp. epithymum	mo	mo	al	6	ITNAP
Cynoglossum officinale L.	tl	tl	tl	5	GECAK
Dactylis glomerata L. subsp. juncinella (Bory) Stebbins & Zohary	tl	al	ni	3	ESSNE
Dactylis glomerata L. subsp. rigida (Boiss and Heldr.) Hayek	tl	id	al	4	GRLEO
Danthonia decumbens (L.) DC.	mo	mo	al	6	ITNAP
Daphne mezereum L.	mo	mo	al	6	GECAK
Daphne striata Tratt.	tl	id	al	4	ITADO
Deschampsia flexuosa (L.) Trin.	mo	tl	al	5	ATHSW, CHVAL, GECAK, ITADO, ITNAP, NODOV, ROCRO, SELAT, SKCTA, UKCAI
Deschampsia flexuosa (L.) Trin. subsp. iberica Rivas Martínez	tl	id	al	4	ESSNE
Dianthus alpinus L.	tl	al	al	3	ATHSW
Dianthus benearnensis Loret	mo	mo	tl	6	ESCPY
Dianthus monspessulanus L. subsp. monspessulanus	mo	mo	al	6	ITNAP
Dianthus subacaulis Vill. subsp. brachyanthus (Boiss.) P.Fourn.	mo	al	ni	4	ESSNE
Diapensia lapponica L.	al	al	ni	2	NODOV, SELAT
Diphasiastrum alpinum (L.) Holub	mo	al	al	4	CHVAL, SELAT
Doronicum clusii (All.) Tausch	tl	al	ni	3	SKCTA
Doronicum glaciale (Wulfen) Nyman	tl	al	al	3	ATHSW
Draba aizoides L.	tl	id	al	4	ATHSW, ITADO
Draba aizoides L. subsp. aizoides	tl	id	al	4	ITCAM
Draba alpina L.	al	al	al	3	RUPUR
Draba cretica Boiss. & Heldr.	mo	al	al	4	GRLEO
Draba dolomitica Buttler	al	al	al	3	ITADO
Draba dubia Suter	al	al	ni	2	CHVAL, ITADO

Draba fladnizensis Wulfen	al	al	ni	2	ITADO
Draba hispanica Boiss. subsp. laderoi Rivas Martínez, M.E. García & Penas	tl	al	ni	3	ESSNE
Draba hispida Willd.	tl	tl	ni	5	GECAK
Draba hoppeana Rchb.	al	al	al	3	ITADO
Draba sauteri Hoppe	al	al	al	3	ATHSW
Draba stellata Jacq.	al	al	al	3	ATHSW
Draba supranivalis Rupr.	al	ni	ni	1	GECAK
Draba tomentosa Clairv.	al	al	ni	2	ITADO
Dryas caucasica Juz.	al	al	al	3	GECAK
Dryas octopetala L.	al	al	al	3	ATHSW, ITADO, RUPUR, SELAT
Dryopteris fragrans (L.) Schott	mo	id	tl	6	RUPUR
Edraianthus graminifolius (L.) A.DC. subsp. graminifolius	tl	tl	al	5	ITCAM
Empetrum caucasicum Juz.	tl	tl	al	5	GECAK
Empetrum nigrum L. subsp. hermaphroditum (Hagerup) Böcher	tl	tl	al	5	ATHSW, CHVAL, NODOV, RUPUR, RUSUR, SELAT, SKCTA, UKCAI
Epilobium angustifolium L.	mo	mo	tl	6	RUSUR
Equisetum pratense Ehrh.	mo	mo	al	6	SELAT
Equisetum variegatum Schleich.	mo	mo	al	6	SELAT
Erica herbacea L.	mo	id	tl	6	ITADO
Erigeron epiroticus (Vierh.) Halácsy	tl	tl	al	5	ITCAM
Erigeron frigidus Boiss. ex DC.	al	ni	ni	1	ESSNE
Erigeron major (Boiss.) Vierh.	tl	al	ni	3	ESSNE
Erigeron neglectus A.Kern.	tl	al	al	3	ITADO
Erigeron orientalis Boiss.	mo	id	al	5	GECAK
Erigeron uniflorus L.	al	al	ni	2	ATHSW, CHVAL, ESCPY, ITADO, SELAT
Erinus alpinus L.	mo	al	al	4	ESCPY
Erodium cheilanthifolium Boiss.	mo	al	al	4	ESSNE
Erophila verna (L.) Chevall.	mo	mo	tl	6	ESSNE
Eryngium glaciale Boiss.	al	al	al	3	ESSNE
Erysimum mutabile Boiss. & Heldr.	mo	tl	al	5	GRLEO
Erysimum nevadense Reut. subsp. nevadense	mo	tl	al	5	ESSNE
Euphorbia acanthothamnos Heldr. & Sart. ex Boiss.	mo	id	al	5	GRLEO
Euphorbia herniariifolia Willd.	tl	id	al	4	GRLEO
Euphorbia nevadensis Boiss. & Reut.	mo	al	ni	4	ESSNE
Euphrasia alpina Lam.	tl	al	al	3	ITNAP
Euphrasia frigida Pugsley	mo	id	al	5	SELAT
Euphrasia hirtella Jord. ex Reut.	tl	tl	al	5	GECAK
Euphrasia minima Jacq. ex DC.	tl	id	al	4	GECAK
Euphrasia minima Jacq. ex DC. subsp. minima	tl	id	al	4	ATHSW, CHVAL, ITADO, ITCAM, ITNAP
Euphrasia nemorosa (Pers.) Wallr.	mo	id	tl	6	RUSUR
Euphrasia picta Wimm.	mo	tl	al	5	ATHSW
Euphrasia salisburgensis Funck	mo	tl	al	5	ATHSW, ESCPY, ITADO, SELAT
Festuca airoides Lam.	tl	id	al	4	GECAK, ROCRO, SKCTA
Festuca alpina Suter	al	al	al	3	ITADO
Festuca billyi Kerguélen & Plonka	tl	al	al	3	ITNAP
Festuca circummediterranea Patzke	mo	id	al	5	GRLEO
Festuca clementei Boiss.	al	ni	ni	1	ESSNE
Festuca eskia Ramond ex DC.	mo	al	al	4	ESCPY
Festuca gautieri (Hack.) K.Richt.	mo	al	al	4	ESCPY
Festuca glacialis (Miégeville ex Hack.) K.Richt.	tl	al	ni	3	ESCPY
Festuca halleri All. subsp. halleri	tl	id	al	4	CHVAL, ITADO

Festuca igoschiniae Tzvelev	tl	id	al	4	RUSUR
Festuca indigesta Boiss. subsp. indigesta	tl	id	al	4	ESSNE
Festuca intercedens (Hack.) Lüdi ex Bech.	al	al	ni	2	ITADO
Festuca norica (Hack.) K.Richt.	tl	id	al	4	ITADO
Festuca ovina L.	mo	id	al	5	NODOV, RUPUR, RUSUR, SELAT, UKCAI
Festuca ovina agg.	mo	id	al	5	ESCPY, GECAK, ITCAM
Festuca paniculata (L.) Schinz & Thell. subsp. paniculata	tl	id	al	4	ITNAP
Festuca picta Kit.	tl	id	al	4	SKCTA
Festuca pseudeskia Boiss.	tl	al	al	3	ESSNE
Festuca pyrenaica Reut.	tl	al	ni	3	ESCPY
Festuca quadriflora Honck.	tl	al	al	3	ATHSW, CHVAL, ITADO
Festuca riccerii Foggi & Graz. Rossi	tl	id	al	4	ITNAP
Festuca rubra agg.	mo	id	al	5	ATHSW, ESCPY, ITNAP
Festuca rupicaprina (Hack.) A.Kern.	tl	id	al	4	ATHSW
Festuca scabriculmis (Hack.) K.Richt. subsp. luedii Markgr.-Dann.	tl	al	al	3	CHVAL
Festuca varia Haenke	mo	id	al	5	ITADO
Festuca varia Haenke subsp. woronowii (Hack.) Tzvelev	tl	id	al	4	GECAK
Festuca versicolor Tausch subsp. brachystachys (Hack.) Markgr.-Dann.	tl	id	al	4	ATHSW
Festuca violacea Gaudin subsp. italicai Foggi, Rossi Graz. & Signorini	tl	id	al	4	ITCAM
Festuca vivipara (L.) Sm.	al	al	al	3	SELAT
Fritillaria lutea Mill.	tl	al	al	3	GECAK
Galium anisophyllon Vill.	tl	id	al	4	ATHSW, ITADO, ITNAP
Galium magellense Ten.	tl	id	al	4	ITCAM
Galium marchandii Roem. & Schult.	mo	al	al	4	ESCPY
Galium noricum Ehrend.	tl	id	al	4	ATHSW
Galium pyrenaicum Gouan	mo	al	ni	4	ESCPY, ESSNE
Galium rosellum (Boiss.) Boiss. & Reut.	tl	al	al	3	ESSNE
Galium saxatile L.	mo	mo	al	6	UKCAI
Galium verticillatum Danthoine	mo	mo	tl	6	GRLEO
Genista baetica Spach	mo	tl	al	5	ESSNE
Genista tinctoria L.	mo	id	al	5	ITNAP
Gentiana acaulis L.	tl	tl	al	5	ITADO, ITNAP
Gentiana angulosa Bieb.	tl	id	ni	4	GECAK
Gentiana aquatica L.	tl	id	ni	4	GECAK
Gentiana bavarica L.	al	al	ni	2	CHVAL
Gentiana brachyphylla Vill. subsp. brachyphylla	al	al	al	3	CHVAL
Gentiana brachyphylla Vill. subsp. favratii (Rittener) Tutin	al	al	al	3	ATHSW, ITADO, ITCAM
Gentiana clusii E.P.Perrier & Songeon	mo	al	al	4	ATHSW
Gentiana frigida Haenke	al	al	ni	2	SKCTA
Gentiana nivalis L.	tl	id	al	4	ATHSW, ESCPY, SELAT
Gentiana pumila Jacq. subsp. pumila	tl	id	al	4	ATHSW
Gentiana purpurea L.	tl	tl	al	5	CHVAL, ITNAP
Gentiana septemfida Pall.	tl	id	al	4	GECAK
Gentiana terglouensis Hacq. subsp. terglouensis	al	al	al	3	ITADO
Gentiana verna L. subsp. verna	mo	id	al	5	ATHSW, ESCPY, ITADO, ITCAM, ITNAP
Gentianella anisodonta (Borbás) Á.Löve & D.Löve	tl	tl	al	5	ITADO
Gentianella campestris (L.) Börner subsp. campestris	mo	tl	al	5	CHVAL, ESCPY, ITNAP
Gentianella caucasea (G.Lodd. ex Sims) Holub	tl	id	al	4	GECAK

Gentianella germanica (Willd.) E.F.Warb.	mo	id	tl	6	ATHSW
Gentianella tenella (Rottb.) Börner	al	al	al	3	ITADO
Geranium cinereum Cav. subsp. cinereum	mo	al	al	4	ESCPY
Geranium ibericum Cav.	tl	tl	al	5	GECAK
Geranium ruprechtii (Woronow) Grossh.	mo	id	tl	6	GECAK
Geranium sylvaticum L.	mo	id	tl	6	ITADO
Geranium sylvaticum L. subsp. sylvaticum	mo	id	tl	6	ATHSW
Geum montanum L.	tl	id	al	4	ATHSW, CHVAL, ITNAP, ROCRO, SKCTA
Geum reptans L.	al	al	ni	2	ITADO
Gymnadenia conopsea (L.) R.Br.	mo	id	tl	6	ITADO
Gypsophila uralensis Less.	tl	al	al	3	RUSUR
Hedysarum hedysaroides (L.) Schinz & Thell.	tl	id	al	4	ITADO
Hedysarum hedysaroides (L.) Schinz & Thell. subsp. arcticum (B.Fedtsch.) P.W.Ball	mo	id	al	5	RUPUR
Hedysarum hedysaroides (L.) Schinz & Thell. subsp. hedysaroides	tl	id	al	4	ATHSW
Helianthemum nummularium (L.) Mill. subsp. glabrum (W.D.J.Koch) Wilczek	tl	tl	al	5	ATHSW
Helianthemum nummularium (L.) Mill. subsp. grandiflorum (Scop.) Schinz & Thell.	mo	tl	al	5	ITADO
Helianthemum oelandicum (L.) DC. subsp. alpestre (Jacq.) Breistr.	tl	id	al	4	ATHSW, ITADO, ITCAM
Helictotrichon asiaticum (Roshev.) Grossh.	tl	tl	al	5	GECAK
Helictotrichon sedenense (DC.) Holub	mo	al	al	4	ESCPY
Herniaria boissieri J.Gay	tl	al	ni	3	ESSNE
Herniaria parnassica Boiss. subsp. cretica Chaudhri	mo	id	al	5	GRLEO
Hieracium alpinum L.	tl	al	al	3	ATHSW, CHVAL, NODOV, ROCRO, SELAT, SKCTA
Hieracium amplexicaule L.	mo	tl	al	5	ITNAP
Hieracium castellanum Boiss. & Reut.	mo	tl	al	5	ESSNE
Hieracium glaciale A.Reyn.	tl	id	al	4	CHVAL
Hieracium glanduliferum Hoppe	tl	al	al	3	CHVAL
Hieracium iremelense (Elfstr.) Juxip	tl	al	al	3	RUSUR
Hieracium lactucella Wallr.	mo	id	al	5	ESCPY, ITNAP
Hieracium mixtum Froel.	mo	id	al	5	ESCPY
Hieracium murorum agg.	mo	id	al	5	ITADO
Hieracium nigrescens agg.	mo	al	al	4	SELAT
Hieracium pilosella L.	mo	id	al	5	ESCPY, GECAK, ITNAP
Hieracium ramondii Griseb.	mo	id	tl	6	ESCPY
Hieracium villosum Jacq.	tl	id	al	4	ATHSW, ITADO
Hieracium x pannoniciforme (Litw. & Zahn) Zahn	tl	tl	al	5	GECAK
Hierochloe alpina (Willd.) Roem. & Schult.	tl	al	al	3	RUPUR
Homogyne alpina (L.) Cass.	mo	id	al	5	ATHSW, CHVAL, ITADO, ITNAP, ROCRO, SKCTA
Homogyne discolor (Jacq.) Cass.	tl	id	al	4	ATHSW
Huperzia selago (L.) Bernh. ex Schrank & Mart.	tl	id	al	4	UKCAI
Huperzia selago (L.) Bernh. ex Schrank & Mart. subsp. arctica (Grossh. ex Tolm.) Á. Löve & D. Löve	tl	al	ni	3	SELAT
Huperzia selago (L.) Bernh. ex Schrank & Mart. subsp. selago	tl	id	al	4	CHVAL, ITADO, ITNAP, ROCRO, RUSUR, SKCTA
Hypericum empetrifolium Willd.	mo	id	al	5	GRLEO
Hypericum maculatum Crantz	mo	mo	tl	6	ATHSW
Hypericum richeri Vill. subsp. richeri	tl	al	al	3	ITNAP
Hypochoeris robertia Fiori	mo	id	al	5	FRCRI
Hypochoeris uniflora Vill.	mo	al	al	4	ITADO, SKCTA
Iberis carnosa Willd. subsp. embergeri (Serve) Moreno	al	al	ni	2	ESSNE
Iberis saxatilis L. subsp. saxatilis	tl	al	al	3	ITCAM

Inula orientalis Lam.	tl	tl	al	5	GECAK
Jasione crispa (Pourret) Samp. subsp. amethystina (Lag. & Rodr.) Tutin	tl	al	ni	3	ESSNE
Jasione montana L.	mo	mo	mo	6	ESCPY
Juncus biglumis L.	al	al	al	3	RUPUR
Juncus trifidus L. subsp. monanthos (Jacq.) Asch. & Graebn.	tl	al	al	3	ATHSW, ITCAM
Juncus trifidus L. subsp. trifidus	tl	al	al	3	CHVAL, ITADO, ITNAP, NODOV, ROCRO, RUSUR, SELAT, SKCTA, UKCAI
Juniperus communis L. subsp. alpina (Suter) Čelak.	tl	tl	al	5	CHVAL, ITADO, ITNAP, NODOV, RUSUR, SELAT
Juniperus oxycedrus L. subsp. oxycedrus	mo	id	tl	6	GRLEO
Jurinella subacaulis (Fisch. & Mey.) Iljin	al	ni	ni	1	GECAK
Knautia drymeia Heuff. subsp. intermedia (Pernh. & Wettst.) Ehrend.	mo	mo	tl	6	ATHSW
Kobresia capilliformis Ivanova	tl	al	al	3	GECAK
Kobresia myosuroides (Vill.) Fiori	al	al	ni	2	ITADO, ITCAM, NODOV
Kobresia simpliciuscula (Wahlenb.) Mack.	al	al	al	3	ATHSW
Koeleria asiatica Domin	al	al	al	3	RUSUR
Lactuca perennis L. subsp. granatensis Charpin & Fernández. Casas	mo	al	al	4	ESSNE
Lactuca viminea (L.) J.Presl & C.Presl subsp. alpestris (Gand.) Feráková	mo	id	al	5	GRLEO
Lagotis uralensis Schischk.	tl	al	al	3	RUSUR
Larix decidua Mill.	mo	tl	tl	5	ITADO
Ledum palustre L. subsp. palustre	mo	id	al	5	RUPUR
Leontodon boryi Boiss. ex DC.	tl	al	ni	3	ESSNE
Leontodon caucasicus (Bieb.) Fisch.	al	al	al	3	GECAK
Leontodon hispidus L.	mo	id	al	5	ATHSW, ESCPY, GECAK, ITADO, ITNAP
Leontodon hispidus L. subsp. danubialis (Jacq.) Simonk.	mo	id	al	5	GECAK
Leontodon montanus Lam. subsp. montanus	al	al	al	3	ITCAM
Leontodon pyrenaicus Gouan subsp. helveticus (Mérat) Finch & P.D.Sell	tl	id	al	4	ATHSW, CHVAL, ITADO, ITNAP
Leontodon pyrenaicus Gouan subsp. pyrenaicus	mo	al	ni	4	ESCPY
Leontopodium alpinum Cass. subsp. alpinum	tl	al	al	3	ITADO
Leontopodium alpinum Cass. subsp. nivale (Ten.) Tutin	tl	al	al	3	ITCAM
Lepidium hirtum (L.) Sm. subsp. stylatum (Lag. & Rodr.) Thell.	al	al	ni	2	ESSNE
Leucanthemopsis alpina (L.) Heywood subsp. alpina	al	al	ni	2	CHVAL, ESCPY
Leucanthemopsis alpina (L.) Heywood subsp. tatrae (Vierh.) Holub	al	al	ni	2	SKCTA
Leucanthemum atratum (Jacq.) DC. subsp. atratum	tl	id	al	4	ATHSW
Ligularia sibirica (L.) Cass.	tl	tl	al	5	RUSUR
Ligusticum mutellina (L.) Crantz	tl	id	al	4	ATHSW, ROCRO, SKCTA
Ligusticum mutellinoides (Crantz) Vill.	al	al	al	3	CHVAL, ITADO, RUSUR
Linaria aeruginea (Gouan) Cav. subsp. nevadensis (Boiss.) Rivas Martínez, Asensi, Molero Mesa & F. Valle	tl	al	ni	3	ESSNE
Linaria alpina (L.) Mill.	al	al	ni	2	ESCPY, ITCAM
Linnaea borealis L.	mo	mo	tl	6	RUSUR, SELAT
Linum alpinum Jacq. subsp. gracilius (Bertol.) Pignatti	tl	tl	al	5	ITNAP
Linum hypericifolium Salisb.	tl	tl	al	5	GECAK
Lloydia serotina (L.) Rchb.	tl	al	al	3	RUPUR, RUSUR
Loiseleuria procumbens (L.) Desv.	tl	id	al	4	NODOV, SELAT
Lotus alpinus (DC.) Schleich. ex Ramond	mo	al	al	4	ESCPY, ITADO, ITNAP

Lotus corniculatus L.	mo	id	al	5	ITADO, ITNAP
Lotus corniculatus L. subsp. glacialis (Boiss.) Valdés	al	al	ni	2	ESSNE
Lotus corniculatus agg.	mo	al	al	4	ATHSW
Luzula alpinopilosa (Chaix) Breistr. subsp. obscura S.E.Fröhner	tl	al	al	3	ROCRO, SKCTA
Luzula arctica Blytt	al	ni	ni	1	RUPUR
Luzula arcuata (Wahlenb.) Swartz	al	al	ni	2	SELAT
Luzula arcuata agg.	al	al	ni	2	NODOV
Luzula confusa Lindeb.	al	al	ni	2	RUPUR
Luzula glabrata (Hoppe) Desv.	tl	id	al	4	ATHSW
Luzula lutea (All.) DC.	tl	id	al	4	CHVAL, ITADO, ITNAP
Luzula luzuloides (Lam.) Dandy & Wilmott	mo	id	tl	6	ITADO, SKCTA
Luzula multiflora (Retz.) Lej.	mo	id	al	5	GECAK, ITNAP
Luzula multiflora (Retz.) Lej. subsp. frigida (Buchenau) V.I.Krecz.	tl	al	ni	3	RUPUR, RUSUR
Luzula sieberi Tausch	tl	id	al	4	ITNAP
Luzula spicata (L.) DC.	al	al	ni	2	ESCPY, FRCRI, GECAK, NODOV
Luzula spicata (L.) DC. subsp. mutabilis Chrtek & Krísa	tl	al	al	3	CHVAL, ITNAP
Luzula stenophylla Steud.	al	al	al	3	GECAK
Macrotomia echioides (L.) Boiss.	tl	id	al	4	GECAK
Maianthemum bifolium (L.) F.W.Schmidt	mo	mo	al	6	RUSUR
Matricaria caucasica (Willd.) Poir.	al	ni	ni	1	GECAK
Medicago lupulina L.	mo	id	tl	6	GRLEO
Melica rectiflora Boiss. & Heldr.	mo	id	al	5	GRLEO
Minuartia arctica (Ser.) Graebn.	al	al	al	3	RUPUR
Minuartia biflora (L.) Schinz & Thell.	al	al	ni	2	SELAT
Minuartia cherlerioides (Hoppe) Bech. subsp. cherlerioides	al	al	ni	2	ATHSW, ITADO
Minuartia circassica (Albov) Woronow	tl	id	ni	4	GECAK
Minuartia imbricata (Bieb.) Woronow	tl	id	ni	4	GECAK
Minuartia inamoena (C.A.Mey.) Woronow	al	ni	ni	1	GECAK
Minuartia macrocarpa (Pursh) Ostenf.	tl	id	al	4	RUPUR
Minuartia oreina (Mattf.) Schischk.	tl	id	ni	4	GECAK
Minuartia recurva (All.) Schinz & Thell. subsp. recurva	al	al	al	3	CHVAL
Minuartia rupestris (Scop.) Schinz & Thell.	al	al	al	3	ITADO
Minuartia sedoides (L.) Hiern	tl	al	ni	3	ATHSW, CHVAL, ITADO, SKCTA
Minuartia stricta (Sw.) Hiern	tl	al	al	3	SELAT
Minuartia verna (L.) Hiern subsp. attica (Boiss. & Spruner) Hayek	tl	id	al	4	GRLEO
Minuartia verna (L.) Hiern subsp. verna	tl	al	al	3	ATHSW, ESCPY, ITADO, ITCAM, ITNAP
Muscari spreitzenhoferi (Heldr.) Vierh.	mo	id	al	5	GRLEO
Myosotis alpestris F.W.Schmidt	tl	id	al	4	ATHSW, ITADO, ITNAP
Myosotis ambigens (Béguinot) Grau	tl	id	al	4	ITCAM
Myosotis arvensis (L.) Hill	mo	id	al	5	GECAK
Myosotis minutiflora Boiss. & Reut.	mo	tl	al	5	ESSNE
Nardus stricta L.	mo	id	al	5	CHVAL, ESCPY, GECAK, ITNAP, SKCTA
Nigritella nigra (L.) Rchb.f. subsp. nigra	tl	al	al	3	ITADO
Omalotheca supina (L.) DC.	tl	al	al	3	CHVAL, ROCRO, SELAT, SKCTA
Oreochloa disticha (Wulfen) Link	al	al	ni	2	ROCRO, SKCTA
Oxyria digyna (L.) Hill	al	al	al	3	ESCPY
Oxytropis campestris (L.) DC. subsp. campestris	mo	al	al	4	ESCPY, ITCAM
Oxytropis campestris (L.) DC. subsp. sordida (Willd.) C.Hartm.	tl	id	al	4	RUPUR
Oxytropis cyanea Bieb.	tl	tl	al	5	GECAK

Oxytropis jacquinii Bunge	al	al	al	3	ATHSW, ITADO
Oxytropis pyrenaica Godr. & Gren.	tl	id	al	4	ESCPY
Papaver alpinum L. subsp. rhaeticum (Ler. ex Gremli) Nyman	tl	al	al	3	ITADO
Papaver julicum E.Mayer et Merxm.	tl	al	al	3	ITCAM
Paracaryum lithospermifolium (Lam.) Grande subsp. cariense (Boiss.) R. Mill	tl	id	al	4	GRLEO
Parnassia palustris L.	mo	id	al	5	ATHSW, ITADO, SELAT
Paronychia macrosepala Boiss.	mo	id	al	5	GRLEO
Paronychia polygonifolia (Vill.) DC.	mo	al	ni	4	ESSNE
Parrya nudicaulis (L.) Boiss.	al	al	al	3	RUPUR
Pedicularis amoena Adams ex Steven	tl	al	al	3	RUPUR
Pedicularis compacta Stephan ex Willd.	tl	al	al	3	RUSUR
Pedicularis elegans Ten.	tl	tl	al	5	ITCAM
Pedicularis kerneri Dalla Torre	al	al	al	3	CHVAL
Pedicularis lapponica L.	mo	al	al	4	NODOV, SELAT
Pedicularis oederi Vahl	tl	al	al	3	RUPUR
Pedicularis portenschlagii Saut. ex Rchb.	tl	al	al	3	ATHSW
Pedicularis rosea Wulfen subsp. rosea	al	al	al	3	ATHSW, ITADO
Pedicularis rostratocapitata Crantz	tl	al	al	3	ITADO
Pedicularis rostratocapitata Crantz subsp. rostratocapitata	tl	al	al	3	ATHSW
Pedicularis tuberosa L.	tl	id	al	4	ITADO, ITNAP
Pedicularis verticillata L.	tl	id	al	4	ATHSW, ITADO
Petrocallis pyrenaica (L.) R.Br.	tl	al	al	3	ATHSW
Peucedanum alpinum (Sieber ex Schult.) B.L.Burtt & P.H.Davis	tl	id	al	4	GRLEO
Phleum alpinum L. subsp. alpinum	tl	id	al	4	GECAK
Phleum alpinum L. subsp. rhaeticum Humphries	tl	tl	al	5	ITNAP
Phyllodoce caerulea (L.) Bab.	mo	al	ni	4	NODOV, SELAT
Phyteuma betonicifolium Vill.	tl	tl	al	5	CHVAL
Phyteuma hemisphaericum L.	tl	al	al	3	CHVAL, ESCPY, ITNAP
Phyteuma orbiculare L.	mo	tl	al	5	ATHSW, ESCPY, ITNAP
Phyteuma sieberi Spreng.	al	al	al	3	ITADO
Picea abies (L.) H.Karst. subsp. abies	mo	mo	tl	6	SKCTA
Picea abies (L.) H.Karst. subsp. obovata (Ledeb.) Hultén	mo	mo	tl	6	RUSUR
Pimpinella procumbens (Boiss.) H.Wolff	tl	al	ni	3	ESSNE
Pimpinella saxifraga L.	mo	mo	tl	6	ESCPY, ITNAP
Pimpinella tragium Vill. subsp. depressa (DC.) Tutin	tl	id	al	4	GRLEO
Pinguicula alpina L.	tl	id	al	4	ITADO, SELAT
Pinus cembra L.	mo	tl	tl	5	ITADO
Pinus mugo Turra	mo	tl	tl	5	ATHSW, SKCTA
Pinus sylvestris L.	mo	mo	tl	6	RUSUR
Plantago alpina L.	tl	id	al	4	CHVAL, ESCPY, ITNAP
Plantago atrata Hoppe	tl	id	al	4	ITNAP
Plantago caucasica T. Pop.	tl	tl	al	5	GECAK
Plantago lanceolata L.	mo	mo	mo	6	GECAK
Plantago maritima L. subsp. serpentina (All.) Arcang.	tl	id	al	4	ITNAP
Plantago monosperma Pourr.	mo	al	al	4	ESCPY
Poa alpigena (Fr.) Lindm.	mo	tl	al	5	RUPUR, RUSUR
Poa alpina L.	tl	al	al	3	ATHSW, CHVAL, ESCPY, GECAK, ITADO, ITNAP, RUPUR, SELAT
Poa alpina L. subsp. alpina	tl	al	al	3	ITCAM
Poa balbisii Parl.	mo	al	al	4	FRCRI
Poa bulbosa L. subsp. bulbosa	mo	id	tl	6	GRLEO
Poa caucasica Trin.	al	al	ni	2	GECAK

Poa cenisia All.	tl	id	al	4	FRCRI
Poa granitica Br.-Bl. subsp. disparilis (E.I. Nyárády) E.I. Nyárády	al	al	al	3	ROCRO
Poa laxa Haenke	al	ni	ni	1	CHVAL, SKCTA
Poa ligulata Boiss.	mo	al	ni	4	ESSNE
Poa longifolia Trin.	tl	tl	al	5	GECAK
Poa media Schur	al	al	al	3	ROCRO
Poa molinerii Balb.	mo	tl	al	5	ITCAM
Polygala alpestris Rchb.	mo	tl	al	5	ITADO
Polygala alpestris Rchb. subsp. alpestris	mo	tl	al	5	ESCPY, ITCAM, ITNAP
Polygala chamaebuxus L.	mo	id	tl	6	ITADO
Polygonatum verticillatum (L.) All.	mo	mo	al	6	ITADO
Polygonum alpinum All.	mo	id	al	5	RUSUR
Polygonum bistorta L.	mo	id	al	5	ITNAP, RUPUR, RUSUR, SKCTA
Polygonum carneum C. Koch	tl	id	al	4	GECAK
Polygonum viviparum L.	tl	id	al	4	ATHSW, CHVAL, GECAK, ITADO, ITCAM, NODOV, RUPUR, RUSUR, SELAT, SKCTA
Potentilla aurea L. subsp. aurea	tl	id	al	4	ATHSW, CHVAL, ITADO, ITNAP, SKCTA
Potentilla aurea L. subsp. chrysocraspeda (Lehm.) Nyman	tl	id	al	4	ROCRO
Potentilla brauniana Hoppe	tl	al	al	3	ATHSW, ESCPY
Potentilla clusiana Jacq.	tl	al	al	3	ATHSW
Potentilla crantzii (Crantz) Beck ex Fritsch	tl	id	al	4	ATHSW, GECAK, ITADO, ITNAP, SELAT
Potentilla crantzii (Crantz) G. Beck ex Fritsch subsp. crantzii	tl	id	al	4	ITCAM
Potentilla erecta (L.) Raeusch.	mo	id	al	5	ITNAP
Potentilla frigida Vill.	al	al	ni	2	CHVAL
Potentilla nitida L.	al	al	al	3	ITADO
Potentilla nivalis Lapeyr.	tl	id	al	4	ESCPY
Potentilla tabernaemontani Asch.	mo	id	tl	6	ESCPY
Primula algida Adam	tl	id	ni	4	GECAK
Primula amoena Bieb.	tl	tl	ni	5	GECAK
Primula apennina Widmer	al	al	al	3	ITNAP
Primula auricula L.	mo	al	al	4	ATHSW
Primula clusiana Tausch	mo	al	al	4	ATHSW
Primula hirsuta All.	tl	id	al	4	CHVAL
Primula minima L.	al	al	al	3	ROCRO, SKCTA
Primula veris L. subsp. columnae (Ten.) Lüdi	mo	mo	tl	6	ITNAP
Pritzelago alpina (L.) Kuntze subsp. alpina	tl	id	al	4	ATHSW, ESCPY, ITADO
Prunus prostrata Labill.	mo	al	al	4	GRLEO
Pseudorchis albida (L.) ÁA. Löve & D. Löve subsp. albida	mo	tl	al	5	CHVAL, SKCTA
Pulmonaria angustifolia L.	tl	tl	tl	5	ITADO
Pulsatilla alba Rchb.	tl	al	al	3	ROCRO, SKCTA
Pulsatilla alpina (L.) Delarbre subsp. alpina	tl	id	al	4	ITCAM, ITNAP
Pulsatilla vernalis (L.) Mill.	tl	al	al	3	CHVAL, ITADO
Pyrethrum coccineum (Willd.) Vorosch.	mo	id	tl	6	GECAK
Pyrola minor L.	mo	tl	tl	5	CHVAL, SELAT
Ranunculus acris L. subsp. borealis (Regel) Nyman	mo	id	al	5	RUSUR
Ranunculus alpestris L. subsp. alpestris	tl	id	al	4	ATHSW
Ranunculus apenninus (Chiov.) Pignatti	tl	id	al	4	ITNAP
Ranunculus carinthiacus Hoppe	tl	id	al	4	ITADO
Ranunculus crenatus Waldst. & Kit.	al	al	al	3	ROCRO

Ranunculus demissus DC.	tl	id	al	4	ESSNE
Ranunculus glacialis L.	al	ni	ni	1	NODOV, SELAT, SKCTA
Ranunculus lojkae Somm. & Levier	tl	al	al	3	GECAK
Ranunculus montanus Willd.	tl	id	al	4	ATHSW, ITADO
Ranunculus oreophilus M.Bieb.	tl	id	al	4	GECAK, ITADO, ITCAM
Ranunculus parnassiifolius L. subsp. heterocarpus P.Küpfer	al	al	al	3	ESCPY
Ranunculus seguieri Vill. subsp. seguieri	al	al	al	3	ITCAM
Reseda complicata Bory	mo	al	ni	4	ESSNE
Rhamnus lycioides L. subsp. oleoides (L.) Jahand. & Maire	mo	mo	tl	6	GRLEO
Rhinanthus mediterraneus (Sterneck) Adamov.	mo	id	al	5	ESCPY
Rhinanthus minor L.	mo	id	tl	6	GECAK
Rhodiola rosea L.	tl	id	al	4	SELAT
Rhododendron caucasicum Pall.	tl	id	al	4	GECAK
Rhododendron ferrugineum L.	tl	tl	al	5	CHVAL, ITADO
Rhododendron lapponicum (L.) Wahlenb.	tl	id	al	4	SELAT
Rhododendron myrtifolium Schott & Kotschy	tl	tl	al	5	ROCRO
Rhododendron x intermedium Tausch	tl	tl	al	5	ITADO
Rosa pendulina L.	mo	id	tl	6	CHVAL, ITADO
Rubus arcticus L.	mo	id	tl	6	RUPUR
Rubus idaeus L.	mo	mo	tl	6	RUSUR
Rubus saxatilis L.	mo	id	tl	6	ITADO
Rumex acetosa L.	mo	mo	al	6	GECAK
Rumex alpestris Jacq.	mo	tl	al	5	ATHSW, GECAK, RUSUR
Rumex alpinus L.	tl	id	al	4	GECAK
Sagina glabra (Willd.) Fenzl	tl	id	al	4	ITNAP
Sagina pilifera (DC.) Fenzl	tl	id	al	4	FRCRI
Salix alpina Scop.	tl	tl	al	5	ATHSW
Salix arctica Pall.	al	al	al	3	RUPUR
Salix hastata L.	mo	tl	al	5	SELAT
Salix herbacea L.	tl	al	ni	3	CHVAL, NODOV, SELAT, SKCTA
Salix kazbekensis A. Skvorts.	mo	tl	tl	5	GECAK
Salix lanata L.	mo	tl	al	5	RUSUR
Salix phylicifolia L.	mo	tl	al	5	NODOV, SELAT
Salix polaris Wahlenb.	al	al	ni	2	SELAT
Salix reticulata L.	tl	al	al	3	ATHSW, ITADO, SELAT
Salix retusa L.	tl	al	al	3	ATHSW, ITADO, ITCAM
Salix rotundifolia Trautv.	al	al	al	3	RUPUR
Salix serpillifolia Scop.	al	al	ni	2	ITADO
Sanguisorba officinalis L.	mo	id	tl	6	RUSUR
Satureja spinosa L.	tl	id	al	4	GRLEO
Saussurea alpina (L.) DC.	tl	al	al	3	RUPUR
Saussurea alpina (L.) DC. subsp. alpina	tl	al	al	3	SELAT
Saussurea pygmaea (Jacq.) Spreng.	tl	al	al	3	ATHSW
Saussurea x uralensis Lipsch.	tl	al	al	3	RUSUR
Saxifraga aizoides L.	mo	id	al	5	ATHSW, SELAT
Saxifraga androsacea L.	al	al	ni	2	ATHSW, ITADO
Saxifraga bryoides L.	al	ni	ni	1	CHVAL, SKCTA
Saxifraga caesia L.	tl	al	al	3	ATHSW, ITADO
Saxifraga cespitosa L.	al	al	ni	2	NODOV, SELAT
Saxifraga exarata Vill.	al	al	ni	2	CHVAL
Saxifraga exarata Vill. subsp. ampullacea (Ten.) D.A.Webb	tl	al	al	3	ITCAM
Saxifraga exarata Vill. subsp. moschata (Wulfen) Cavill.	al	al	ni	2	ATHSW, ESCPY, GECAK, ITADO

Saxifraga facchinii W.D.J.Koch	al	al	al	3	ITADO
Saxifraga nevadensis Boiss.	al	ni	ni	1	ESSNE
Saxifraga oppositifolia L.	al	ni	ni	1	ESCPY
Saxifraga oppositifolia L. subsp. oppositifolia	al	ni	ni	1	ITADO, ITCAM, SELAT
Saxifraga paniculata Mill.	tl	id	al	4	ATHSW, CHVAL, ESCPY, ITADO, ITNAP
Saxifraga paniculata Mill. subsp. paniculata	tl	id	al	4	ITCAM
Saxifraga pedemontana All. subsp. cervicornis (Viv.) Engl.	mo	al	al	4	FRCRI
Saxifraga sedoides L. subsp. sedoides	al	al	al	3	ATHSW, ITADO
Saxifraga squarrosa Sieber	tl	al	al	3	ITADO
Scabiosa caucasica Bieb.	tl	tl	al	5	GECAK
Scabiosa lucida Vill.	mo	id	al	5	ATHSW, ITADO, ITNAP
Scorzonera aristata Ramond ex DC.	mo	tl	tl	5	ITADO
Scrophularia minima M. Bieb.	al	id	ni	2	GECAK
Scutellaria hirta Sibth. & Sm.	tl	id	al	4	GRLEO
Sedum acre L.	mo	mo	mo	6	GRLEO
Sedum album L.	mo	mo	al	6	GRLEO
Sedum alpestre Vill.	tl	al	ni	3	FRCRI, ITNAP, ROCRO
Sedum amplexicaule DC. subsp. tenuifolium (Sm.) Greuter	mo	al	al	4	ESSNE, GRLEO
Sedum atratum L.	tl	id	al	4	ITADO
Sedum atratum L. subsp. atratum	tl	id	al	4	ESCPY
Sedum monregalense Balb.	mo	tl	al	5	ITNAP
Sedum spurium M.Bieb.	tl	tl	al	5	GECAK
Sedum tristriatum Boiss.	mo	tl	al	5	GRLEO
Selaginella selaginoides (L.) Link	tl	id	al	4	ATHSW, ITADO, RUPUR, SELAT
Sempervivum arachnoideum L. subsp. arachnoideum	mo	id	al	5	ITCAM, ITNAP
Sempervivum montanum L. subsp. montanum	tl	id	al	4	CHVAL, ESCPY
Sempervivum nevadense Wale	tl	al	ni	3	ESSNE
Sempervivum tectorum L.	mo	id	al	5	ITNAP
Senecio boissieri DC.	tl	al	ni	3	ESSNE
Senecio igoschinae Schischk.	tl	id	al	4	RUSUR
Senecio incanus L. subsp. incanus	tl	al	al	3	CHVAL
Sesleria albicans Kit. ex Schult.	mo	id	al	5	ATHSW, ITADO
Sesleria ovata (Hoppe) A.Kern.	al	al	ni	2	ATHSW
Sesleria sphaerocephala Ard.	tl	al	al	3	ITADO
Sesleria tenuifolia Schrad. subsp. tenuifolia	tl	id	al	4	ITCAM
Sibbaldia procumbens L.	tl	al	al	3	SELAT
Sibbaldia semiglabra C.A. Mey.	al	al	ni	2	GECAK
Sideritis glacialis Boiss.	tl	al	al	3	ESSNE
Silene acaulis (L.) Jacq.	al	al	ni	2	ESCPY
Silene acaulis (L.) Jacq. subsp. acaulis	al	al	ni	2	ATHSW, ITADO, ITCAM, RUPUR, SELAT
Silene acaulis (L.) Jacq. subsp. bryoides (Jord.) Nyman	al	al	ni	2	CHVAL, ITNAP, SKCTA
Silene boryi Boiss.	mo	tl	ni	5	ESSNE
Silene paucifolia Ledeb.	al	al	al	3	RUPUR
Silene rupestris L.	mo	tl	al	5	CHVAL, ITADO, ITNAP
Silene ruprechtii Schischk.	tl	id	al	4	GECAK
Silene uralensis (Rupr.) Bocquet subsp. apetala (L.) Bocquet	al	al	al	3	RUPUR
Silene vulgaris (Moench) Garcke subsp. vulgaris	mo	id	al	5	ITADO
Soldanella alpina L.	tl	id	al	4	ATHSW, CHVAL, ITADO
Soldanella austriaca Vierh.	al	al	al	3	ATHSW

Soldanella carpatica Vierh.	tl	id	al	4	SKCTA
Soldanella hungarica Simonk. subsp. hungarica	tl	id	al	4	ROCRO
Soldanella hungarica Simonk. subsp. major (Neilr.) Pawl.	mo	tl	al	5	ROCRO
Solidago virgaurea L.	mo	tl	al	5	SKCTA
Solidago virgaurea L. subsp. minuta (L.) Arcang.	mo	tl	al	5	ATHSW, NODOV, ROCRO, RUSUR, SELAT
Sorbus aucuparia L. subsp. sibirica (Hedl.) Krylov	mo	mo	tl	6	RUSUR
Stachys corsica Pers.	mo	id	al	5	FRCRI
Stellaria longipes Goldie	tl	id	ni	4	RUPUR
Stipa bromoides (L.) Dörfl.	mo	id	tl	6	GRLEO
Swertia iberica Fisch. & C.A.Mey.	tl	tl	al	5	GECAK
Swertia obtusa Ledeb.	mo	id	al	5	RUSUR
Taraxacum apenninum agg.	tl	id	al	4	ESCPY, ITADO
Taraxacum bithynicum agg.	mo	tl	al	5	GRLEO
Taraxacum confusum Schischk.	tl	tl	al	5	GECAK
Taraxacum porphyranthum Boiss.	mo	id	al	5	GECAK
Taraxacum stevenii DC.	al	al	ni	2	GECAK
Teucrium alpestre Sibth. & Sm. subsp. alpestre	mo	id	tl	6	GRLEO
Teucrium lerrouxii Sennen	mo	al	al	4	ESSNE
Thalictrum alpinum L.	tl	al	al	3	ESCPY, SELAT
Thesium alpinum L.	mo	id	al	5	CHVAL, ITADO, ITNAP
Thesium bergeri Zucc.	mo	id	tl	6	GRLEO
Thlaspi alpinum Crantz subsp. alpinum	tl	id	al	4	ATHSW
Thlaspi brevistylum (DC.) Mutel	mo	id	al	5	FRCRI
Thlaspi rotundifolium (L.) Gaudin, non Tineo subsp. rotundifolium	tl	al	al	3	ITADO
Thlaspi stylosum (Ten.) Mutel	tl	tl	al	5	ITCAM
Thymus capitatus (L.) Hoffmanns. & Link	mo	mo	tl	6	GRLEO
Thymus collinus Bieb.	tl	tl	al	5	GECAK
Thymus nervosus J.Gay ex Willk.	mo	al	al	4	ESCPY
Thymus nummularius Bieb.	tl	tl	al	5	GECAK
Thymus praecox Opiz subsp. polytrichus (A.Kern. ex Borb s) Jalas	tl	id	al	4	ATHSW, ITADO, ITCAM, ITNAP
Thymus serpylloides Bory subsp. serpylloides	tl	al	al	3	ESSNE
Thymus transcaucasicus Ronn.	tl	tl	al	5	GECAK
Tofieldia pusilla (Michx.) Pers. subsp. pusilla	tl	id	al	4	SELAT
Tragopogon filifolius Rehm. ex Boiss.	tl	tl	al	5	GECAK
Tragopogon reticulatus Boiss. & Huet	tl	tl	al	5	GECAK
Trientalis europaea L.	mo	mo	al	6	RUSUR
Trifolium alpinum L.	tl	id	al	4	ESCPY, ITNAP
Trifolium ambiguum M.Bieb.	mo	id	al	5	GECAK
Trifolium badium Schreb.	mo	tl	al	5	ATHSW
Trifolium canescens Willd.	mo	id	al	5	GECAK
Trifolium pratense L.	mo	id	al	5	ESCPY, ITNAP
Trifolium pratense L. subsp. nivale Arc.	tl	id	al	4	ATHSW
Trifolium repens L.	mo	mo	al	6	GECAK
Trifolium thalii Vill.	tl	id	al	4	ESCPY, ITNAP
Trifolium trichocephalum Bieb.	tl	tl	al	5	GECAK
Trinia dalechampii (Ten.) Janch.	mo	tl	al	5	ITCAM
Trisetum glaciale (Bory) Boiss.	al	al	ni	2	ESSNE
Trisetum spicatum (L.) K.Richt. subsp. spicatum	al	al	ni	2	SELAT
Trollius europaeus L.	mo	id	al	5	ITADO
Trollius ranunculinus (Smith) Stearn	tl	id	al	4	GECAK
Vaccinium myrtillus L.	mo	mo	al	6	ATHSW, CHVAL, GECAK, ITADO, ITNAP, NODOV, ROCRO, SELAT, SKCTA, UKCAI

Vaccinium uliginosum L. subsp. microphyllum Lange	tl	id	al	4	ATHSW, CHVAL, ITADO, ITNAP, ROCRO, SELAT, SKCTA
Vaccinium uliginosum L. subsp. uliginosum	mo	tl	al	5	NODOV, RUPUR, RUSUR
Vaccinium vitis-idaea L.	mo	id	al	5	GECAK
Vaccinium vitis-idaea L. subsp. vitis-idaea	mo	id	al	5	ATHSW, CHVAL, ITADO, ITNAP, NODOV, ROCRO, RUPUR, RUSUR, SELAT, SKCTA
Valeriana capitata Link	tl	id	al	4	RUPUR
Valeriana celtica L. subsp. norica Vierh.	tl	al	al	3	ATHSW
Valeriana officinalis L.	mo	mo	al	6	RUSUR
Valeriana saliunca All.	tl	al	al	3	ITCAM
Valeriana tripteris L.	mo	id	tl	6	CHVAL, ITADO
Velezia rigida L.	mo	id	tl	6	GRLEO
Veronica alpina L.	al	al	ni	2	ATHSW, ESCPY, SELAT
Veronica aphylla L.	tl	al	al	3	ATHSW, ITADO
Veronica baumgartenii Roem. & Schult.	tl	id	al	4	ROCRO
Veronica bellidioides L. subsp. bellidioides	tl	al	al	3	CHVAL
Veronica fruticans Jacq.	tl	id	al	4	ITADO, ITNAP, SELAT
Veronica gentianoides Vahl	tl	id	al	4	GECAK
Veronica nummularia Gouan	tl	al	ni	3	ESCPY
Veronica officinalis L.	mo	mo	tl	6	ESCPY
Veronica telephiifolia Vahl	al	ni	ni	1	GECAK
Veronica thymifolia Sibth. & Sm.	tl	id	al	4	GRLEO
Vicia alpestris Stev.	tl	id	al	4	GECAK
Vicia grossheimii Ekvtim.	tl	tl	al	5	GECAK
Vicia pyrenaica Pourr.	mo	al	al	4	ESCPY
Viola alpina Jacq.	al	al	al	3	ATHSW
Viola biflora L.	tl	id	al	4	ATHSW, ITADO, SELAT
Viola calcarata L. subsp. cavillieri (W. Becker) Merxm. & Lippert	tl	id	al	4	ITNAP
Viola crassiuscula Bory	al	al	ni	2	ESSNE
Viola eugeniae Parl. subsp. eugeniae	mo	tl	al	5	ITCAM
Viola magellensis Porta & Rigo ex Strobl	al	al	al	3	ITCAM
Viola rupestris F.W. Schmidt subsp. rupestris	mo	mo	tl	6	ESCPY
Vitaliana primuliflora Bertol. subsp. canescens O.Schwarz	al	al	ni	2	ESCPY
Vitaliana primuliflora Bertol. subsp. praetutiana (Buser ex Sünd.) I.K.Ferguson	al	al	al	3	ITCAM