Table S1. Variation of survey dates along the elevation gradient.

Prescribed time windows for the first and second survey as a function of the length of the vegetation period (which is a function of elevation). For field work at elevation below 2200 m, two surveys were carried out. Note that the survey time window in different elevations was staggered to match the phenology

Length of vegetation period (day)	Dates for the first survey	Dates for the second survey
> 245	20 March – 1 May	20 July – 1 September
215 – 245	1 April – 10 May	20 July – 1 September
200 – 215	15 April – 25 May	20 July – 1 September
165 – 200	1 May – 10 June	1 August – 20 September
120 – 165	20 May – 1 July	1 August – 20 September
80 – 120	5 June – 15 July	1 August – 10 September
55 – 80	20 June – 1 August	1 August – 10 September

Appendix S1. Specification of multi-species site-occupancy model (Model B in Appendix S2) for the randomly sampled 100 plant species from among all the 1700 species that were detected.

We fitted the following model for occupancy with a quadratic effect for elevation (E):

$$\mathrm{logit}(\psi_{i,k}) = \alpha_{0,k} + \alpha_{1,k} \times E_i + \alpha_{2,k} \times E_i^2, \qquad \text{eqn 1.}$$

Here, $\psi_{i,k}$ is the probability of occurrence of species k at quadrat i, $\alpha_{0,k}$ is the mean occurrence probability (on the logit scale) of species k, $\alpha_{1,k}$ and $\alpha_{2,k}$ are the effects for species k of elevation linear and elevation squared, and E_i is the mean of elevation of quadrat i ($i = 1, 2, \ldots, 451$).

We modelled the effects of species and survey date (D) on detection probability with logit-linear function:

$$\mathrm{logit}(p_{i,j,k}) = \beta_{1,k} + \beta_{2,k} \times D_{i,j} + \beta_{3,k} \times D_{i,j}^2, \qquad \text{eqn 2.}$$

Here, $p_{i,j,k}$ is the detection probability for species k ($k = 1, 2, \ldots, 100$) at quadrat i ($i = 1, 2, \ldots, 451$) during survey j ($j = 1, 2$), $\beta_{1,k}$ is the mean detection probability (on the logit scale) of species k, $\beta_{2,k}$ and $\beta_{3,k}$ are the effects of survey date and date squared respectively. $D_{i,j}$ is survey date at quadrat i ($i = 1, 2, \ldots, 451$) during survey j ($j = 1, 2$).

Consistent with the scope of our study and with the sampling scheme, which resulted in the 100 randomly selected species, we treated all parameters indexed by k as random effects, i.e. as draws from a prior distribution whose parameters we estimated. Specifically, we made the assumption that all sets of species-specific random effects come from Normal distributions with mean μ and variance σ^2 that were both estimated.

Appendix S2. Description of hierarchical multi-species site-occupancy model in the BUGS language.

Model *A* was for the random sample of 100 from among 886 vascular plant species that had at least 20 observed occurrences in the Swiss BDM. Model *B* was for the random sample of 100 from 1700 species that were detected at least once. The model was fit in WinBUGS 1.4.3 (Lunn *et al*. 2000; Spiegelhalter *et al.* 2003), which we called from R through package R2WinBUGS (Sturtz, Ligges & Gelman 2005).

Model *A*

```
## Start of Model A
model {
# Priors
for(mm in 1:4){
   alpha00[mm] ~ dunif(-10, 10) # logit(psi) for life forms
   beta0[mm] ~ dunif(-10, 10) # logit(p) for life forms
}
for(k in 1:nspecies){ # For each species
alpha0[k] ~ dnorm(0, tau.alpha0)
alpha1[k] ~ dnorm(mu.alpha1, tau.alpha1)
alpha2[k] ~ dnorm(mu.alpha2, tau.alpha2)

beta1[k] ~ dnorm(0, tau.beta1)
beta3[k] ~ dnorm(mu.beta3, tau.beta3)
beta4[k] ~ dnorm(mu.beta4, tau.beta4)
beta5[k] ~ dnorm(mu.beta5, tau.beta5)
beta6[k] ~ dnorm(mu.beta6, tau.beta6)
beta7[k] ~ dnorm(mu.beta7, tau.beta7)
beta8[k] ~ dnorm(mu.beta8, tau.beta8)
beta9[k] ~ dnorm(mu.beta9, tau.beta9)
}

tau.alpha0 <- 1 / (sd.alpha0 * sd.alpha0)
sd.alpha0 ~ dunif(0, 10)
mu.alpha1 ~ dunif(-5, 5)
tau.alpha1 <- 1 / (sd.alpha1 * sd.alpha1)
sd.alpha1 ~ dunif(0, 5)
mu.alpha2 ~ dunif(-5, 5)
tau.alpha2 <- 1 / (sd.alpha2 * sd.alpha2)
```

```
sd.alpha2 ~ dunif(0, 5)

tau.beta1 <- 1 / (sd.beta1 * sd.beta1)
sd.beta1 ~ dunif(0, 5)
mu.beta3 ~ dunif(-5, 5)
tau.beta3 <- 1 / (sd.beta3 * sd.beta3)
sd.beta3 ~ dunif(0, 5)
mu.beta4 ~ dunif(-5, 5)
tau.beta4 <- 1 / (sd.beta4 * sd.beta4)
sd.beta4 ~ dunif(0, 5)
mu.beta5 ~ dunif(-5, 5)
tau.beta5 <- 1 / (sd.beta5 * sd.beta5)
sd.beta5 ~ dunif(0, 5)
mu.beta6 ~ dunif(-5, 5)
tau.beta6 <- 1 / (sd.beta6 * sd.beta6)
sd.beta6 ~ dunif(0, 5)
mu.beta7 ~ dunif(-5, 5)
tau.beta7 <- 1 / (sd.beta7 * sd.beta7)
sd.beta7 ~ dunif(0, 5)
mu.beta8 ~ dunif(-5, 5)
tau.beta8 <- 1 / (sd.beta8 * sd.beta8)
sd.beta8 ~ dunif(0, 5)
mu.beta9 ~ dunif(-5, 5)
tau.beta9 <- 1 / (sd.beta9 * sd.beta9)
sd.beta9 ~ dunif(0, 5)

# Likelihood
for (i in 1:nsites) { # Loop over sites
  for(k in 1:nspecies){ # Loop over species
# True state model for the partially observed true state
      # True occupancy z at site i for species k
      z[i,k] ~ dbern(psi[i,k])
      logit(psi[i,k]) <- lpsi.lim[i,k]
      lpsi.lim[i,k] <- min(999, max(-999, lpsi[i,k]))
      lpsi[i,k] <- alpha00[LF[k]] + alpha0[k] + alpha1[k] * elev[i]
+ alpha2[k] * pow(elev[i], 2)

        for (j in 1:nreps){ # Loop over surveys
           # Observation model for the actual observations
           # Detection-non-detection at i and j
           y[i,k,j] ~ dbern(mu.p[i,k,j])
           mu.p[i,k,j] <- z[i,k] * p[i,k,j]
           logit(p[i,k,j]) <- beta0[LF[k]] + beta1[k] + beta3[k]
* elev[i] + beta4[k] * pow(elev[i], 2) + beta5[k] * DATES[i,j] +
beta6[k] * pow(DATES[i,j], 2) + beta7[k] * elev[i] * DATES[i,j] +
```

```
beta8[k] * elev[i] * pow(DATES[i,j], 2) + beta9[k] * pow(elev[i],
2) * DATES[i,j]
         }
   }
}

for(k in 1:nspecies){
# Derived quantities (within species loop)
 occ.fs[k] <- sum(z[,k]) # Number of occupied sites
}
}
## End of Model A
```

Model *B*

```
## Start of Model B
model {
# Priors for occurrence
for(k in 1:nspecies){# For each species
alpha0[k] ~ dnorm(mu.alpha0, tau.alpha0)I(-12, 12)
alpha1[k] ~ dnorm(mu.alpha1, tau.alpha1)I(-12, 12)
alpha2[k] ~ dnorm(mu.alpha2, tau.alpha2)I(-12, 12)

beta1[k] ~ dnorm(mu.beta1, tau.beta1)I(-12, 12)
beta2[k] ~ dnorm(mu.beta2, tau.beta2)I(-12, 12)
beta3[k] ~ dnorm(mu.beta3, tau.beta3)I(-12, 12)
}

mu.alpha0 ~ dunif(-10, 10)
tau.alpha0 <- 1 / (sd.alpha0 * sd.alpha0)
sd.alpha0 ~ dunif(0, 10)
mu.alpha1 ~ dunif(-5, 5)
tau.alpha1 <- 1 / (sd.alpha1 * sd.alpha1)
sd.alpha1 ~ dunif(0, 5)
mu.alpha2 ~ dunif(-5, 5)
tau.alpha2 <- 1 / (sd.alpha2 * sd.alpha2)
sd.alpha2 ~ dunif(0, 5)

mu.beta1 ~ dnorm(0, 0.01)
tau.beta1 <- 1 / (sd.beta1 * sd.beta1)
sd.beta1 ~ dunif(0, 5)

mu.beta2 ~ dnorm(0, 0.01)
```

```
tau.beta2 <- 1 / (sd.beta2 * sd.beta2)
sd.beta2 ~ dunif(0, 5)

mu.beta3 ~ dnorm(0, 0.01)
tau.beta3 <- 1 / (sd.beta3 * sd.beta3)
sd.beta3 ~ dunif(0, 5)

# Likelihood
for (i in 1:nsites) {# Loop over sites
  for(k in 1:nspecies){# Loop over species

 # True state model for the partially observed true state
      # True occupancy z at site i for species k
      z[i,k] ~ dbern(psi[i,k])
      logit(psi[i,k]) <- lpsi.lim[i,k]
      lpsi.lim[i,k] <- min(999, max(-999, lpsi[i,k]))
      lpsi[i,k] <- alpha0[k] + alpha1[k] * elev[i] + alpha2[k] *
elev2[i]

      for (j in 1:nreps){# Loop over surveys
        # Observation model for the actual observations
        # Detection-nondetection at i and j
        y[i,k,j] ~ dbern(mu.p[i,k,j])
        mu.p[i,k,j] <- z[i,k] * p[i,k,j]
        logit(p[i,k,j]) <-  beta1[k] + beta2[k] * DATES[i,j] +
beta3[k] * pow(DATES[i,j], 2)
      }
    }
}

for(k in 1:nspecies){
# Derived quantities (within species loop)
 occ.fs[k] <- sum(z[,k])# Number of occupied sites
 mean.p[k] <- exp(beta1[k]) / (1 + exp(beta1[k]) )
# Average detection
}
}
## End of Model B
```

References

Lunn, D.J., Thomas, A., Best, N. & Spiegelhalter, D. (2000) WinBUGS - A Bayesian modelling framework:

Concepts, structure, and extensibility. *Statistics and Computing*, **10**, 325-337.

Spiegelhalter, D., Thomas, A., Best, N. & Lunn, D. (2003) WinBUGS version 1·4, User Manual. MRC Biostatistics Unit, Cambridge, UK.

Sturtz, S., Ligges, U. & Gelman, A. (2005) R2WinBUGS: A package for running WinBUGS from R. *Journal of Statistical Software*, **12**, 1-16.

Table S2. Results of multi-species site-occupancy model analysis of the stratified random sample of 100 plant species from among 886 vascular plant species that had at least 20 observed occurrences in the Swiss BDM.

Results from the analysis of our site-occupancy model applied to detection/non-detection data from 100 plant species at 451 1 km^2 quadrats in Switzerland. For each species, during both the first survey and the second survey, per-visit detection probability was estimated for the optimum elevation of each species, i.e. at the elevation where each species had the highest estimated occupancy probability. The combined detections for both surveys were the proportions of the quadrats observed among the quadrats estimated. E indicated the linear effect of elevation, and E^2 indicated the quadratic effect of elevation. D indicated the linear effect of survey date, and D^2 indicated the quadratic effect of survey date. The sign ‘+’ indicated significant, the sign ‘-’ indicated not significant. Significant effect in our study was identified if the 95% credible interval (CRI) for that parameter did not cover zero, and no significant effect was identified as the 95% CRI for that parameter covered zero

Species	Life form	Detection probability (First survey)	Detection probability (Second survey)	Detection probability (Both surveys)	E	E^2	D	D^2	$E \times D$	E × D^2	E^2 × D
Achillea macrophylla	forb	0.94	0.94	0.99	−	−	−	−	−	−	−

Alchemilla alpina	forb	0.95	0.95	0.99	−	−	−	−	−	−	−
Allium ursinum	forb	0.80	0.10	0.95	−	−	+	−	−	−	−
Erigeron annuus	forb	0.91	0.96	0.97	+	−	+	−	+	−	−
Galeopsis tetrahit	forb	0.89	0.99	0.99	+	+	+	−	+	−	−
Galium anisophyllon	forb	0.88	0.88	0.97	−	−	−	−	−	−	−
Galium aparine	forb	0.95	0.42	0.98	−	−	+	−	+	−	−
Galium verum	forb	0.77	0.81	0.94	−	−	−	+	−	−	−
Helianthemum alpestre	forb	0.93	0.93	0.96	−	−	−	−	−	−	−
Hieracium intybaceum	forb	0.86	0.86	0.96	−	−	−	−	−	−	−
Hippocrepis emerus	forb	0.97	0.97	1	−	−	−	−	−	−	−
Leucanthemum vulgare	forb	0.96	0.95	0.99	−	+	−	−	+	−	−
Myosotis decumbens	forb	0.92	0.55	0.91	−	−	+	−	−	−	−
Oxalis acetosella	forb	0.97	0.97	1	−	+	−	−	−	−	−
Pedicularis kerneri	forb	0.29	0.29	0.86	−	−	−	−	−	−	−

Phyteuma spicatum	forb	0.95	0.95	1	−	−	−	−	−	−	−
Ranunculus ficaria	forb	0.52	0.01	0.93	−	−	+	−	−	−	−
Rumex sanguineus	forb	0.77	0.99	0.98	−	−	+	−	−	−	−
Sedum dasyphyllum	forb	0.84	0.84	0.87	+	−	−	−	−	−	−
Sherardia arvensis	forb	0.55	0.55	0.82	−	−	−	−	−	−	−
Succisa pratensis	forb	0.67	0.88	0.91	−	+	+	−	−	−	−
Thesium alpinum	forb	0.87	0.87	0.93	−	+	−	−	−	−	−
Verbascum lychnitis	forb	0.87	0.87	0.97	−	−	−	−	−	−	−
Veronica urticifolia	forb	0.96	0.96	1	−	−	−	−	−	−	−
Viola calcarata	forb	0.86	0.36	0.67	−	−	+	−	−	−	−
Achnatherum calamagrostis	grass	0.61	0.94	0.95	−	−	+	−	−	−	−
Agrostis rupestris	grass	0.09	0.73	0.9	−	−	+	−	−	−	−
Alopecurus pratensis	grass	0.78	0.21	0.9	−	−	+	−	+	−	−
Arrhenatherum elatius	grass	0.99	1.00	0.99	+	−	+	−	−	−	−

Brachypodium sylvaticum	grass	0.94	0.99	0.98	+	−	+	−	−	−	−
Calamagrostis villosa	grass	0.70	0.95	0.98	−	−	+	−	−	−	−
Carex caryophyllea	grass	0.89	0.29	0.9	−	−	+	−	−	−	−
Carex muricata	grass	0.88	0.74	0.9	+	−	+	+	−	−	−
Carex parviflora	grass	0.68	0.68	0.85	−	−	−	−	−	−	−
Carex pilulifera	grass	0.88	0.48	0.87	−	−	+	−	−	−	−
Carex sylvatica	grass	0.96	0.96	0.99	+	+	−	−	−	−	−
Digitaria ischaemum	grass	0.07	0.63	0.56	−	−	+	−	−	−	−
Festuca altissima	grass	0.81	0.81	0.9	−	−	−	−	−	−	−
Festuca halleri	grass	0.82	0.82	0.92	−	−	−	−	−	−	−
Festuca ovina	grass	0.79	0.86	0.93	−	+	−	−	+	−	−
Koeleria pyramidata	grass	0.70	0.70	0.87	−	−	−	−	−	−	−
Lolium perenne	grass	0.98	1.00	0.97	+	−	+	−	−	−	−
Luzula campestris	grass	0.96	0.56	0.93	+	+	+	−	+	−	−

Panicum dichotomiflorum	grass	0.08	0.76	0.6	−	−	+	−	−	−	−
Phleum hirsutum	grass	0.26	0.82	0.85	−	−	+	−	−	−	−
Phleum pratense	grass	0.59	0.97	0.96	−	−	+	−	−	−	−
Poa annua	grass	0.99	0.99	1	+	−	−	−	+	−	−
Poa nemoralis	grass	0.82	0.91	0.97	−	−	+	−	+	−	−
Poa supina	grass	0.95	0.82	0.96	−	−	+	−	−	−	−
Trisetum spicatum	grass	0.17	0.17	0.74	−	−	−	−	−	−	−
Amelanchier ovalis	shrub	0.82	0.82	0.92	−	−	−	−	−	−	−
Buddleja davidii	shrub	0.72	0.94	0.98	−	−	+	−	−	−	−
Crataegus laevigata	shrub	0.86	0.86	0.97	−	−	−	−	−	−	−
Dryas octopetala	shrub	0.93	0.93	0.98	−	−	−	−	−	−	−
Ilex aquifolium	shrub	0.86	0.86	0.99	−	−	−	−	−	−	−
Juniperus communis	shrub	0.88	0.96	0.99	−	−	+	−	−	−	−
Lonicera caerulea	shrub	0.66	0.94	0.97	−	−	+	−	−	−	−

Lonicera nigra	shrub	0.89	0.89	0.98	−	−	−	−	−	−	−
Lonicera xylosteum	shrub	0.97	0.93	1	+	+	+	−	−	−	−
Potentilla grandiflora	shrub	0.92	0.92	0.96	−	−	−	−	−	−	−
Prunus laurocerasus	shrub	0.71	0.71	0.96	−	−	−	−	−	−	−
Prunus spinosa	shrub	0.97	0.97	1	−	−	−	−	−	−	−
Rhododendron ferrugineum	shrub	0.84	0.84	0.78	−	+	−	−	−	−	−
Ribes uva-crispa	shrub	0.69	0.69	0.88	−	−	−	−	−	−	−
Rosa arvensis	shrub	0.79	0.96	0.98	−	−	+	−	−	−	−
Rosa pendulina	shrub	0.87	0.95	0.98	−	+	−	−	+	−	−
Rubus fruticosus	shrub	0.98	1.00	1	+	−	+	−	−	−	−
Salix cinerea	shrub	0.77	0.90	0.96	−	−	+	−	−	−	−
Salix hastata	shrub	0.40	0.40	0.59	−	−	−	−	−	−	−
Salix retusa	shrub	0.93	0.93	0.98	−	−	−	−	−	−	−
Salix serpyllifolia	shrub	0.88	0.88	0.9	−	−	−	−	−	−	−

Sambucus nigra	shrub	0.99	0.99	0.99	+	−	−	−	−	−	−
Sambucus racemosa	shrub	0.89	0.86	0.97	+	−	−	−	+	−	−
Vaccinium myrtillus	shrub	0.96	0.96	0.97	−	+	−	−	−	−	−
Viburnum opulus	shrub	0.95	0.95	0.99	−	−	−	−	−	−	−
Abies alba	tree	0.96	0.96	1	+	−	−	−	−	−	−
Acer campestre	tree	0.97	0.97	1	−	−	−	−	−	−	−
Acer platanoides	tree	0.96	0.96	0.99	+	−	−	−	−	−	−
Alnus incana	tree	0.94	0.94	0.98	−	+	−	−	−	−	−
Betula pendula	tree	0.88	0.96	0.98	−	−	+	−	−	−	−
Carpinus betulus	tree	0.96	0.96	0.99	−	−	−	−	−	−	−
Frangula alnus	tree	0.73	0.73	0.94	−	−	−	−	−	−	−
Larix decidua	tree	0.95	0.95	0.97	−	−	−	−	−	−	−
Pinus cembra	tree	0.82	0.82	0.86	−	−	−	−	−	−	−
Pinus mugo	tree	0.90	0.90	0.92	−	−	−	−	−	−	−

Populus alba	tree	0.89	0.89	0.96	−	−	−	−	−	−	−
Populus nigra ssp. nigra	tree	0.81	0.81	0.95	−	−	−	−	−	−	−
Populus tremula	tree	0.87	0.94	0.98	−	+	+	−	−	−	−
Prunus avium	tree	0.95	0.95	0.99	+	−	−	−	−	−	−
Prunus domestica	tree	0.51	0.79	0.93	−	−	+	−	−	−	−
Prunus padus	tree	0.84	0.84	0.92	+	−	−	−	−	−	−
Pyrus pyraster	tree	0.57	0.93	0.94	−	−	+	−	−	−	−
Quercus petraea	tree	0.79	0.79	0.94	−	−	−	−	−	−	−
Quercus robur	tree	0.96	0.99	0.99	+	−	+	−	−	−	−
Robinia pseudoacacia	tree	0.83	0.97	0.98	−	−	+	−	−	−	−
Salix appendiculata	tree	0.76	0.94	0.97	−	−	+	−	−	−	−
Sorbus aucuparia	tree	0.97	0.97	0.99	−	+	−	−	−	−	−
Sorbus mougeotii	tree	0.52	0.78	0.8	−	−	+	−	−	−	−
Taxus baccata	tree	0.72	0.72	0.94	−	−	−	−	−	−	−

Tilia platyphyllos	tree	0.87	0.87	0.97	–	–	–	–	–	–	–