

New Phytologist Supporting Information

Article title: Disturbed habitats locally reduce the signal of deep evolutionary history in functional traits of plants

Authors: Andreas Prinzing, Sandrine Pavoine, Hervé Jactel, Joaquin Hortal, Stephan M. Hennekens, Wim A. Ozinga, Igor Bartish, R. Matthew Helmus, Ingolf Kühn, Daniel S. Moen, Evan Weiher, Martin Brändle, Marten Winter, Cyrille Violle, Patrick Venail, Oliver Purschke and Benjamin Yguel Article acceptance date: 26 July 2021

Notes S1: Criteria for retaining local communities, sample sizes of communities and species, calculus of phylogenetic signal, and baseline data per habitat type.

Criteria for retaining local communities

From the Dutch vegetation database, we first excluded communities without information on plot size, as plot size was needed to calculate abundance, resulting in about 250,000 communities. A second filter excluded all communities containing at least one species not present in our Angiosperm phylogeny, hybrids or individuals not identified at the species level. This filter left 48,339 communities. We decided to reduce this number arbitrarily to around 10,000 to reduce computation time (4 days for 10 traits and the about 6,700 communities finally studied, see below) and tried to obtain similar numbers of communities per habitat type (i.e. about 232 communities per habitat type). We chose those communities randomly from the 48,339 communities. However, some habitat types were represented by less than 232 communities; and we chose to exclude habitat types that had less than 25 communities to ensure representative information for each habitat type considered. Note that not all traits were available for all species and a few of the remaining habitat types had less

than 25 communities for some traits, and were hence also excluded. Overall, we retained 38 out of the 43 habitat types and 6,851 communities containing 984 angiosperm species.

Finally, we removed communities without variation in traits among species (as it can occur for ordinal traits in species-poor communities), because phylogenetic signal (PS) cannot be calculated without trait variation. This left 6,704 communities in total, and between 6,424 to 6,693 communities per trait. See Table A for the number of communities per trait and per habitat type.

Measuring phylogenetic signal (PS)

We used a modified version of the tips/root skewness test by Pavoine et al. (2010). The advantage of this approach compared to other metrics such as Blomberg' K is that it can handle multiple traits, including quantitative, qualitative, and ordered traits (See Pavoine et al. 2010). This parameter has proven to be consistent with but more powerful than other measures to detect PS (e.g. Bennett et al. 2013). According to Pavoine et al. (2016), we calculated the functional dissimilarity among the lineages that descend from a node as:

$$w_i^* = \frac{\text{card}(\text{dd}_{n_i})}{\text{card}(\text{dd}_{n_i}) - 1} \left[\frac{H_{\Delta} \left(\sum_{g=1}^{\text{card}(\text{dd}_{n_i})} P_{\text{dd}_{n_i}[g]} \right) - \sum_{g=1}^{\text{card}(\text{dd}_{n_i})} H_{\Delta} \left(P_{\text{dd}_{n_i}[g]} \right)}{1 - \sum_{g=1}^{\text{card}(\text{dd}_{n_i})} H_{\Delta} \left(P_{\text{dd}_{n_i}[g]} \right)} \right]$$

where n_i is the i th interior node of a phylogenetic tree, dd_{n_i} is the set of direct descending nodes, which may be interior nodes or tips, that arise from the node n_i , $\text{dd}_{n_i}[g]$ is the g th direct descending node from n_i , $\text{card}(\text{dd}_{n_i})$ is the number of nodes that directly descend from

the node n_i , $H_{\Delta}(P)$ is trait diversity measured by Rao's Q (Botta-Dukat 2005) applied to $P_{dd_{ni}}$ [g] the vector of abundance of species descending from dd_{ni} [g] and Δ the matrix of functional distances between species. This statistic, w_i^* , corresponds to de Bello et al. (2010, Eq. 14) scaled beta diversity where the focal species assemblages here are the lineages that descend from node n_i . It varies between 0 and 1.

Then, as a modification of the S3 statistics by Pavoine et al. (2010), we calculated PS as:

$$PS = 1 - \frac{1}{N} \sum_{i=1}^N i \frac{w_i^*}{\sum_{i=1}^N w_i^*}$$

where the sum of w_i^* is over interior nodes ordered from low to high values of the sum of branch lengths between the node and the root, N is the total number of interior nodes in the phylogenetic tree (including the root node) and w_i^* is the phylogenetic dissimilarity among the lineages descending from node i as defined above. The advantage of this modification is that varies from 0 to 1, signifying low to a strong PS, respectively.

Measures were performed in R (R Core Team 2020) with function *decdiv* (with argument *option* = 2 in package *adiv* v2.0, Pavoine 2020).

REFERENCES

Bennett J. A. and Cahill J. F. (2013) Conservatism of responses to environmental change is rare under natural conditions in a native grassland. *Perspect. Plant Ecol. Evol. Syst.*, 15, 328-337.

Botta-Dukat Z. (2005). Rao's quadratic entropy as a measure of functional diversity based on multiple traits. *Journal of Vegetation Science* 16: 533-540.

De Bello, F., Lavergne, S., Meynard, C. N., Lepš, J., & Thuiller, W. (2010). The partitioning of diversity: showing Theseus a way out of the labyrinth. *J Veg. Sci.*, 21(5), 992-1000.

Pavoine, S., M. Baguette, and M. B. Bonsall. (2010). Decomposition of trait diversity among the nodes of a phylogenetic tree. *Ecol. Monogr.* 80:485-507.

Pavoine, S., Marcon, E., & Ricotta, C. (2016). 'Equivalent numbers' for species, phylogenetic or functional diversity in a nested hierarchy of multiple scales. *Methods in Ecology and Evolution*, 7(10), 1152-1163

Pavoine, S. (2020) adiv: an R package to analyse biodiversity in ecology. *Methods in Ecology and Evolution*. In press..

R Core Team. (2020). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. ISBN 3-900051-07-0, URL <http://www.R-project.org/>.

Baseline data per habitat type

Notes S1 Table A. Characterising habitat types by local trait diversity, trait PS and phylogenetic diversity (MPD). N = number of communities; m = mean across local communities per habitat types; s.d. = standard deviation; LDMC = leaf dry matter content; SLA = specific leaf area. Nsp = total number of species analyzed per trait. Habitat terminology as in the Dutch National Vegetation Database.

		Trait diversity									
Habitat type ... name	no.	Flowering duration	LDMC	Life Form	Plant Height	Breeding	Reproduction type	Seed Shape	Seed Mass	SLA	Flowering date
		Nsps=977	Nsps=846	Nsps=982	Nsps=935	Nsps=855	Nsps=977	Nsps=820	Nsps=822	Nsps=889	Nsps=977
Free floating duckweeds	1	N:141; m:4.30E-03; s.d.:7.82E-03	N:140; m:2.09E-02; s.d.:2.94E-02	N:90; m:1.90E-03; s.d.:2.12E-03	N:141; m:3.17E-04; s.d.:6.07E-04	N:140; m:3.26E-02; s.d.:2.77E-02	N:138; m:1.58E-02; s.d.:1.51E-02	N:121; m:2.81E-03; s.d.:4.61E-03	N:103; m:1.22E-04; s.d.:3.44E-04	N:141; m:2.34E-03; s.d.:7.16E-03	N:141; m:7.53E-02; s.d.:4.48E-02
Sublittoral and eulittoral zones of temperate seas	3	N:66; m:1.65E-03; s.d.:2.04E-03	N:3; m:5.52E-03; s.d.:4.19E-03	N:19; m:3.33E-03; s.d.:2.38E-03	N:35; m:3.20E-05; s.d.:2.98E-05	N:20; m:2.95E-02; s.d.:2.10E-02	N:20; m:6.44E-02; s.d.:4.89E-02	NA	N:18; m:2.06E-06; s.d.:1.94E-07	N:35; m:2.82E-03; s.d.:2.61E-03	N:67; m:2.88E-02; s.d.:3.74E-02
Submerged stonewort swards	4	N:24; m:5.44E-03; s.d.:4.45E-03	N:28; m:3.10E-02; s.d.:2.39E-02	N:21; m:5.09E-03; s.d.:2.22E-03	N:28; m:6.63E-04; s.d.:5.71E-04	N:28; m:2.78E-02; s.d.:2.95E-02	N:24; m:1.29E-02; s.d.:1.33E-02	N:9; m:5.81E-04; s.d.:5.75E-04	N:28; m:3.30E-07; s.d.:3.47E-07	N:28; m:1.06E-02; s.d.:7.07E-03	N:28; m:4.15E-02; s.d.:2.21E-02
Floating or submerged rooted plants in fresh waters	5	N:219; m:4.98E-03; s.d.:5.91E-03	N:229; m:1.45E-02; s.d.:1.50E-02	N:145; m:5.06E-03; s.d.:5.04E-03	N:215; m:2.78E-04; s.d.:2.91E-04	N:222; m:3.74E-02; s.d.:3.20E-02	N:176; m:1.58E-02; s.d.:1.34E-02	N:192; m:2.23E-03; s.d.:5.35E-03	N:206; m:2.18E-04; s.d.:3.96E-04	N:229; m:1.49E-02; s.d.:1.51E-02	N:221; m:4.39E-02; s.d.:3.22E-02
Soakways and shallow, fluctuating standing waters	6	N:205; m:4.27E-03; s.d.:4.08E-03	N:211; m:1.51E-02; s.d.:1.40E-02	N:205; m:8.92E-03; s.d.:1.27E-02	N:211; m:1.36E-03; s.d.:1.22E-02	N:211; m:3.67E-02; s.d.:3.43E-02	N:174; m:1.63E-02; s.d.:1.66E-02	N:207; m:1.40E-03; s.d.:4.29E-03	N:211; m:4.10E-06; s.d.:5.56E-05	N:211; m:9.01E-03; s.d.:1.01E-02	N:211; m:6.02E-02; s.d.:3.37E-02
Swamps and fens	8	N:223; m:4.30E-03; s.d.:4.72E-03	N:232; m:2.32E-02; s.d.:2.31E-02	N:214; m:1.01E-02; s.d.:1.65E-02	N:232; m:1.50E-03; s.d.:7.94E-03	N:215; m:4.23E-02; s.d.:3.78E-02	N:220; m:1.70E-02; s.d.:1.54E-02	N:232; m:9.96E-04; s.d.:1.52E-03	N:232; m:1.89E-05; s.d.:1.20E-04	N:232; m:2.77E-03; s.d.:3.49E-03	N:232; m:6.45E-02; s.d.:4.18E-02
Small sedges on wet to moist soils	9	N:232; m:3.98E-03; s.d.:2.51E-03	N:232; m:1.77E-02; s.d.:1.31E-02	N:232; m:7.70E-03; s.d.:6.58E-03	N:232; m:5.79E-04; s.d.:3.00E-03	N:225; m:2.59E-02; s.d.:1.67E-02	N:201; m:1.05E-02; s.d.:9.36E-03	N:232; m:1.80E-03; s.d.:3.01E-03	N:232; m:4.60E-04; s.d.:3.27E-03	N:232; m:1.55E-03; s.d.:8.16E-04	N:232; m:7.86E-02; s.d.:2.53E-02
Bog vegetation of deep, wet peats	11	N:232; m:2.08E-03; s.d.:1.60E-03	N:232; m:1.67E-02; s.d.:1.44E-02	N:232; m:2.27E-02; s.d.:1.54E-02	N:232; m:7.38E-03; s.d.:1.59E-02	N:232; m:6.18E-02; s.d.:4.07E-02	N:232; m:1.42E-02; s.d.:1.15E-02	N:232; m:2.99E-03; s.d.:5.48E-03	N:232; m:2.99E-03; s.d.:1.03E-02	N:232; m:8.48E-04; s.d.:7.96E-04	N:232; m:7.69E-02; s.d.:5.03E-02
Strongly trampled vegetation in moist places	12	N:232; m:3.59E-02; s.d.:2.54E-02	N:232; m:1.08E-02; s.d.:5.62E-03	N:227; m:1.09E-02; s.d.:8.06E-03	N:232; m:5.32E-04; s.d.:6.49E-03	N:232; m:6.55E-02; s.d.:3.15E-02	N:231; m:4.24E-02; s.d.:2.20E-02	N:232; m:1.32E-03; s.d.:8.84E-04	N:232; m:7.70E-07; s.d.:6.34E-06	N:232; m:1.37E-03; s.d.:8.56E-04	N:232; m:1.16E-01; s.d.:3.79E-02
Swards on sandy soils	14	N:232; m:2.02E-02; s.d.:1.68E-02	N:232; m:2.21E-02; s.d.:1.11E-02	N:227; m:1.86E-02; s.d.:1.95E-02	N:232; m:6.96E-03; s.d.:2.81E-02	N:227; m:6.97E-02; s.d.:5.01E-02	N:232; m:3.81E-02; s.d.:2.27E-02	N:232; m:5.20E-03; s.d.:1.32E-02	N:232; m:6.56E-03; s.d.:2.85E-02	N:232; m:2.00E-03; s.d.:9.56E-04	N:232; m:1.11E-01; s.d.:3.61E-02
Chalk grasslands	15	N:116; m:1.27E-02; s.d.:2.58E-03	N:116; m:3.37E-02; s.d.:5.91E-03	N:116; m:1.50E-02; s.d.:7.95E-03	N:116; m:8.33E-04; s.d.:1.61E-03	N:116; m:6.11E-02; s.d.:8.67E-03	N:116; m:4.77E-02; s.d.:9.55E-03	N:116; m:4.18E-03; s.d.:1.11E-03	N:116; m:1.91E-04; s.d.:1.27E-03	N:116; m:7.00E-04; s.d.:2.44E-04	N:116; m:1.11E-01; s.d.:1.84E-02
Meadows and pastures of well-drained soils	16	N:232; m:2.35E-02; s.d.:1.69E-02	N:232; m:1.50E-02; s.d.:6.91E-03	N:226; m:8.41E-03; s.d.:7.17E-03	N:232; m:5.81E-04; s.d.:3.07E-03	N:232; m:6.37E-02; s.d.:3.34E-02	N:230; m:3.93E-02; s.d.:1.81E-02	N:232; m:1.88E-03; s.d.:1.67E-03	N:232; m:2.71E-04; s.d.:2.52E-03	N:232; m:1.75E-03; s.d.:1.17E-03	N:232; m:1.09E-01; s.d.:3.18E-02
Fringe communities	17	N:45; m:1.10E-02; s.d.:4.21E-03	N:45; m:2.69E-02; s.d.:1.41E-02	N:45; m:2.50E-02; s.d.:1.89E-02	N:45; m:4.63E-03; s.d.:2.10E-02	N:45; m:4.68E-02; s.d.:1.48E-02	N:45; m:4.69E-02; s.d.:1.25E-02	N:45; m:3.23E-03; s.d.:1.33E-03	N:45; m:2.20E-04; s.d.:1.28E-03	N:45; m:9.74E-04; s.d.:4.26E-04	N:45; m:1.07E-01; s.d.:2.03E-02
Woodland margin and ride vegetation in drier situations	18	N:230; m:1.51E-02; s.d.:1.13E-02	N:230; m:1.75E-02; s.d.:7.83E-03	N:230; m:6.40E-02; s.d.:4.10E-02	N:230; m:8.97E-02; s.d.:7.82E-02	N:230; m:4.27E-02; s.d.:3.02E-02	N:230; m:5.00E-02; s.d.:1.97E-02	N:230; m:4.57E-02; s.d.:4.26E-02	N:230; m:9.20E-02; s.d.:9.14E-02	N:230; m:3.20E-03; s.d.:1.25E-03	N:230; m:1.35E-01; s.d.:3.03E-02
Unfertilized mat-grass pastures at	19	N:228; m:3.87E-03;	N:232; m:1.83E-02;	N:228; m:2.39E-02;	N:232; m:1.75E-02;	N:228; m:2.84E-02;	N:232; m:2.96E-02;	N:232; m:6.97E-03;	N:232; m:1.14E-02;	N:232; m:1.33E-03;	N:232; m:1.08E-01;

lower elevations		s.d.:4.19E-03	s.d.:1.28E-02	s.d.:1.89E-02	s.d.:2.96E-02	s.d.:2.74E-02	s.d.:2.02E-02	s.d.:1.37E-02	s.d.:2.62E-02	s.d.:1.12E-03	s.d.:4.72E-02
Heathlands	20	N:121; m:3.56E-03; s.d.:3.48E-03	N:121; m:1.85E-02; s.d.:1.19E-02	N:121; m:2.68E-02; s.d.:1.80E-02	N:121; m:1.46E-02; s.d.:3.00E-02	N:121; m:3.87E-02; s.d.:2.70E-02	N:121; m:2.32E-02; s.d.:1.62E-02	N:121; m:6.31E-03; s.d.:1.44E-02	N:121; m:1.10E-02; s.d.:3.31E-02	N:121; m:1.04E-03; s.d.:9.48E-04	N:121; m:1.18E-01; s.d.:4.48E-02
Communities of crevices of sunny wells	21	N:33; m:3.07E-02; s.d.:2.46E-02	N:33; m:2.90E-02; s.d.:2.66E-02	N:31; m:2.73E-02; s.d.:1.94E-02	N:33; m:4.44E-03; s.d.:9.01E-03	N:33; m:7.28E-02; s.d.:4.08E-02	N:33; m:4.42E-02; s.d.:1.41E-02	N:33; m:2.84E-03; s.d.:4.75E-03	N:33; m:1.82E-05; s.d.:4.31E-05	N:33; m:3.48E-03; s.d.:3.26E-03	N:33; m:1.15E-01; s.d.:4.55E-02
Salt-marsh and strandlines sometimes mixed with sand	22	N:173; m:4.23E-03; s.d.:7.79E-03	N:174; m:1.08E-02; s.d.:1.57E-02	N:171; m:1.49E-02; s.d.:9.12E-03	N:174; m:8.42E-05; s.d.:1.85E-04	N:172; m:4.10E-02; s.d.:3.54E-02	N:171; m:3.77E-02; s.d.:2.57E-02	N:174; m:2.24E-03; s.d.:2.32E-03	N:174; m:1.33E-06; s.d.:2.83E-06	N:174; m:6.74E-04; s.d.:7.04E-04	N:173; m:5.16E-02; s.d.:3.50E-02
Pioneer vegetation of coastal foredunes	23	N:146; m:4.14E-03; s.d.:7.54E-03	N:116; m:1.03E-02; s.d.:9.46E-03	N:149; m:8.08E-03; s.d.:6.48E-03	N:117; m:6.50E-05; s.d.:6.00E-05	N:110; m:5.91E-02; s.d.:3.99E-02	N:134; m:3.45E-02; s.d.:1.93E-02	N:149; m:5.10E-03; s.d.:3.30E-03	N:115; m:3.08E-06; s.d.:3.30E-06	N:116; m:8.59E-04; s.d.:9.76E-04	N:148; m:6.03E-02; s.d.:3.48E-02
Perennial cord grasses on intertidal mud and sand	24	N:232; m:4.83E-03; s.d.:2.36E-03	N:232; m:1.05E-02; s.d.:9.10E-03	N:232; m:8.73E-03; s.d.:6.22E-03	N:232; m:4.64E-05; s.d.:7.66E-05	N:232; m:3.44E-02; s.d.:2.41E-02	N:232; m:5.40E-02; s.d.:3.43E-02	N:232; m:3.20E-03; s.d.:2.32E-03	N:232; m:1.29E-06; s.d.:6.07E-07	N:232; m:6.65E-04; s.d.:4.89E-04	N:232; m:4.70E-02; s.d.:2.44E-02
Annual succulent halophytes, periodically flooded	25	N:222; m:2.31E-03; s.d.:1.86E-03	N:232; m:1.22E-02; s.d.:8.75E-03	N:225; m:1.74E-02; s.d.:9.84E-03	N:232; m:2.73E-05; s.d.:1.02E-04	N:222; m:6.87E-02; s.d.:4.31E-02	N:223; m:4.86E-02; s.d.:2.78E-02	N:232; m:1.23E-03; s.d.:1.64E-03	N:232; m:2.30E-07; s.d.:4.74E-07	N:232; m:1.32E-03; s.d.:1.21E-03	N:232; m:5.33E-02; s.d.:2.70E-02
Inundated and inland salt marsh ephemerals	26	N:231; m:4.10E-03; s.d.:4.07E-03	N:232; m:1.42E-02; s.d.:1.01E-02	N:230; m:1.04E-02; s.d.:7.93E-03	N:232; m:6.58E-05; s.d.:1.90E-04	N:228; m:6.68E-02; s.d.:3.97E-02	N:231; m:2.82E-02; s.d.:2.17E-02	N:232; m:1.74E-03; s.d.:1.47E-03	N:232; m:8.43E-08; s.d.:1.58E-07	N:232; m:1.19E-03; s.d.:1.11E-03	N:232; m:6.36E-02; s.d.:3.30E-02
Ephemerals on bare or disturbed salt-marsh mud and sand	27	N:49; m:1.32E-02; s.d.:1.65E-02	N:49; m:2.84E-02; s.d.:1.12E-02	N:49; m:2.06E-02; s.d.:9.00E-03	N:49; m:1.81E-04; s.d.:2.24E-04	N:49; m:9.51E-02; s.d.:3.23E-02	N:49; m:4.12E-02; s.d.:1.37E-02	N:49; m:1.20E-03; s.d.:1.02E-03	N:49; m:2.18E-07; s.d.:4.42E-07	N:49; m:2.86E-03; s.d.:1.26E-03	N:49; m:1.02E-01; s.d.:2.93E-02
Therophytes on bare, periodically flooded ground	28	N:232; m:2.75E-02; s.d.:3.02E-02	N:232; m:1.67E-02; s.d.:9.51E-03	N:227; m:2.39E-02; s.d.:1.49E-02	N:232; m:1.37E-03; s.d.:6.28E-03	N:232; m:1.24E-01; s.d.:5.56E-02	N:232; m:4.78E-02; s.d.:1.90E-02	N:232; m:1.12E-03; s.d.:1.82E-03	N:232; m:3.30E-04; s.d.:3.49E-03	N:232; m:5.08E-03; s.d.:4.70E-03	N:232; m:1.12E-01; s.d.:4.76E-02
Heavily nutrient-loaded ruderal habitats	29	N:232; m:2.11E-02; s.d.:2.30E-02	N:232; m:1.63E-02; s.d.:1.02E-02	N:231; m:2.10E-02; s.d.:2.13E-02	N:232; m:2.62E-03; s.d.:1.28E-02	N:232; m:1.10E-01; s.d.:4.84E-02	N:231; m:4.49E-02; s.d.:1.95E-02	N:232; m:1.38E-03; s.d.:1.27E-03	N:232; m:8.17E-05; s.d.:1.21E-03	N:232; m:4.27E-03; s.d.:6.43E-03	N:232; m:1.05E-01; s.d.:3.77E-02
Arable weed communities	30	N:230; m:5.40E-02; s.d.:3.57E-02	N:230; m:1.26E-02; s.d.:6.94E-03	N:221; m:1.51E-02; s.d.:8.95E-03	N:230; m:2.20E-04; s.d.:6.24E-04	N:230; m:1.07E-01; s.d.:4.31E-02	N:224; m:4.48E-02; s.d.:2.88E-02	N:230; m:4.15E-03; s.d.:6.26E-03	N:230; m:6.81E-05; s.d.:6.14E-04	N:230; m:3.15E-03; s.d.:2.08E-03	N:230; m:1.35E-01; s.d.:5.55E-02
Xero-mesophilous ruderals on nutrient-rich soils	31	N:232; m:2.20E-02; s.d.:2.05E-02	N:232; m:1.48E-02; s.d.:8.41E-03	N:232; m:1.38E-02; s.d.:1.57E-02	N:232; m:3.57E-03; s.d.:1.80E-02	N:223; m:6.56E-02; s.d.:4.83E-02	N:232; m:4.76E-02; s.d.:2.42E-02	N:232; m:4.54E-03; s.d.:8.82E-03	N:232; m:2.74E-03; s.d.:1.89E-02	N:232; m:1.59E-03; s.d.:1.18E-03	N:232; m:1.08E-01; s.d.:4.23E-02
Tall-herb vegetation on moist fertile soils and	32	N:230; m:4.77E-03; s.d.:6.23E-03	N:231; m:3.14E-02; s.d.:2.06E-02	N:230; m:1.36E-02; s.d.:1.85E-02	N:231; m:2.40E-03; s.d.:1.02E-02	N:230; m:3.75E-02; s.d.:2.54E-02	N:231; m:2.25E-02; s.d.:1.73E-02	N:231; m:1.55E-03; s.d.:1.01E-03	N:231; m:5.74E-06; s.d.:7.65E-06	N:231; m:2.39E-03; s.d.:1.72E-03	N:231; m:7.37E-02; s.d.:4.12E-02

peats												
Sunny and semi-shaded margins and clearings of woods	33	N:231; m:1.14E-02; s.d.:1.41E-02	N:231; m:1.36E-02; s.d.:1.16E-02	N:216; m:3.04E-02; s.d.:4.34E-02	N:231; m:1.81E-02; s.d.:4.19E-02	N:226; m:4.46E-02; s.d.:3.11E-02	N:230; m:3.44E-02; s.d.:2.23E-02	N:231; m:7.90E-03; s.d.:1.93E-02	N:231; m:9.42E-03; s.d.:3.91E-02	N:231; m:1.82E-03; s.d.:4.58E-03	N:231; m:1.08E-01; s.d.:5.51E-02	
Herbaceous forest-clearing communities on poor soils	34	N:53; m:1.36E-02; s.d.:2.18E-02	N:53; m:1.64E-02; s.d.:9.68E-03	N:53; m:7.79E-02; s.d.:3.09E-02	N:53; m:9.29E-02; s.d.:6.76E-02	N:53; m:4.41E-02; s.d.:3.50E-02	N:52; m:5.81E-02; s.d.:1.80E-02	N:53; m:3.78E-02; s.d.:3.62E-02	N:53; m:7.20E-02; s.d.:8.21E-02	N:53; m:3.05E-03; s.d.:1.27E-03	N:53; m:1.42E-01; s.d.:4.17E-02	
Bramble underscrub of woodland edges and clearings	35	N:124; m:6.03E-03; s.d.:6.99E-03	N:124; m:9.81E-03; s.d.:8.83E-03	N:124; m:6.19E-02; s.d.:3.52E-02	N:124; m:1.11E-01; s.d.:6.63E-02	N:122; m:3.43E-02; s.d.:3.02E-02	N:124; m:4.98E-02; s.d.:2.52E-02	N:124; m:5.58E-02; s.d.:3.55E-02	N:124; m:1.25E-01; s.d.:9.26E-02	N:124; m:3.71E-03; s.d.:6.49E-03	N:124; m:1.34E-01; s.d.:4.66E-02	
Willow scrub and woodland of mires	36	N:232; m:4.71E-03; s.d.:4.43E-03	N:232; m:4.34E-02; s.d.:2.26E-02	N:232; m:6.58E-02; s.d.:2.40E-02	N:232; m:2.32E-02; s.d.:3.33E-02	N:228; m:2.87E-02; s.d.:2.23E-02	N:224; m:2.58E-02; s.d.:2.17E-02	N:232; m:7.42E-03; s.d.:1.72E-02	N:232; m:9.19E-03; s.d.:3.11E-02	N:232; m:4.45E-03; s.d.:4.00E-03	N:232; m:1.73E-01; s.d.:4.95E-02	
Hedges and scrub of mesotrophic, base-rich soils	37	N:232; m:9.37E-03; s.d.:7.80E-03	N:232; m:2.44E-02; s.d.:9.37E-03	N:232; m:9.19E-02; s.d.:3.10E-02	N:232; m:3.64E-02; s.d.:5.21E-02	N:232; m:5.09E-02; s.d.:2.85E-02	N:232; m:5.13E-02; s.d.:1.70E-02	N:232; m:1.50E-02; s.d.:2.08E-02	N:232; m:1.75E-02; s.d.:5.25E-02	N:232; m:3.50E-03; s.d.:1.65E-03	N:232; m:1.24E-01; s.d.:4.37E-02	
Woodland of river shoals and terraces	38	N:231; m:8.82E-03; s.d.:8.05E-03	N:228; m:2.61E-02; s.d.:1.38E-02	N:231; m:8.96E-02; s.d.:3.37E-02	N:228; m:5.77E-02; s.d.:4.12E-02	N:228; m:4.63E-02; s.d.:2.89E-02	N:229; m:4.96E-02; s.d.:2.00E-02	N:228; m:3.17E-03; s.d.:7.74E-03	N:228; m:1.94E-03; s.d.:1.66E-02	N:228; m:4.09E-03; s.d.:1.96E-03	N:231; m:1.75E-01; s.d.:4.42E-02	
Woodlands of swamps, fens and wet pastures	39	N:107; m:9.00E-03; s.d.:6.35E-03	N:107; m:1.51E-02; s.d.:8.48E-03	N:107; m:1.00E-01; s.d.:2.07E-02	N:107; m:6.47E-02; s.d.:3.58E-02	N:107; m:4.21E-02; s.d.:1.99E-02	N:107; m:3.80E-02; s.d.:1.59E-02	N:107; m:1.40E-02; s.d.:2.49E-02	N:107; m:2.45E-02; s.d.:5.60E-02	N:107; m:3.67E-03; s.d.:2.16E-03	N:107; m:2.01E-01; s.d.:2.76E-02	
Birch-dominated swampy woodlands	40	N:79; m:4.67E-03; s.d.:6.24E-03	N:79; m:1.13E-02; s.d.:5.79E-03	N:79; m:7.60E-02; s.d.:2.69E-02	N:79; m:8.58E-02; s.d.:3.64E-02	N:65; m:2.37E-02; s.d.:3.53E-02	N:79; m:3.81E-02; s.d.:2.47E-02	N:79; m:2.81E-02; s.d.:2.76E-02	N:79; m:5.50E-02; s.d.:6.10E-02	N:79; m:8.97E-04; s.d.:9.93E-04	N:79; m:1.59E-01; s.d.:3.82E-02	
Acidophilous oak, birch, or beech forests	42	N:230; m:7.70E-03; s.d.:5.43E-03	N:230; m:7.30E-03; s.d.:4.33E-03	N:230; m:7.22E-02; s.d.:3.22E-02	N:230; m:1.37E-01; s.d.:5.33E-02	N:221; m:3.31E-02; s.d.:2.67E-02	N:230; m:5.60E-02; s.d.:2.37E-02	N:230; m:8.53E-02; s.d.:2.60E-02	N:230; m:1.94E-01; s.d.:5.47E-02	N:230; m:2.81E-03; s.d.:4.63E-03	N:230; m:1.27E-01; s.d.:4.19E-02	
Broadleaved woodlands on lime-rich and neutral mull soils	43	N:114; m:1.34E-02; s.d.:9.59E-03	N:114; m:2.17E-02; s.d.:1.18E-02	N:114; m:1.06E-01; s.d.:2.70E-02	N:114; m:1.03E-01; s.d.:5.05E-02	N:114; m:6.52E-02; s.d.:2.29E-02	N:114; m:4.69E-02; s.d.:1.90E-02	N:114; m:2.57E-02; s.d.:3.05E-02	N:114; m:4.57E-02; s.d.:7.71E-02	N:114; m:6.72E-03; s.d.:1.67E-02	N:114; m:1.79E-01; s.d.:3.51E-02	
Number of communities analyzed		Ntotal=6653	Ntotal =6602	Ntotal =6424	Ntotal =6622	Ntotal =6513	Ntotal =6466	Ntotal =6553	Ntotal =6556	Ntotal =6635	Ntotal =6693	
Phylogenetic signal												
habitat name	Habit at type	Flowering duration	LDMC	Life Form	Plant Height	Breeding	Reproduction type	Seed Shape	Seed Mass	SLA	Flowering date	
Free floating duckweeds	1	N:141; m:7.76E-01; s.d.:1.81E-01	N:140; m:9.16E-01; s.d.:9.44E-02	N:90; m:7.47E-01; s.d.:2.02E-01	N:141; m:8.38E-01; s.d.:1.86E-01	N:140; m:9.14E-01; s.d.:8.24E-02	N:138; m:8.43E-01; s.d.:1.07E-01	N:121; m:9.03E-01; s.d.:1.06E-01	N:103; m:8.51E-01; s.d.:1.79E-01	N:141; m:7.87E-01; s.d.:1.69E-01	N:141; m:8.46E-01; s.d.:1.20E-01	
Sublittoral and eulittoral zones of temperate seas	3	N:66; m:6.76E-01; s.d.:3.25E-01	N:3; m:9.32E-01; s.d.:1.08E-01	N:19; m:9.95E-01; s.d.:0.00E00	N:35; m:9.89E-01; s.d.:1.90E-02	N:20; m:9.85E-01; s.d.:3.81E-02	N:20; m:9.89E-01; s.d.:2.51E-02	NA	N:18; m:9.96E-01; s.d.:6.92E-11	N:35; m:9.89E-01; s.d.:1.96E-02	N:67; m:6.63E-01; s.d.:3.26E-01	

Submerged stonewort swards	4	N:24; m:7.52E-01; s.d.:1.66E-01	N:28; m:6.51E-01; s.d.:3.16E-01	N:21; m:5.17E-01; s.d.:2.19E-01	N:28; m:9.26E-01; s.d.:1.35E-01	N:28; m:5.91E-01; s.d.:3.43E-01	N:24; m:5.47E-01; s.d.:2.39E-01	N:9; m:9.04E-01; s.d.:8.36E-02	N:28; m:6.73E-01; s.d.:2.81E-01	N:28; m:7.18E-01; s.d.:2.31E-01	N:28; m:7.57E-01; s.d.:1.60E-01
Floating or submerged rooted plants in fresh waters	5	N:219; m:8.63E-01; s.d.:1.94E-01	N:229; m:8.64E-01; s.d.:2.02E-01	N:145; m:8.17E-01; s.d.:2.36E-01	N:215; m:8.61E-01; s.d.:1.79E-01	N:222; m:7.65E-01; s.d.:2.68E-01	N:176; m:8.36E-01; s.d.:1.94E-01	N:192; m:9.22E-01; s.d.:1.14E-01	N:206; m:7.92E-01; s.d.:2.22E-01	N:229; m:8.17E-01; s.d.:2.08E-01	N:221; m:8.62E-01; s.d.:1.76E-01
Soakways and shallow, fluctuating standing waters	6	N:205; m:8.42E-01; s.d.:1.62E-01	N:211; m:8.90E-01; s.d.:1.30E-01	N:205; m:8.82E-01; s.d.:1.46E-01	N:211; m:8.59E-01; s.d.:1.54E-01	N:211; m:9.02E-01; s.d.:1.21E-01	N:174; m:8.42E-01; s.d.:1.90E-01	N:207; m:8.82E-01; s.d.:1.32E-01	N:211; m:8.80E-01; s.d.:1.53E-01	N:211; m:8.91E-01; s.d.:1.41E-01	N:211; m:8.57E-01; s.d.:1.31E-01
Swamps and fens	8	N:223; m:8.68E-01; s.d.:1.56E-01	N:232; m:8.20E-01; s.d.:1.34E-01	N:214; m:8.66E-01; s.d.:1.45E-01	N:232; m:8.31E-01; s.d.:1.70E-01	N:215; m:8.80E-01; s.d.:1.53E-01	N:220; m:8.81E-01; s.d.:1.26E-01	N:232; m:8.84E-01; s.d.:1.42E-01	N:232; m:9.16E-01; s.d.:1.30E-01	N:232; m:8.62E-01; s.d.:1.42E-01	N:232; m:8.65E-01; s.d.:1.32E-01
Small sedges on wet to moist soils	9	N:232; m:8.17E-01; s.d.:1.32E-01	N:232; m:8.72E-01; s.d.:8.87E-02	N:232; m:8.81E-01; s.d.:1.40E-01	N:232; m:7.10E-01; s.d.:1.92E-01	N:225; m:8.17E-01; s.d.:1.57E-01	N:201; m:7.77E-01; s.d.:1.92E-01	N:232; m:7.18E-01; s.d.:1.57E-01	N:232; m:8.08E-01; s.d.:1.49E-01	N:232; m:8.09E-01; s.d.:1.13E-01	N:232; m:7.83E-01; s.d.:1.21E-01
Bog vegetation of deep, wet peats	11	N:232; m:9.04E-01; s.d.:7.75E-02	N:232; m:8.51E-01; s.d.:1.08E-01	N:232; m:9.48E-01; s.d.:1.17E-01	N:232; m:8.92E-01; s.d.:1.01E-01	N:232; m:8.96E-01; s.d.:6.92E-02	N:232; m:8.65E-01; s.d.:1.05E-01	N:232; m:8.82E-01; s.d.:1.70E-01	N:232; m:9.10E-01; s.d.:1.39E-01	N:232; m:9.34E-02; s.d.:9.46E-02	N:232; m:8.71E-01; s.d.:8.70E-02
Strongly trampled vegetation in moist places	12	N:232; m:7.70E-01; s.d.:1.52E-01	N:232; m:7.45E-01; s.d.:1.27E-01	N:227; m:7.91E-01; s.d.:1.90E-01	N:232; m:7.91E-01; s.d.:1.49E-01	N:232; m:7.06E-01; s.d.:1.32E-01	N:231; m:6.42E-01; s.d.:1.04E-01	N:232; m:6.80E-01; s.d.:1.04E-01	N:232; m:6.98E-01; s.d.:1.24E-01	N:232; m:7.11E-01; s.d.:1.40E-01	N:232; m:6.44E-01; s.d.:1.04E-01
Swards on sandy soils	14	N:232; m:7.16E-01; s.d.:1.62E-01	N:232; m:8.11E-01; s.d.:1.13E-01	N:227; m:7.61E-01; s.d.:1.74E-01	N:232; m:7.43E-01; s.d.:1.80E-01	N:227; m:7.59E-01; s.d.:1.57E-01	N:232; m:6.76E-01; s.d.:1.63E-01	N:232; m:7.42E-01; s.d.:1.44E-01	N:232; m:7.85E-01; s.d.:1.77E-01	N:232; m:6.74E-01; s.d.:1.40E-01	N:232; m:7.07E-01; s.d.:1.10E-01
Chalk grasslands	15	N:116; m:5.44E-01; s.d.:6.54E-02	N:116; m:8.36E-01; s.d.:3.81E-02	N:116; m:7.77E-01; s.d.:8.32E-02	N:116; m:7.41E-01; s.d.:1.14E-01	N:116; m:6.71E-01; s.d.:6.85E-02	N:116; m:6.76E-01; s.d.:7.38E-02	N:116; m:6.86E-01; s.d.:5.94E-02	N:116; m:7.59E-01; s.d.:1.06E-01	N:116; m:7.07E-01; s.d.:7.98E-02	N:116; m:6.16E-01; s.d.:4.66E-02
Meadows and pastures of well-drained soils	16	N:232; m:6.34E-01; s.d.:1.72E-01	N:232; m:7.65E-01; s.d.:1.06E-01	N:226; m:6.56E-01; s.d.:1.99E-01	N:232; m:6.47E-01; s.d.:1.39E-01	N:232; m:7.14E-01; s.d.:1.21E-01	N:230; m:6.20E-01; s.d.:1.18E-01	N:232; m:6.99E-01; s.d.:1.06E-01	N:232; m:7.44E-01; s.d.:1.40E-01	N:232; m:6.77E-01; s.d.:1.35E-01	N:232; m:6.71E-01; s.d.:1.05E-01
Fringe communities	17	N:45; m:6.13E-01; s.d.:8.41E-02	N:45; m:7.72E-01; s.d.:1.04E-01	N:45; m:7.81E-01; s.d.:7.11E-02	N:45; m:7.75E-01; s.d.:9.48E-02	N:45; m:6.92E-01; s.d.:1.00E-01	N:45; m:6.41E-01; s.d.:8.74E-02	N:45; m:6.92E-01; s.d.:7.22E-02	N:45; m:7.78E-01; s.d.:1.06E-01	N:45; m:6.65E-01; s.d.:8.98E-02	N:45; m:6.57E-01; s.d.:5.32E-02
Woodland margin and ride vegetation in drier situations	18	N:230; m:6.74E-01; s.d.:1.68E-01	N:230; m:7.95E-01; s.d.:8.07E-02	N:230; m:8.96E-01; s.d.:6.92E-02	N:230; m:9.21E-01; s.d.:5.27E-02	N:230; m:7.99E-01; s.d.:1.21E-01	N:230; m:7.10E-01; s.d.:1.00E-01	N:230; m:8.89E-01; s.d.:7.42E-02	N:230; m:9.24E-01; s.d.:5.00E-02	N:230; m:6.72E-01; s.d.:1.07E-01	N:230; m:7.24E-01; s.d.:8.59E-02
Unfertilized mat-grass pastures at lower elevations	19	N:228; m:7.82E-01; s.d.:1.56E-01	N:232; m:8.51E-01; s.d.:1.00E-01	N:228; m:9.53E-01; s.d.:6.50E-02	N:232; m:9.00E-01; s.d.:1.01E-01	N:228; m:9.04E-01; s.d.:8.81E-02	N:232; m:7.78E-01; s.d.:1.42E-01	N:232; m:8.68E-01; s.d.:9.94E-02	N:232; m:8.74E-01; s.d.:1.29E-01	N:232; m:8.00E-01; s.d.:1.38E-01	N:232; m:8.50E-01; s.d.:8.92E-02
Heathlands	20	N:121; m:7.75E-01; s.d.:1.65E-01	N:121; m:7.81E-01; s.d.:8.67E-02	N:121; m:4.47E-01; s.d.:5.73E-02	N:121; m:8.85E-01; s.d.:8.91E-02	N:121; m:8.53E-01; s.d.:8.46E-02	N:121; m:7.56E-01; s.d.:1.43E-01	N:121; m:8.94E-01; s.d.:7.63E-02	N:121; m:9.04E-01; s.d.:7.38E-02	N:121; m:8.26E-01; s.d.:1.44E-01	N:121; m:8.27E-01; s.d.:8.32E-02
Communities of crevices of sunny wells	21	N:33; m:7.07E-01; s.d.:2.03E-01	N:33; m:8.81E-01; s.d.:6.44E-02	N:31; m:8.09E-01; s.d.:1.68E-01	N:33; m:8.38E-01; s.d.:1.42E-01	N:33; m:7.50E-01; s.d.:1.25E-01	N:33; m:8.32E-01; s.d.:1.27E-01	N:33; m:8.60E-01; s.d.:1.11E-01	N:33; m:8.79E-01; s.d.:1.42E-01	N:33; m:7.30E-01; s.d.:1.76E-01	N:33; m:7.63E-01; s.d.:1.46E-01
Salt-marsh and strandlines sometimes	22	N:173; m:8.38E-01; s.d.:1.84E-01	N:174; m:7.99E-01; s.d.:1.83E-01	N:171; m:8.81E-01; s.d.:1.44E-01	N:174; m:8.10E-01; s.d.:1.44E-01	N:172; m:7.35E-01; s.d.:2.28E-01	N:171; m:8.91E-01; s.d.:1.31E-01	N:174; m:7.65E-01; s.d.:1.85E-01	N:174; m:8.10E-01; s.d.:1.87E-01	N:174; m:6.84E-01; s.d.:1.78E-01	N:173; m:8.51E-01; s.d.:1.51E-01

mixed with sand												
Pioneer vegetation of coastal foredunes	23	N:146; m:9.07E-01; s.d.:1.24E-01	N:116; m:9.12E-01; s.d.:1.07E-01	N:149; m:9.02E-01; s.d.:1.44E-01	N:117; m:8.87E-01; s.d.:1.19E-01	N:110; m:9.33E-01; s.d.:1.13E-01	N:134; m:9.28E-01; s.d.:1.00E-01	N:149; m:9.39E-01; s.d.:9.49E-02	N:115; m:9.34E-01; s.d.:8.72E-02	N:116; m:8.71E-01; s.d.:1.37E-01	N:148; m:9.24E-01; s.d.:9.88E-02	
Perennial cord grasses on intertidal mud and sand	24	N:232; m:9.72E-01; s.d.:6.92E-02	N:232; m:8.03E-01; s.d.:1.53E-01	N:232; m:8.67E-01; s.d.:1.39E-01	N:232; m:8.80E-01; s.d.:8.98E-02	N:232; m:9.26E-01; s.d.:8.09E-02	N:232; m:9.26E-01; s.d.:8.81E-02	N:232; m:9.55E-01; s.d.:5.68E-02	N:232; m:9.14E-01; s.d.:7.99E-02	N:232; m:8.40E-01; s.d.:1.09E-01	N:232; m:8.59E-01; s.d.:9.64E-02	
Annual succulent halophytes, periodically flooded	25	N:222; m:9.03E-01; s.d.:1.26E-01	N:232; m:7.22E-01; s.d.:1.31E-01	N:225; m:8.93E-01; s.d.:1.21E-01	N:232; m:7.65E-01; s.d.:1.45E-01	N:222; m:9.54E-01; s.d.:6.80E-02	N:223; m:9.47E-01; s.d.:7.48E-02	N:232; m:9.00E-01; s.d.:1.24E-01	N:232; m:8.24E-01; s.d.:1.39E-01	N:232; m:8.11E-01; s.d.:9.80E-02	N:232; m:8.12E-01; s.d.:9.33E-02	
Inundated and inland salt marsh ephemerals	26	N:231; m:8.39E-01; s.d.:1.50E-01	N:232; m:8.39E-01; s.d.:1.02E-01	N:230; m:8.21E-01; s.d.:1.55E-01	N:232; m:7.69E-01; s.d.:1.14E-01	N:228; m:9.26E-01; s.d.:7.73E-02	N:231; m:8.55E-01; s.d.:1.46E-01	N:232; m:9.02E-01; s.d.:1.02E-01	N:232; m:7.88E-01; s.d.:1.31E-01	N:232; m:7.94E-01; s.d.:1.17E-01	N:232; m:8.40E-01; s.d.:1.04E-01	
Ephemerals on bare or disturbed salt-marsh mud and sand	27	N:49; m:7.73E-01; s.d.:1.48E-01	N:49; m:8.38E-01; s.d.:8.47E-02	N:49; m:8.02E-01; s.d.:1.21E-01	N:49; m:7.10E-01; s.d.:1.04E-01	N:49; m:8.96E-01; s.d.:1.00E-01	N:49; m:8.13E-01; s.d.:1.20E-01	N:49; m:7.94E-01; s.d.:1.14E-01	N:49; m:7.62E-01; s.d.:1.64E-01	N:49; m:7.74E-01; s.d.:1.14E-01	N:49; m:7.69E-01; s.d.:9.13E-02	
Therophytes on bare, periodically flooded ground	28	N:232; m:7.05E-01; s.d.:1.71E-01	N:232; m:8.48E-01; s.d.:8.26E-02	N:227; m:8.02E-01; s.d.:1.09E-01	N:232; m:7.79E-01; s.d.:1.30E-01	N:232; m:8.16E-01; s.d.:1.08E-01	N:232; m:8.19E-01; s.d.:1.18E-01	N:232; m:8.09E-01; s.d.:8.91E-02	N:232; m:8.38E-01; s.d.:1.26E-01	N:232; m:8.25E-01; s.d.:1.02E-01	N:232; m:7.67E-01; s.d.:1.06E-01	
Heavily nutrient-loaded ruderal habitats	29	N:232; m:6.37E-01; s.d.:2.02E-01	N:232; m:7.87E-01; s.d.:1.19E-01	N:231; m:7.17E-01; s.d.:1.59E-01	N:232; m:6.85E-01; s.d.:1.65E-01	N:232; m:7.63E-01; s.d.:1.30E-01	N:231; m:7.49E-01; s.d.:1.32E-01	N:232; m:7.85E-01; s.d.:1.04E-01	N:232; m:7.76E-01; s.d.:1.62E-01	N:232; m:7.13E-01; s.d.:1.41E-01	N:232; m:7.05E-01; s.d.:1.24E-01	
Arable weed communities	30	N:230; m:7.81E-01; s.d.:1.32E-01	N:230; m:8.09E-01; s.d.:8.51E-02	N:221; m:7.05E-01; s.d.:1.33E-01	N:230; m:7.20E-01; s.d.:9.29E-02	N:230; m:7.14E-01; s.d.:1.17E-01	N:224; m:7.23E-01; s.d.:1.23E-01	N:230; m:7.49E-01; s.d.:1.02E-01	N:230; m:7.84E-01; s.d.:1.34E-01	N:230; m:7.56E-01; s.d.:1.00E-01	N:230; m:7.22E-01; s.d.:9.90E-02	
Xero-mesophilous ruderals on nutrient-rich soils	31	N:232; m:6.63E-01; s.d.:1.58E-01	N:232; m:8.09E-01; s.d.:1.01E-01	N:232; m:7.72E-01; s.d.:1.57E-01	N:232; m:7.24E-01; s.d.:1.35E-01	N:223; m:7.29E-01; s.d.:1.49E-01	N:232; m:6.77E-01; s.d.:1.25E-01	N:232; m:7.28E-01; s.d.:1.12E-01	N:232; m:7.76E-01; s.d.:1.59E-01	N:232; m:7.39E-01; s.d.:1.34E-01	N:232; m:7.04E-01; s.d.:1.12E-01	
Tall-herb vegetation on moist fertile soils and peats	32	N:230; m:8.77E-01; s.d.:1.17E-01	N:231; m:9.02E-01; s.d.:8.67E-02	N:230; m:9.00E-01; s.d.:9.22E-02	N:231; m:8.57E-01; s.d.:1.21E-01	N:230; m:8.90E-01; s.d.:1.23E-01	N:231; m:8.75E-01; s.d.:1.18E-01	N:231; m:8.93E-01; s.d.:1.07E-01	N:231; m:9.39E-01; s.d.:9.69E-02	N:231; m:8.79E-01; s.d.:1.16E-01	N:231; m:8.81E-01; s.d.:8.33E-02	
Sunny and semi-shaded margins and clearings of woods	33	N:231; m:8.09E-01; s.d.:1.63E-01	N:231; m:8.71E-01; s.d.:1.02E-01	N:216; m:8.96E-01; s.d.:1.31E-01	N:231; m:8.45E-01; s.d.:1.25E-01	N:226; m:8.05E-01; s.d.:1.59E-01	N:230; m:8.11E-01; s.d.:1.37E-01	N:231; m:8.38E-01; s.d.:1.14E-01	N:231; m:9.01E-01; s.d.:1.04E-01	N:231; m:8.29E-01; s.d.:1.30E-01	N:231; m:8.30E-01; s.d.:1.09E-01	
Herbaceous forest-clearing communities on poor soils	34	N:53; m:7.71E-01; s.d.:1.34E-01	N:53; m:8.04E-01; s.d.:8.86E-02	N:53; m:9.29E-01; s.d.:5.80E-02	N:53; m:8.96E-01; s.d.:6.04E-02	N:53; m:8.56E-01; s.d.:9.19E-02	N:52; m:8.09E-01; s.d.:8.24E-02	N:53; m:8.65E-01; s.d.:7.28E-02	N:53; m:8.72E-01; s.d.:9.29E-02	N:53; m:7.47E-01; s.d.:1.09E-01	N:53; m:7.92E-01; s.d.:7.18E-02	

mesotrophic, base-rich soils		s.d.:35.80									
Woodland of river shoals and terraces	38	N:231; m:172.17; s.d.:41.74									
Woodlands of swamps, fens and wet pastures	39	N:107; m:186.22; s.d.:18.96									
Birch-dominated swampy woodlands	40	N:79; m:158.21; s.d.:27.35									
Acidophilous oak, birch, or beech forests	42	N:230; m:159.97; s.d.:35.36									
Broadleaved woodlands on lime-rich and neutral mull soils	43	N:114; m:194.88; s.d.:21.07									
Number of communities analyzed		6704									

Notes S1 Table B. Species richness of communities averaged by habitat type and species richness of the species pool of each habitat type.

Habitat Type -		Mean species richness of communities	Species richness of the species pool
Number	Name		
1	Free floating duckweeds	6.12	87
3	Sublittoral and eulittoral zones of temperate seas	1.45	74
4	Submerged stonewort swards	4.43	233
5	Floating or submerged rooted plants in fresh waters	5.39	353
6	Soakways and shallow, fluctuating standing waters	7.75	135
8	Swamps and fens	8.81	299
9	Small sedges on wet to moist soils	11.29	176
11	Bog vegetation of deep, wet peats	5.52	289

12	Strongly trampled vegetation in moist places	16.83	182
14	Swards on sandy soils	17.58	126
15	Chalk grasslands	31.84	96
16	Meadows and pastures of well-drained soils	20.81	133
17	Fringe communities	30.13	73
18	Woodland margin and ride vegetation in drier situations	24.9	27
19	Unfertilized mat-grass pastures at lower elevations	10.09	41
20	Heathlands	10.04	115
21	Communities of crevices of sunny wells	9.39	146
22	Salt-marsh and strandlines sometimes mixed with sand	7.44	292
23	Pioneer vegetation of coastal foredunes	4.40	305
24	Perennial cord grasses on intertidal mud and sand	5.34	8
25	Annual succulent halophytes, periodically flooded	5.38	279
26	Inundated and inland salt marsh ephemerals	8.86	379
27	Ephemerals on bare or disturbed salt-marsh mud and sand	17.73	215
28	Therophytes on bare, periodically flooded ground	13.57	271
29	Heavily nutrient-loaded ruderal habitats	18.96	163
30	Arable weed communities	18.49	169
31	Xero-mesophilous ruderals on nutrient-rich soils	18.47	222
32	Tall-herb vegetation on moist fertile soils and peats	10.79	269
33	Sunny and semi-shaded margins and clearings of woods	11.59	259
34	Herbaceous forest-clearing communities on poor soils	18.19	183
35	Bramble underscrub of woodland edges and clearings	13.06	36
36	Willow scrub and woodland of mires	12.86	100
37	Hedges and scrub of mesotrophic, base-rich soils	15.56	173
38	Woodland of river shoals and terraces	16.01	251
39	Woodlands of swamps, fens and wet pastures	19.11	133

40	Birch-dominated swampy woodlands	9.53	179
42	Acidophilous oak, birch, or beech forests	14.23	226
43	Broadleaved woodlands on lime-rich and neutral mull soils	22.41	165

Notes S2: Ranking of habitat types for local disturbance and stress

Notes S2 Tab. A. Ranking of local disturbance and stress based on observation approach

Binary level of disturbance and stress for habitat types from the Netherlands, from direct observation reflected by habitat names (explained in text). NA = Habitat name not informative as explained in the text. Habitat terminology from the Dutch National Vegetation Database.

Number	Habitat Type - Name	Disturbance	Stress
1	Free floating duckweeds	NA	1
3	Sublittoral and eulittoral zones of temperate seas	NA	1
4	Submerged stonewort swards	NA	1
5	Floating or submerged rooted plants in fresh waters	NA	1
6	Soakways and shallow, fluctuating standing waters	1	1
8	Swamps and fens	NA	NA
9	Small sedges on wet to moist soils	NA	0
11	Bog vegetation of deep, wet peats	NA	1
12	Strongly trampled vegetation in moist places	1	0
14	Swards on sandy soils	NA	1
15	Chalk grasslands	1	0
16	Meadows and pastures of well-drained soils	1	0
17	Fringe communities	NA	0
18	Woodland margin and ride vegetation in drier situations	NA	0
19	Unfertilized mat-grass pastures at lower elevations	1	0
20	Heathlands	NA	1
21	Communities of crevices of sunny wells	NA	1
22	Salt-marsh and strandlines sometimes mixed with sand	1	1
23	Pioneer vegetation of coastal foredunes	1	1
24	Perennial cord grasses on intertidal mud and sand	1	1
25	Annual succulent halophytes, periodically flooded	1	1
26	Inundated and inland salt marsh ephemerals	1	1
27	Ephemerals on bare or disturbed salt-marsh mud and sand	1	1
28	Therophytes on bare, periodically flooded ground	1	NA
29	Heavily nutrient-loaded ruderal habitats	1	0
30	Arable weed communities	1	0
31	Xero-mesophilous ruderals on nutrient-rich soils	1	NA
32	Tall-herb vegetation on moist fertile soils and peats	NA	0
33	Sunny and semi-shaded margins and clearings of woods	NA	0
34	Herbaceous forest-clearing communities on poor soils	NA	1
35	Bramble underscrub of woodland edges and clearings	NA	0

36	Willow scrub and woodland of mires	0	0
37	Hedges and scrub of mesotrophic, base-rich soils	NA	0
38	Woodland of river shoals and terraces	0	0
39	Woodlands of swamps, fens and wet pastures	0	0
40	Birch-dominated swampy woodlands	0	0
42	Acidophilous oak, birch, or beech forests	0	NA
43	Broadleaved woodlands on lime-rich and neutral mull soils	0	0

Notes S2 Tab. B. Ranking of local disturbance and stress based on inference approach

Means (and SDs) of local disturbance and stress within Dutch habitat types; underlying local values are means across rankings of S and R strategies of species present (Methods). Note that these means across local communities within habitat types strongly correlate to means across species present in the respective habitat species-pools ($R^2 = 0.70$ and 0.84 for the disturbance, and stress, respectively). N: number of local communities with ranking available for at least one species.

Habitat Typ		Disturbance		Stress		
Number	Name	Mean	SD	Mean	SD	N
1	Free floating duckweeds	1.06	1.21	6.60	1.41	113
3	Sublittoral and eulittoral zones of temperate seas	0.00	0.00	12.00	0.00	19
4	Submerged stonewort swards	0.84	1.14	7.46	1.26	14
5	Floating or submerged rooted plants in fresh waters	1.08	1.51	6.81	1.40	121
6	Soakways and shallow, fluctuating standing waters	2.38	1.44	5.58	1.26	211
8	Swamps and fens	1.01	1.10	5.56	1.66	232
9	Small sedges on wet to moist soils	1.77	0.59	5.29	1.18	232
11	Bog vegetation of deep, wet peats	0.45	0.60	7.11	1.53	232
12	Strongly trampled vegetation in moist places	3.23	1.25	2.58	1.17	232
14	Swards on sandy soils	3.17	1.59	2.97	1.13	232
15	Chalk grasslands	2.85	0.29	3.35	0.41	116
16	Meadows and pastures of well-drained soils	2.43	0.66	2.39	0.93	232
17	Fringe communities	2.51	0.56	2.11	0.52	45
18	Woodland margin and ride vegetation in drier situations	1.88	0.77	2.40	0.71	230
19	Unfertilized mat-grass pastures at lower elevations	1.38	0.72	5.22	1.22	232
20	Heathlands	1.17	0.69	5.13	1.68	121

21	Communities of crevices of sunny wells	3.96	1.33	2.59	1.16	33
22	Salt-marsh and strandlines sometimes mixed with sand	1.17	1.30	8.28	2.18	174
23	Pioneer vegetation of coastal foredunes	2.09	1.76	7.79	2.50	149
24	Perennial cord grasses on intertidal mud and sand	0.01	0.08	10.66	0.70	232
25	Annual succulent halophytes, periodically flooded	0.05	0.28	11.19	0.91	232
26	Inundated and inland salt marsh ephemerals	0.59	0.85	9.05	1.75	232
27	Ephemerals on bare or disturbed salt-marsh mud and sand	3.16	0.83	5.71	1.36	49
28	Therophytes on bare, periodically flooded ground	6.30	1.81	2.62	1.13	232
29	Heavily nutrient-loaded ruderal habitats	3.89	1.47	3.38	1.19	232
30	Arable weed communities	7.64	1.37	0.72	0.54	230
31	Xero-mesophilous ruderals on nutrient-rich soils	2.92	1.87	1.42	0.75	232
32	Tall-herb vegetation on moist fertile soils and peats	0.95	0.77	2.80	1.28	231
33	Sunny and semi-shaded margins and clearings of woods	1.86	0.97	1.28	0.81	231
34	Herbaceous forest-clearing communities on poor soils	1.59	1.02	1.81	0.98	53
35	Bramble underscrub of woodland edges and clearings	0.93	0.58	1.17	0.90	124
36	Willow scrub and woodland of mires	0.69	0.67	3.53	1.30	232
37	Hedges and scrub of mesotrophic, base-rich soils	1.68	0.77	0.92	0.56	232
38	Woodland of river shoals and terraces	1.41	0.79	2.23	1.00	231
39	Woodlands of swamps, fens and wet pastures	0.97	0.56	2.07	1.09	107
40	Birch-dominated swampy woodlands	0.27	0.43	3.25	1.12	79
42	Acidophilous oak, birch, or beech forests	0.75	0.54	1.64	0.84	230
43	Broadleaved woodlands on lime-rich and neutral mull soils	1.63	0.58	1.56	0.67	114

Notes S3: Definitions of species traits

For each species, we extracted the values of 10 functional traits relevant to community assembly and ecosystem functioning (e.g. Kunstler et al. 2016) from two complementary databases: BIOLFLOR (Klotz et al. 2002) and LEDA (Kleyer et al. 2008). To match the species names between the phylogeny and the trait dataset, we checked the synonymy using the Taxonomic Name Resolution Service (TNRS: <http://tnrs.iplantcollaborative.org>, Boyle et al. 2013). From BIOLFLOR, we collated the following traits, taking the most common trait state if several states were indicated for the same species: 1) “flowering duration” in months. 2) “flowering date”, treated as a multivariate trait integrating months of flowering start and end (as in Pavoine et al. 2009). 3) “reproduction type” (coded from 1 completely vegetative, to 3 completely sexual); 4) “breeding system” (coded from 1 always allogamous, to 5 always autogamous); 5) “seed mass” (i.e. diaspore mass) in mg; 6) “seed shape” (using the scores on the second axis of a principal component analysis based on heights, lengths and widths of seeds, in cm); and 7) “life form”, ranked from entirely ephemeral, to ephemeral above ground but persistent below ground, to persistent also above ground but close to the soil surface, to persistent far above soil surface (0-Therophyte, 1-Geophyte, 2-Hemicryptophyte, 3-Chamaephyte, dwarf shrub, 4-Hemiphanerophyte, 5-Nanophanerophyte, and 6-Macrophanerophyte). From LEDA, we obtained: 8) “specific leaf area” (SLA) in mm²/mg; 9) “leaf dry-matter content” (LDMC) in mg/g; and 10) “maximum height” in meters. In LEDA, we also collected seed-mass data (i.e. trait 5) that were not available in BIOLFLOR. When for a trait information differed between LEDA and BIOLFLOR we calculated the mean values for quantitative traits, and we used LEDA values for qualitative traits. The number of species with trait data varied between 820 and 982 (984 species in total), depending on the trait. For details about the number of species available per trait, see Notes S1 Table A.

Boyle, B., Hopkins, N., Lu, Z., Garay JAR, Mozzherin D, Rees T, Matasci N, Narro ML, Piel WH *et al.*. 2013. The taxonomic name resolution service: an online tool for automated standardization of plant names. *BMC Bioinformatics* **14**. <https://doi.org/10.1186/1471-2105-14-16>.

Kleyer M, Bekker RM, Knevel IC, Bakker JP, Thompson K, Sonnenschein M, Poschlod P, van Groenendael JM, Klimes L, Klimesova J. 2008. The LEDA Traitbase: A database of life-history traits of Northwest European flora. *Journal of Ecology* **96**: 1266-1274.

Klotz S, Kühn I, Durka W. 2002. BIOLFLOR - Eine Datenbank zu biologisch-ökologischen Merkmalen zur Flora von Deutschland. *Schriftenreihe für Vegetationskunde. Bonn, Bundesamt für Naturschutz* **38**: 1-333.

Kunstler G, Lavergne S, Courbaud B, Thuiller W, Vieilledent G, Zimmermann NE, [Kattge J](#), [Coomes DA](#). 2012. Competitive interactions between forest trees are driven by species' trait hierarchy, not phylogenetic or functional similarity: implications for forest community assembly. *Ecology Letters* **15**: 831-840.

Pavoine S, Love MS, Bonsall MB. 2009. Hierarchical partitioning of evolutionary and ecological patterns in the organization of phylogenetically-structured species assemblages: application to rockfish (genus: *Sebastes*) in the Southern California Bight. *Ecology Letters* **12**: 898-908.

Notes S4: Sufficient resolution of our phylogenetic tree

We characterized the evolutionary relationships between all native species through a recent, dated phylogeny of all 1,283 species of Dutch angiosperm flora (excluding hybrids, subspecies, and exotics; Tree Base ID S13572). The data on sequences of genes, fossil calibrations, and specific analyses used to reconstruct this phylogeny have been more thoroughly described in Hermant et al. (2012) and Bartish et al. (2016). This phylogeny is consistent with, but regionally more representative than, the phylogeny of Zanne et al. (2014). Among others, our phylogeny is resolved within the older genera (>35 Myrs). As a result, the overall resolution of our phylogeny is 58%. Such a resolution permits reliable conclusions: Bartish et al. (2016) calculated from this phylogeny diversity of lineages dating back to a given geological epoch (Bartish et al. 2016) and found that they are correlated at $r^2=0.999$ to those calculated after randomly resolving the remaining polytomies, resulting in the same conclusions in further analyses in Bartish et al. (2016, 2020). Even in less resolved phylogenies, phylogenetic signals calculated from unresolved phylogenies are very highly correlated to those calculated from randomly resolved phylogenies (Li et al. 2019; data in Seger et al. 2013 appendix 7). Finally, with a 58% resolved phylogeny even absolute values of phylogenetic signal are almost identical to those after 100% resolution (Davies et al. 2011, Molina-Venegas & Rodríguez 2017).

Bartish IV, Ozinga WA, Bartish MI, Wamelink GWW, Hennekens SM, Prinzing A. 2016. Different habitats within a region contain evolutionary heritage from different epochs depending on the abiotic environment. *Global Ecology and Biogeography* **25**: 274–285.

Bartish IV, Ozinga WA, Bartish MI, Wamelink GWW, Hennekens SM, Yguel B, Prinzing A. 2020. Anthropogenic threats to evolutionary heritage of angiosperms in the Netherlands through an increase in high-competition environments. *Conservation Biology* **34**: 1536-1548.

Davies TJ, Kraft NJB, Salamin N, Wolkovich EM. 2011. Incompletely resolved phylogenetic trees inflate estimates of phylogenetic conservatism. *Ecology*, **93**: 242–247. doi: 10.1890/11-1360.1

Hermant M, Hennion F, Bartish IV, Yguel B, Prinzing A. 2012. Disparate relatives: Life histories vary more in genera occupying intermediate environments. *Perspectives in Plant Ecology, Evolution and Systematics* **14**: 283-301.

Li DJ, Trotta L, Marx HE, Allen JM, Sun M, Soltis DE, Soltis PS, Guralnick RP, Baiser B. 2019. For common community phylogenetic analyses, go ahead and use synthesis phylogenies. *Ecology* **100**: Article e02788.

Molina-Venegas R, Rodríguez MÁ. 2017. Revisiting phylogenetic signal; strong or negligible impacts of polytomies and branch length information? *BMC Evolutionary Biology* **17**: Article number 53

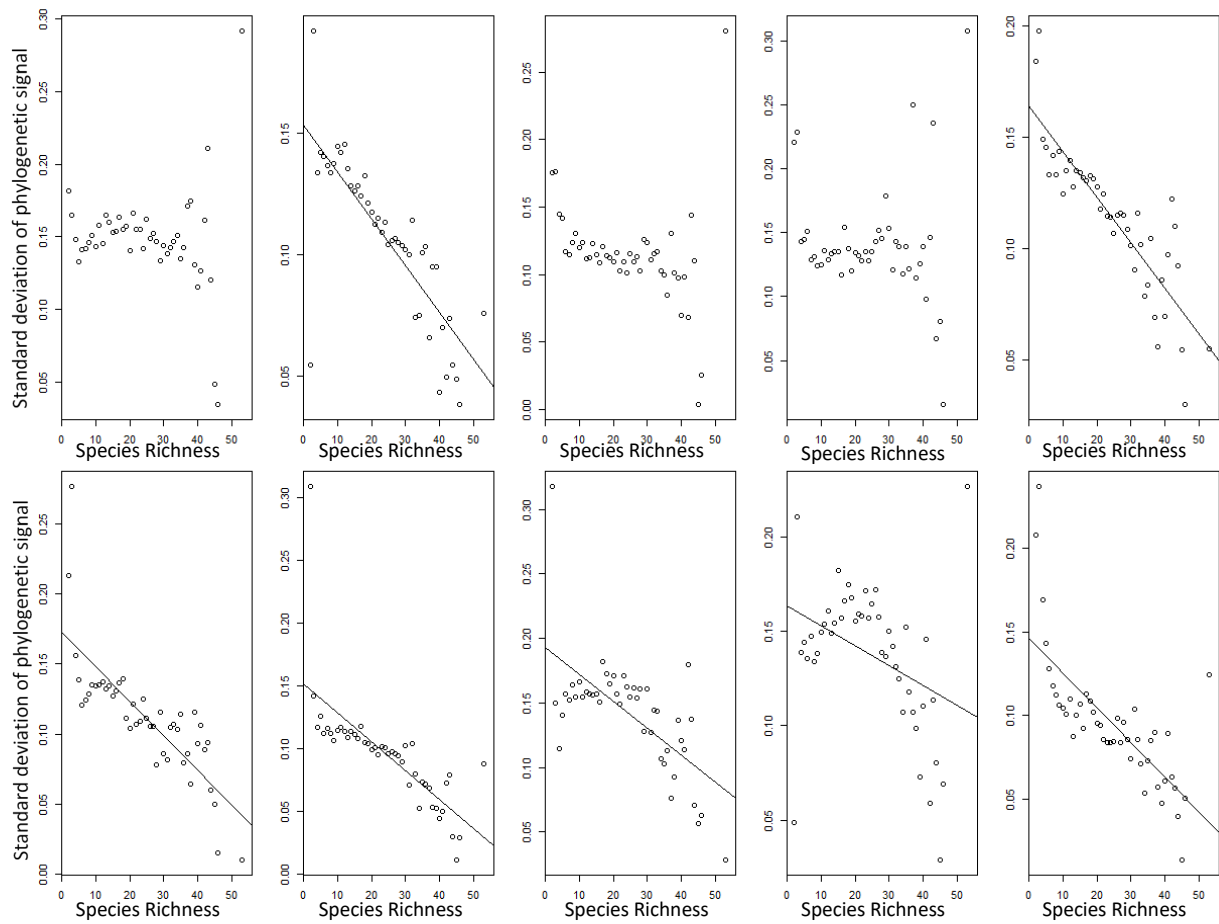
Seeger GDS, Duarte LDS, Debastiani VJ, Kindel A, Jarenkow JA. 2013. Discriminating the effects of phylogenetic hypothesis, tree resolution and clade age estimates on phylogenetic signal measurements. *Plant Biology* **15**: 858–867.

Zanne AE, Tank DC, Cornwell WK, Eastman JM, Smith SA, FitzJohn RG, McGlenn DJ. et al. 2014. Three keys to the radiation of angiosperms into freezing environments. *Nature* **506**: 89-92.

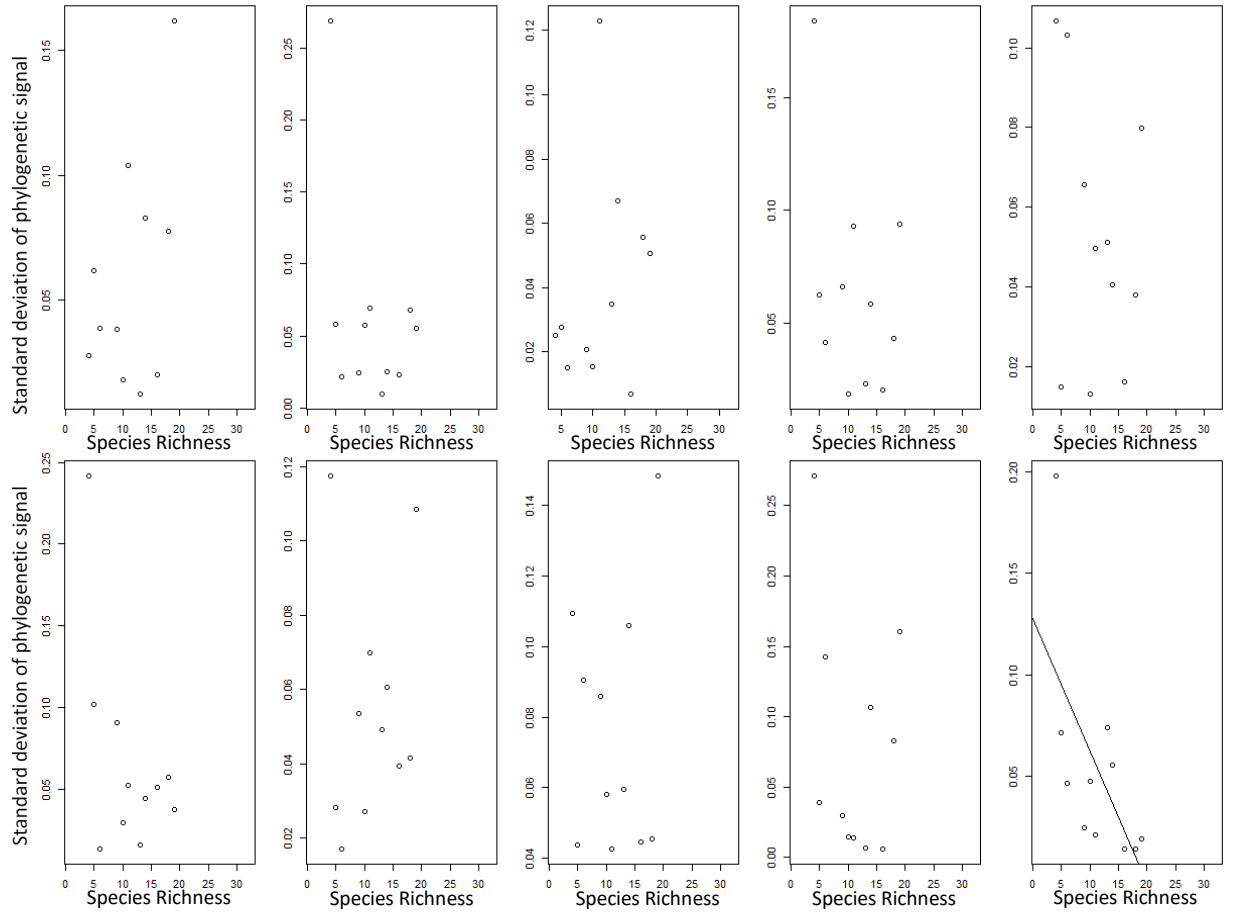
Notes S5: Relationship between the standard deviation of phylogenetic signal (PS) and species richness.

Figure S5 Local PS of traits varies strongly among species-poor local communities, but mean-local PS does not vary strongly among locally species-poor habitats (Fig. S5-1 vs. Fig. S5-2). PS is measured with a modified version of the S3 of Pavoine et al. 2010 (see Notes S1).

Notes S5 – Figure - A. Standard deviation of local PS across local communities of identical species richness, plotted as a function of local species richness. Traits are, from left to right and top to bottom: Max plant height, reproduction type, seed shape, seed mass, surface leaf area (SLA), breeding system, start/end dates of flowering, flowering duration, life form, leaf dry mass content (LDMC). Regression lines indicate significant relationships (we apply a significance threshold of $p < 0.01$ here given the large sample size and 0.05 in the below analysis across means of species pools, given the smaller sample size).

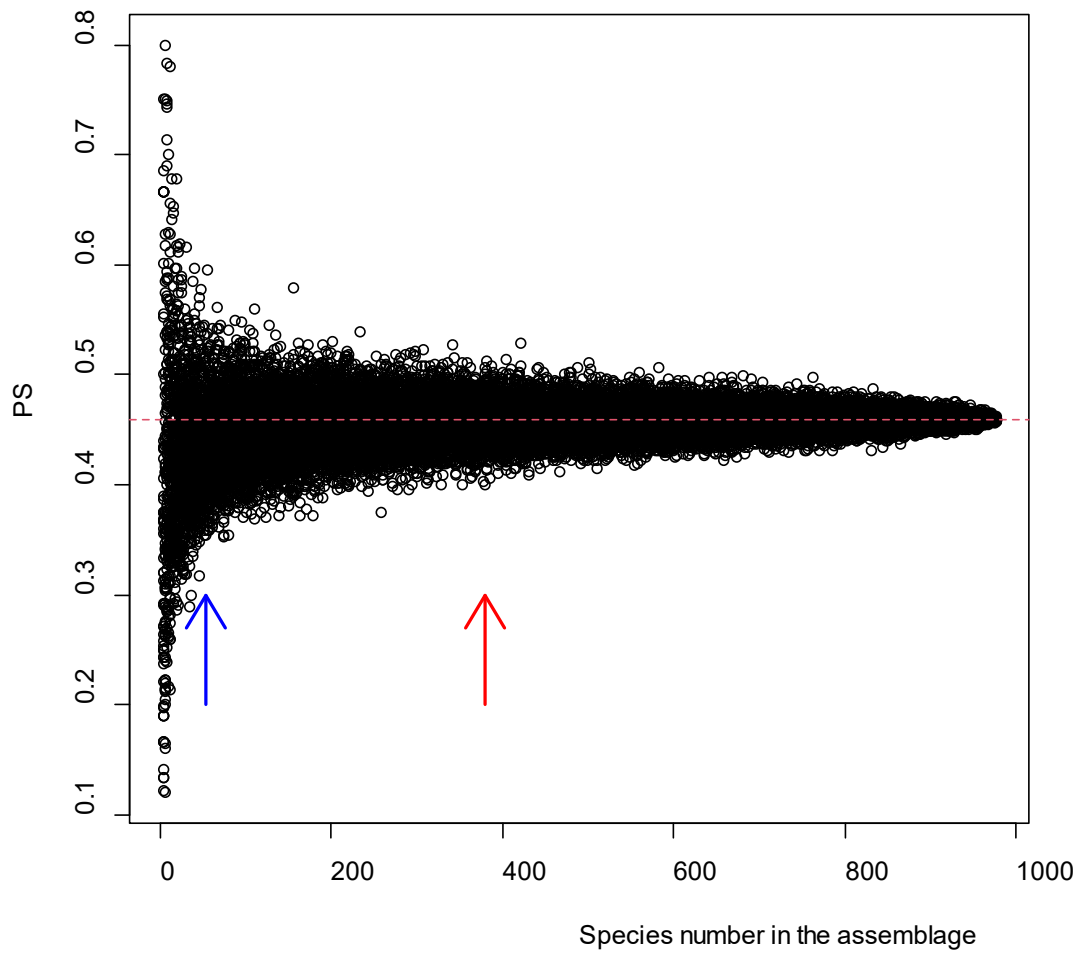


Notes S5 – Figure - B. Standard deviation of mean local PSs across habitat types of identical mean local species richness rounded to units, plotted as a function of rounded means of local species richness. Traits are from left to right and top to bottom: Max plant height, reproduction type, seed shape, seed mass, surface leaf area (SLA), breeding system, start/end dates of flowering, flowering duration, life form, leaf dry mass content (LDMC). One significant relationship ($p < 0.05$) is indicated by the regression line.



Notes S6: Effect of species richness on local PS in randomly sampled communities.

Testing how species richness affects PS in randomly sampled communities. We again use reproduction type as an example. In our dataset, 977 species had a known value for the reproduction type. We randomly drew X species from the pool of 977 species and calculated phylogenetic signal in the set of X species. We considered 30 simulations per species number (X) and X varying from 4 to 976 (with a step of 1), which led to $30 \times 973 = 29190$ simulations. Marks correspond to maxima of observed mean local species richness (blue) and of observed species pool richness (red); Note that at the smallest species richnesses, variation of PS is massive, but there is practically no tendency of PS being larger at smaller species richnesses ($r = -0.038$). This is contrary to our observation for real communities (Tab. 3). Also, the PS of the random communities converges on the PS of the species pool (dotted line).



Notes S7: Relationship of mean local PS to habitat disturbance and stress using the inference approach, accounting for covariables

Statistically explaining mean local PS by habitat disturbance and stress in Tab. 3 and 4, but using the inference approach to quantify habitat disturbance and stress.

equivalent Table 3. Mean local phylogenetic signal (PS) in a habitat type decreases with disturbance. Significant ($p < 0.05$) relationships to disturbance or stress are indicated in bold, marginally significant ($0.05 \leq p < 0.1$) in italics. Species richness and mean trait values are included as covariables. Variables have been selected by best subset search, using adjusted R^2 as a criterion. Disturbance and stress ranked by inference approach. A maximum of three residual outliers were excluded per trait, rendering stress (marginally) significant twice, and non-significant once, and disturbance marginally significant once. Analyses without covariables species richness and trait mean are given in Notes S8 and tend to confirm a negative relationship of PS to disturbance and reveal an often positive relationship to stress.

PS of trait	disturbance		stress		species richness		trait mean		df	adjR ²
	t	p	t	p	t	p	t	p		
Height	-1.9420	0.0607			-2.2703	0.0298	3.3903	0.0018	33	0.4653
Type of reproduction	-2.4014	0.0221			-6.3958	<0.0001	1.4587	0.1541	33	0.6474
Seed shape	-1.7215	0.0948			-5.3878	<0.0001	-1.8839	0.0687	32	0.6076
Seed mass	-3.1321	0.0036	-2.4216	0.0211	-2.9204	0.0063			33	0.3537
SLA			-2.0324	0.0502	-4.1006	0.0003	-1.8168	0.0783	33	0.3200
Breeding system	-3.9962	0.0004	1.2160	0.2332	-5.5639	<0.0001			31	0.7930
FloweringStartEnd			-5.5350	0.0000	-8.0388	<0.0001	7.107/7.5588	<0.0001/<0.0001	30	0.8171
Flowering duration					-5.2703	<0.0001	-5.0536	<0.0001	34	0.6193
Life form	-1.9325	0.0622			-2.8785	0.0071	4.2501	0.0002	32	0.6012
LDMC			-1.9498	0.0597	-3.5254	0.0013			33	0.2449

equivalent Table 4. The relationship between habitat disturbance and PS of four traits becomes at least marginally significantly more negative when PS is quantified as mean across local communities in a habitat type than when quantified across the habitat species-pool, contributing to the negative overall relationship observed in above equivalent-Table 3. The relationship between habitat stress and PS of three traits becomes at least marginally significantly more positive, contributing to the positive overall relationship observed in above equivalent-Table 3 albeit plant height shows the opposite pattern. Significant ($p < 0.05$) interaction terms are indicated in bold, marginally significant ($0.05 \leq p < 0.1$) in italics. Species richness is included as covariables (ln transformed as pool-richness tend to be orders of magnitude larger than local richness). See Notes S9 for an analysis without species richness. Disturbance and stress ranked by inference approach. A maximum of two residual outliers were excluded, contributing to (marginal) significance of two interaction terms for disturbance.

PS of trait	Mean local (vs species pool)		Disturbance		Stress		Ln no of spp		Mean local: disturbance		Mean local: stress		df	adjR ²
	t	p	t	p	t	p	t	p	t	p	t	p		
Height	0.2089	0.8351	-0.6773	0.5005	0.3996	0.6907	-2.4149	0.0184	-0.6314	0.5299	-2.2608	0.0269	69	0.2892
Seed shape	-1.6980	0.0941	-1.4603	0.1488	-3.0321	0.0034	-3.8094	0.0003	0.9734	0.3338	1.1714	0.2455	68	0.6670
Type of reproduction	0.7774	0.4396	3.1367	0.0025	-2.7921	0.0068	-4.4924	0.0000	-2.3520	0.0216	1.1216	0.2660	68	0.8818
Seed mass	-0.3752	0.7086	-0.5600	0.5773	0.3117	0.7562	-2.3598	0.0212	-0.7171	0.4758	-1.3922	0.1684	68	0.1167
SLA	-2.1210	0.0375	-1.8877	0.0633	-4.2244	0.0001	-4.2976	0.0001	0.9527	0.3441	2.9059	0.0049	69	0.7552
Breeding system	1.0567	0.2944	2.4916	0.0152	-3.6015	0.0006	-3.4597	0.0009	-2.2548	0.0274	1.6089	0.1123	68	0.8665
FloweringStartEnd	0.4366	0.6638	-0.3773	0.7071	-3.9816	0.0002	-4.7662	0.0000	-0.5343	0.5949	1.1573	0.2512	68	0.8928
Flowering duration	1.8461	0.0693	1.5273	0.1314	-1.7169	0.0906	-4.6209	0.0000	-1.7703	0.0812	-0.4919	0.6244	67	0.8975
Life form	-1.9552	0.0547	-3.2144	0.0020	-6.5846	0.0000	-4.0265	0.0001	1.2262	0.2244	2.9120	0.0049	68	0.8126
LDMC	-0.9705	0.3353	0.6651	0.5082	-2.8141	0.0064	-5.9950	0.0000	-2.5562	0.0129	2.3704	0.0207	67	0.8649

Notes S8: Relationship of mean local PS to habitat disturbance and stress using observational approach and inference approach, without accounting for covariables

Statistically explaining mean local PS by habitat disturbance and stress to mean local PS as in Tab. 3 (and its equivalent in Note S7) but without accounting for species richness and trait means as covariables.

Significant ($p < 0.05$) relationships to disturbance or stress are indicated in bold, marginally significant ($0.05 \leq p < 0.1$) in italics.

Observational approach:

Mean local PS decreases with disturbance and increases with stress (except for LDMC). (Exclusion of maximum one outlier, not changing conclusions on the effect of disturbance, but rendering the effect of stress only marginally significant in one case.) Note that in an analysis including species richness and trait means as covariables (Tab. 3a), significant relationships of stress to mean local PS disappear in five traits. For four of these traits, species richness then scores significant (trait means do not).

Mean local PS of trait	disturbance		stress		df	adjR ²
	t	p	t	p		
Height	-6.4576	0.0000	4.1551	0.0010	14	0.7160
Seed shape	-3.1993	0.0060	3.7138	0.0021	15	0.4560
Type of reproduction	-4.6560	0.0003	6.8353	0.0000	15	0.7338
Seed mass	-3.9060	0.0014	2.3235	0.0346	15	0.4419
SLA	-4.8851	0.0002	4.4244	0.0006	14	0.6326
Breeding system	-2.1793	0.0457	3.3082	0.0048	15	0.3545
FloweringStartEnd	-7.7187	0.0000	7.2934	0.0000	14	0.8169
Flowering duration	-5.3108	0.0001	5.9097	0.0000	15	0.7042
Life form	-8.7400	0.0000	6.4890	0.0000	14	0.8312
LDMC	-2.2253	0.0418	1.0955	0.2906	15	0.1480

Inference approach:

Mean local PS decreases with disturbance (except for LDMC), and increases with stress for type of reproduction and breeding system. (Exclusion of one to three residual outliers, rendering stress (marginally) significant twice, and disturbance significant twice.) Note that in an analysis including species richness and trait means as covariables (Tab. 3b) significant relationships of stress to mean local PS disappear in both traits, and for both of which species richness then scores significant (trait mean does not).

Mean local PS of trait	disturbance		stress		df	adjR ²
	t	p	t	p		
Height	-4.9873	0.0000	-1.6850	0.1014	33	0.4028
Seed shape	-4.9346	0.0000			33	0.4072
Seed mass	-3.5590	0.0012	-1.5878	0.1219	33	0.2340
Type of reproduction	-2.0375	0.0494	3.3664	0.0019	34	0.4205
SLA	-3.9863	0.0003			33	0.2985
Breeding system	-4.4374	0.0001	2.2311	0.0328	32	0.5538
FloweringStartEnd	-5.4072	0.0000			32	0.4537
Flowering duration	-5.4587	0.0000	1.2124	0.2342	32	0.5617
Life form	-5.5186	0.0000	-1.7439	0.0908	32	0.4644
LDMC	-0.3876	0.7007			34	-0.0249

Notes S9: Relationship of mean local PS to disturbance, stress and their interaction with local (vs. species pool), without accounting for species richness

Statistically explaining PS by habitat disturbance, stress, mean-local (vs. species pool) and its interaction terms with disturbance and stress, equivalent to Tab. 4 / Notes S8 (and same outliers excluded), but without accounting for species richness. Significant ($p < 0.05$) interaction terms are indicated in bold, marginally significant ($0.05 \leq p < 0.1$) in italics. Similar to Tab. 4, mean-local PS of multiple traits declines with habitat disturbance more than does species-pool PS. In contrast to Tab. 4, mean local PS is larger than species pool PS in all traits except LDMC, and more strongly reinforced by stress than species-pool PS in eight traits.

observational approach:

PS of trait	mean local (vs. spp pool)		disturbance		stress		local:dist		local:stress		df	adjR ²
	t	p	t	p	t	p	t	p	t	p		
Height	4.1569	0.0002	-1.3418	0.1897	-0.5750	0.5695	-3.9999	0.0004	3.5731	0.0012	30	0.3857
Seed shape	8.6049	0.0000	-3.0272	0.0053	0.3842	0.7038	-1.4967	0.1457	4.6404	0.0001	28	0.7428
Type of reproduction	11.6199	0.0000	-4.4268	0.0001	6.5869	0.0000	-1.4559	0.1562	<i>1.8879</i>	<i>0.0691</i>	29	0.8671
Seed mass	2.7428	0.0105	-0.5751	0.5698	-0.4155	0.6809	-2.7827	0.0095	2.3696	0.0249	28	0.1626
SLA	8.1170	0.0000	-6.1901	0.0000	5.0846	0.0000	1.4618	0.1542	-1.5453	0.1328	30	0.8292
Breeding system	8.6793	0.0000	-2.3282	0.0271	3.7264	0.0008	-0.4614	0.6480	0.4291	0.6710	29	0.7801
FloweringStartEnd	15.1246	0.0000	-7.2260	0.0000	6.7419	0.0000	-2.5616	0.0161	2.3752	0.0246	27	0.9151
Flowering duration	12.3384	0.0000	-4.0516	0.0003	4.6281	0.0001	<i>-1.9982</i>	<i>0.0552</i>	<i>1.9780</i>	<i>0.0575</i>	29	0.8643
Life form	7.7726	0.0000	-4.9723	0.0000	2.2398	0.0327	-0.9559	0.3468	<i>1.7742</i>	<i>0.0862</i>	30	0.7362
LDMC	-8.7774	0.0000	4.0103	0.0004	-5.0846	0.0000	-0.8551	0.3995	2.6725	0.0122	29	0.9292

inference approach:

PS of trait	mean local (vs. spp pool)		disturbance		stress		local:dist		local:stress		df	adjR ²
	t	p	t	p	t	p	t	p	t	p		
Height	2.4097	0.0186	0.7443	0.4592	0.1281	0.8985	-1.0738	0.2866	-2.0774	0.0414	70	0.2401
Seed shape	1.1772	0.2432	0.7278	0.4692	-3.1899	0.0021	0.0741	0.9411	1.2418	0.2185	69	0.6018
Type of reproduction	4.5908	0.0000	5.9345	0.0000	-2.9319	0.0046	-2.9246	0.0047	1.1924	0.2372	69	0.8489
Seed mass	1.5614	0.1230	0.8117	0.4197	-0.0009	0.9993	-1.1175	0.2677	-1.1976	0.2352	69	0.0582
SLA	0.9445	0.3482	0.4958	0.6216	-4.2320	0.0001	0.1243	0.9015	2.7863	0.0069	70	0.6940
Breeding system	4.2907	0.0001	-3.7275	0.0004	-3.7275	0.0004	-2.7854	0.0069	1.6573	0.1020	69	0.8453
FloweringStartEnd	4.4916	0.0000	2.3907	0.0195	-3.9713	0.0002	-1.4838	0.1424	1.2127	0.2294	69	0.8591
Flowering duration	6.0511	0.0000	4.3257	0.0001	-1.9969	0.0498	-2.5733	0.0123	-0.2190	0.8273	68	0.8668
Life form	0.9485	0.3462	-1.0855	0.2815	-6.4073	0.0000	0.3967	0.6928	2.8217	0.0062	69	0.7713
LDMC	0.9485	0.3462	-1.0855	0.2815	-6.4073	0.0000	0.3967	0.6928	2.8217	0.0062	69	0.7713

Notes S10: Distributions of habitat types across the Netherlands

We note that spatial position is little informative in our study system of habitats within a region of the Netherlands, in our approach of characterising each habitat type by the mean across spatially distinct patches: Across the Netherlands, none of the habitat types is geographically entirely distinct from the remaining ones, they are almost all widely scattered across the Netherlands (Figure Notes S10 1a, b). Mean spatial positions of habitat types would hence be similar to identical and would not represent the strong local mosaic of habitats types imposed by the local environmental mosaic (Schaminée et al 1995-1999), in some habitat types, the mean spatial position would even be in a zone little occupied by this very habitat type (Figure Notes S10 2 - 39). Also, within habitat types, no spatial, non-environmental patterning of species composition has been reported, neither across the Netherlands nor between the Netherlands and the adjacent countries (Schaminée et al (1995-1999) and European vegetation map (accessed at https://is.muni.cz/el/sci/podzim2010/Bi9420/um/Bohn_etal2004_Map-Nat-Veg-Europe.pdf on May / 17 / 2021), respectively).

Schaminée JHJ, Hommel PWFM, Stortelder AHF., Weeda, EJ, Westhoff V 1995-1999.
De Vegetatie van Nederland 1-5. Opulus, Uppsala/Leiden.



(a) Distribution of plots of habitats classified as imposing high (grey blocks) or low (black triangles) levels of stress according to observational approach.



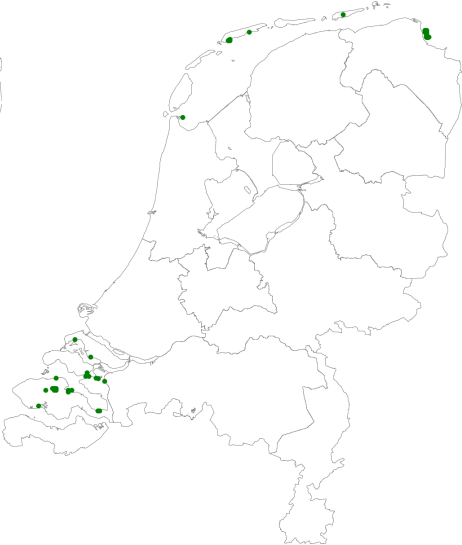
(b) Distribution of plots of habitats classified as imposing high (grey blocks) or low (black triangles) levels of disturbance according to observational approach.

Notes S10 – Figure B: Maps of all 38 habitat types studied. Dots represent the plant communities sampled for each habitat type.

Habitat 1



Habitat 3



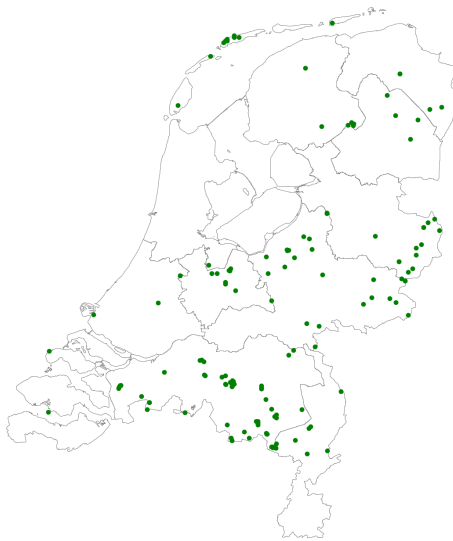
Habitat 4



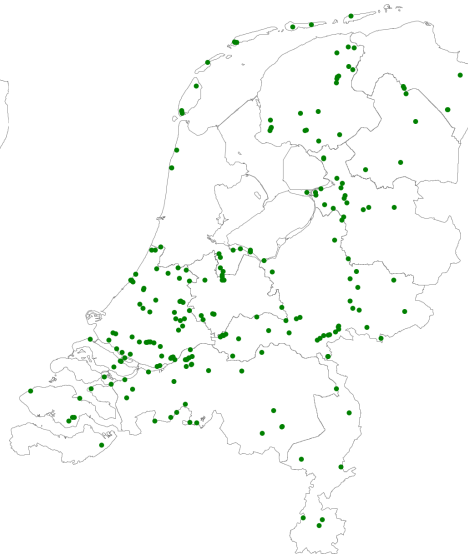
Habitat 5



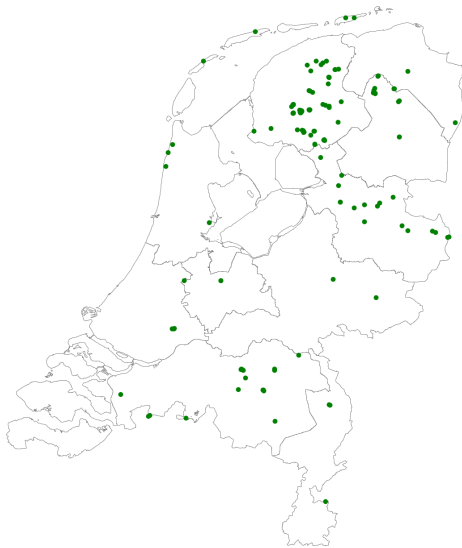
Habitat 6



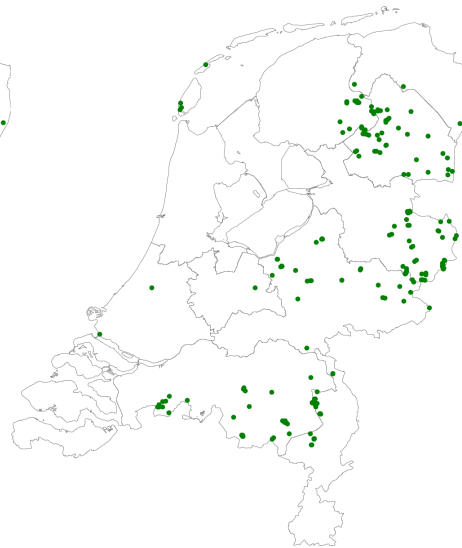
Habitat 8



Habitat 9



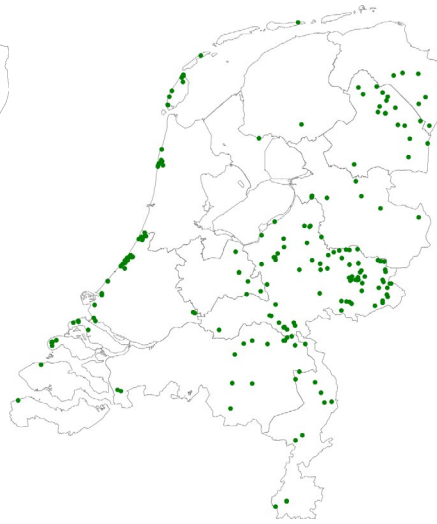
Habitat 11



Habitat 12



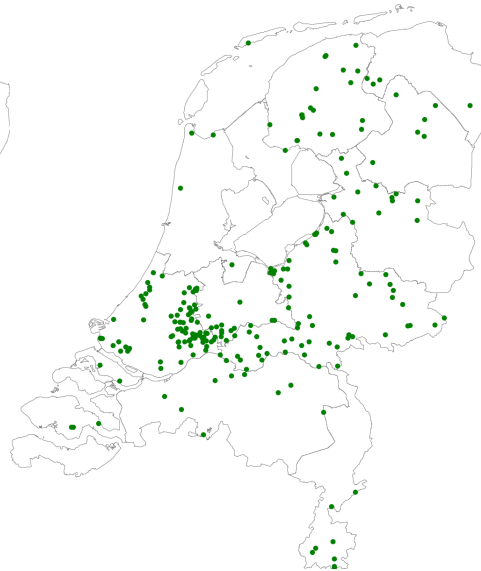
Habitat 14



Habitat 15



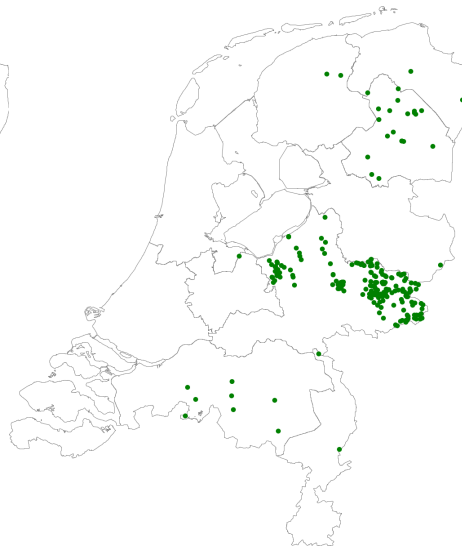
Habitat 16



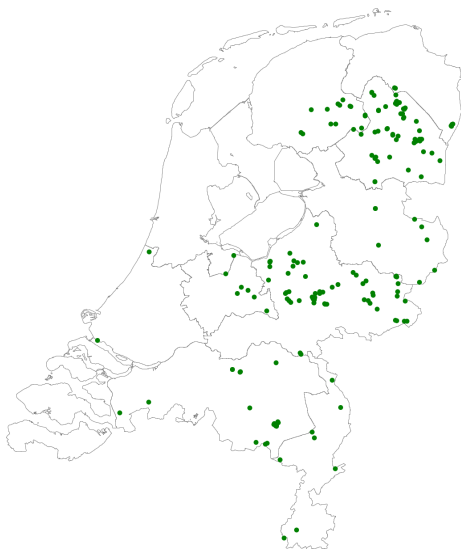
Habitat 17



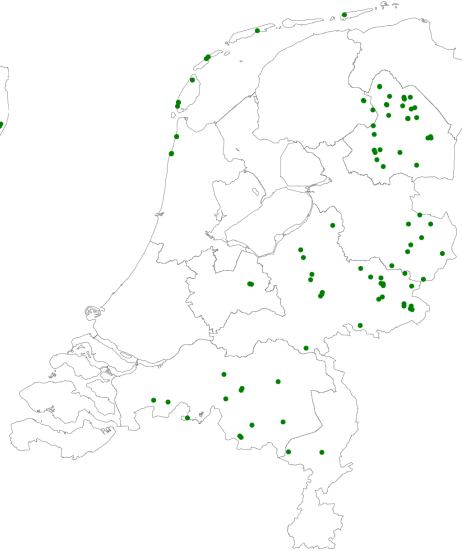
Habitat 18



Habitat 19



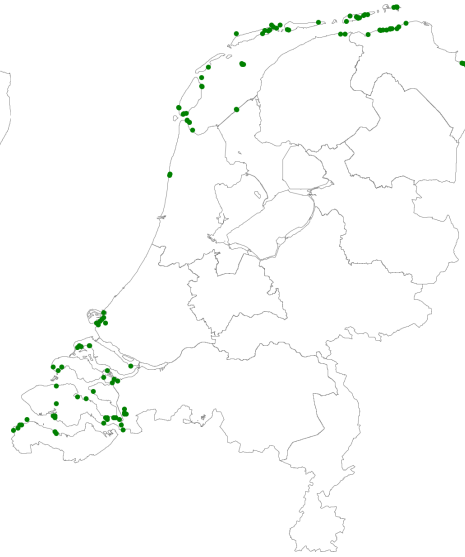
Habitat 20



Habitat 21



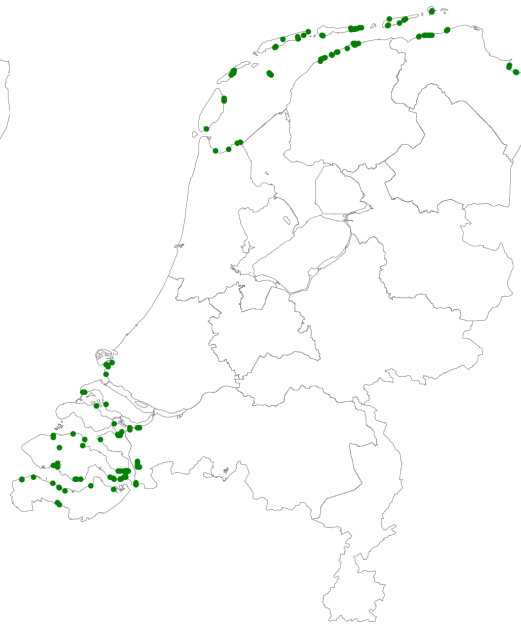
Habitat 22



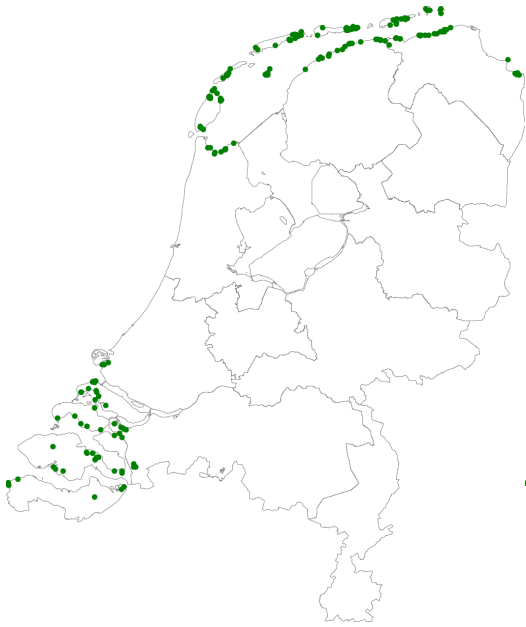
Habitat 23



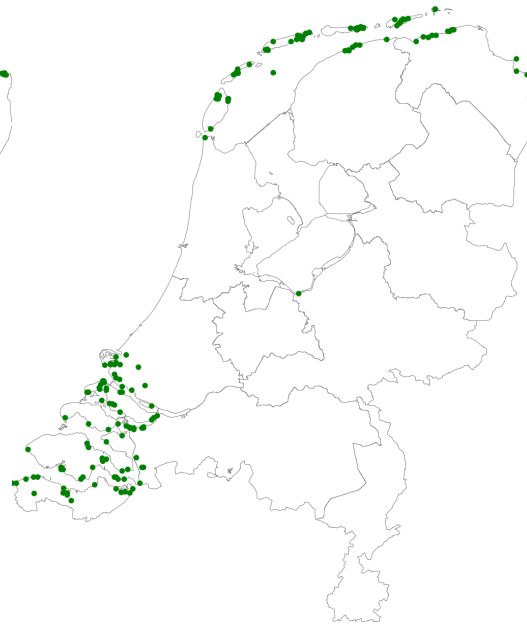
Habitat 24



Habitat 25



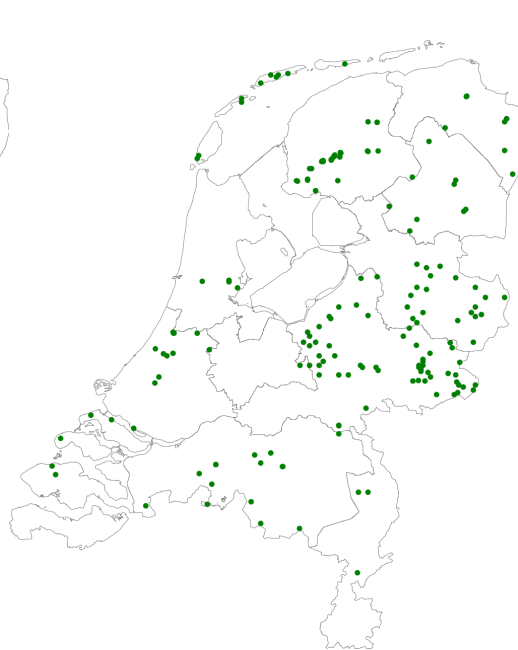
Habitat 26



Habitat 27



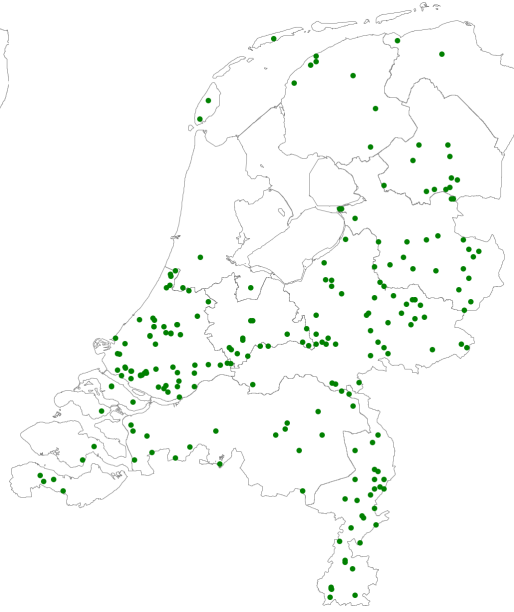
Habitat 28



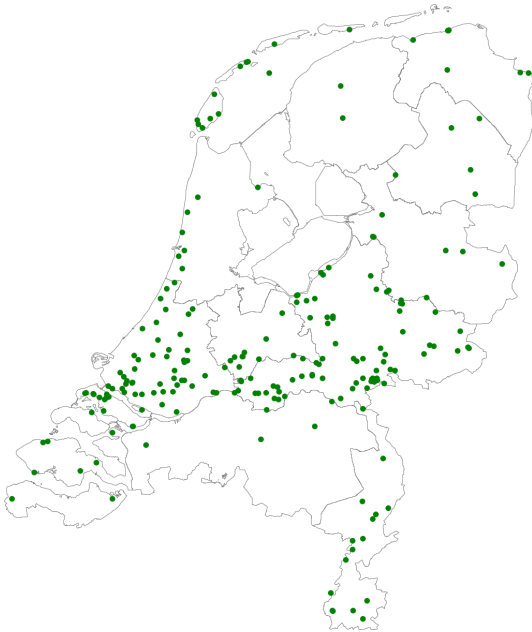
Habitat 29



Habitat 30



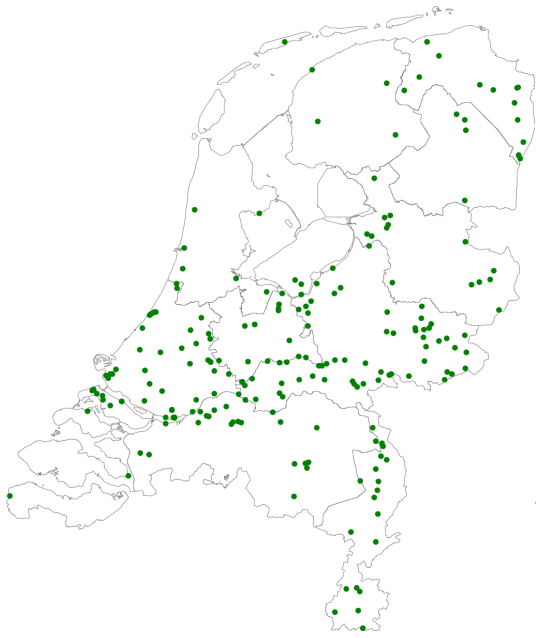
Habitat 31



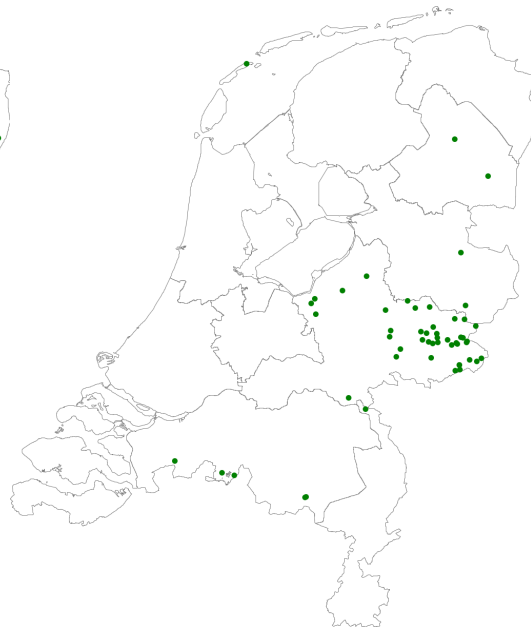
Habitat 32



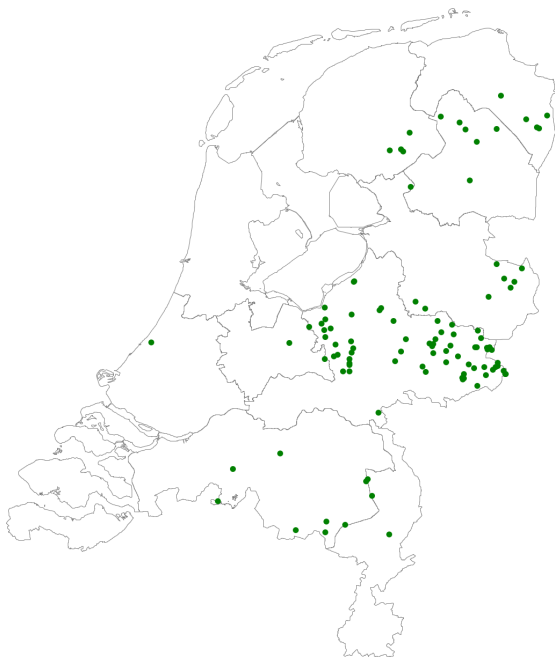
Habitat 33



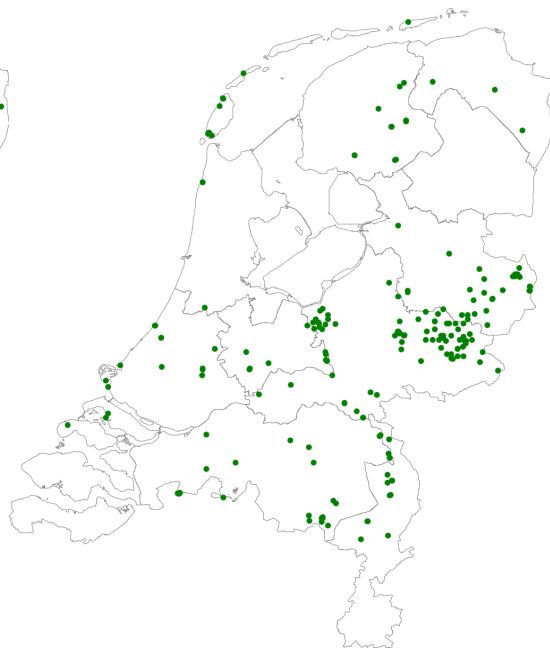
Habitat 34



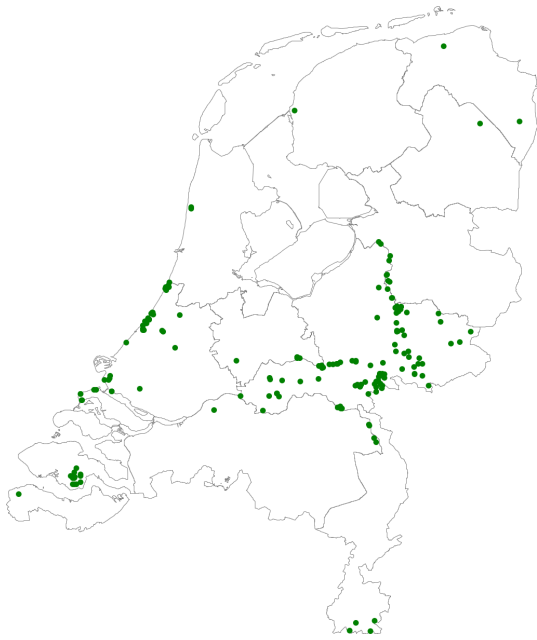
Habitat 35



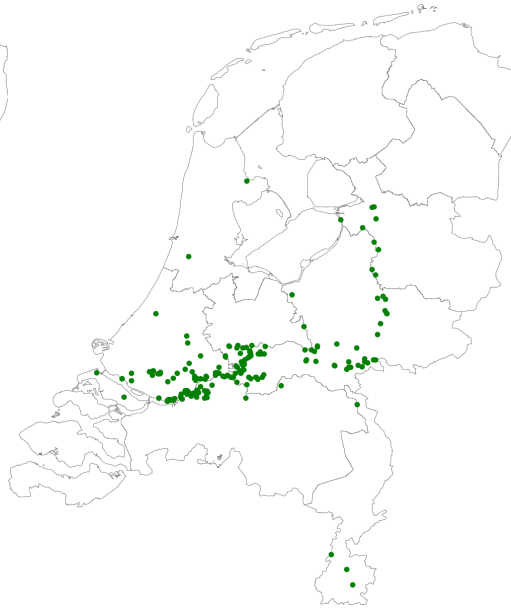
Habitat 36



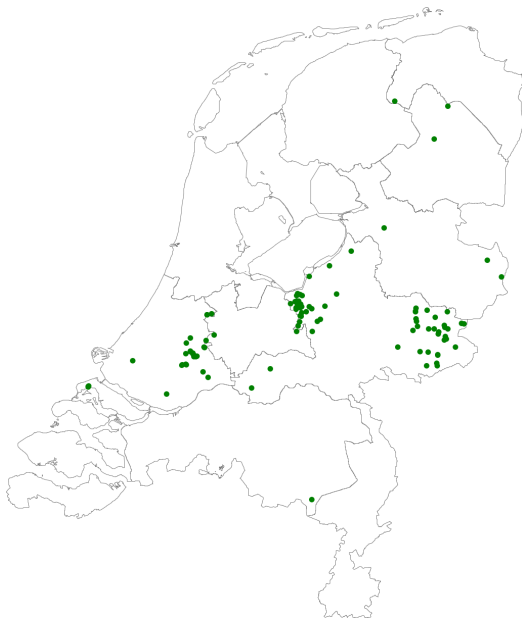
Habitat 37



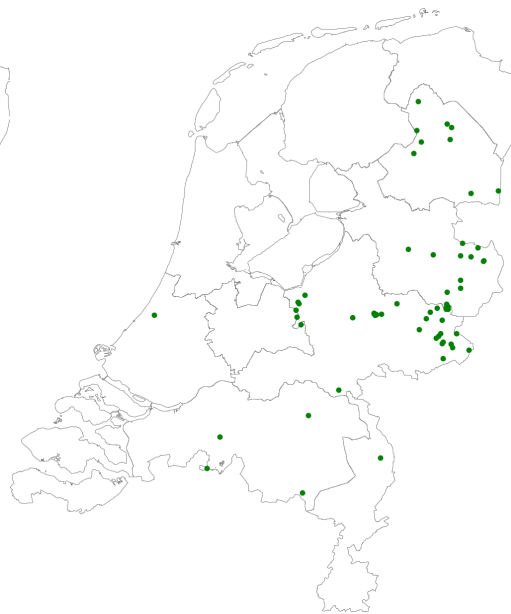
Habitat 38



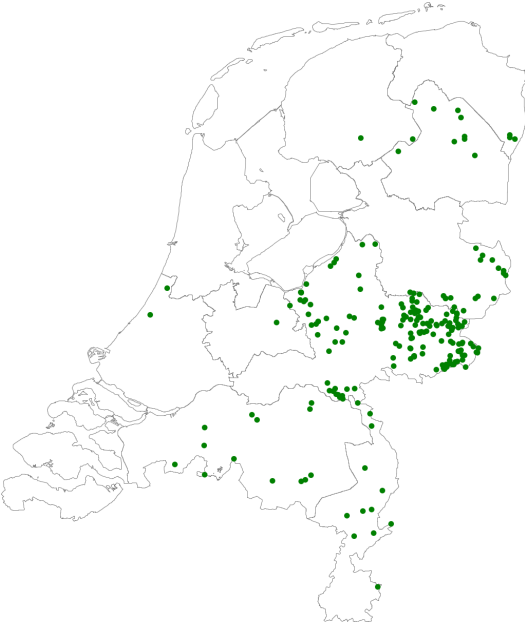
Habitat 39



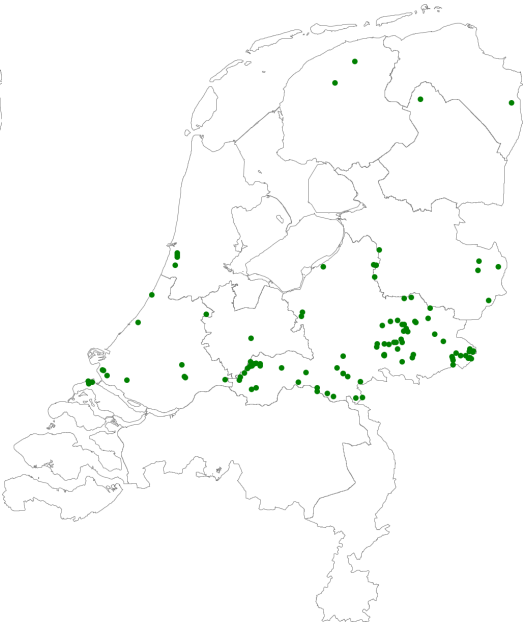
Habitat 40



Habitat 42



Habitat 43



Notes S11: Relating mean local phylogenetic signal to mean local trait and phylogenetic diversities

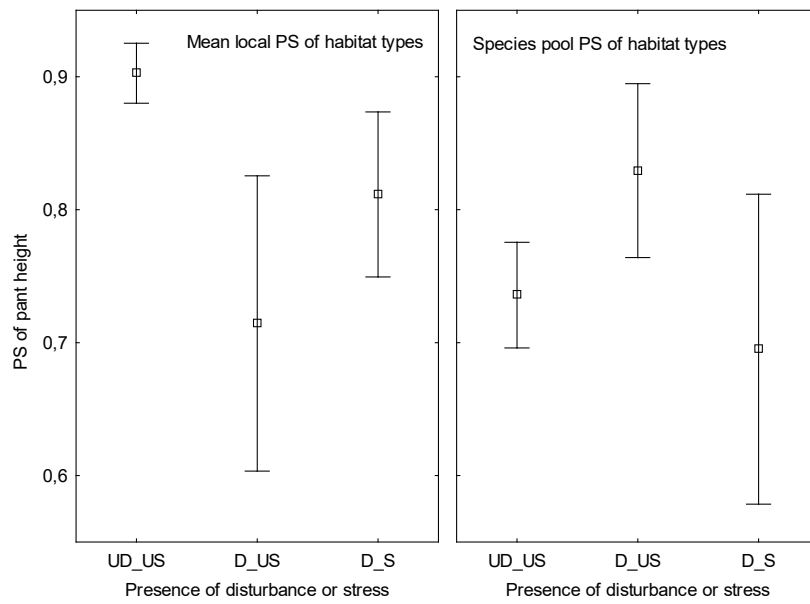
Mean local phylogenetic signal (PS) of a trait in different habitat types can only partly be explained by both the mean local diversity of the same trait and the mean local phylogenetic diversity. Results of multiple regression analysis of within-habitat means in local PS across local communities within habitat types. Standardized regression coefficients of the two explanatory variables and explained variances (R^2) of PS are given. Significant relationships ($P < 0.05$) are indicated in bold. Df = 35, except for seed shape (df = 34). See Figure 2 in body of the manuscript for an illustration using reproduction type.

Trait	St.regr.coeff. Trait diversity	St.regr.coeff Phylogenetic diversity	R^2 Proportion explained variance in PS
Plant Height	-0.48	0.67	0.42
Reproduction type	-0.20	0.44	0.18
Seed shape	-0.38	0.50	0.28
Seed Mass	-0.36	0.23	0.14
SLA	0.10	0.41	0.18
Breeding type	0.15	0.33	0.17
Start/End Flowering	-0.36	0.46	0.09
Flowering Duration	0.56	0.04	0.33
Life Form	-0.71	0.39	0.36
Leaf Dry Matter Content	-0.15	0.09	0.02

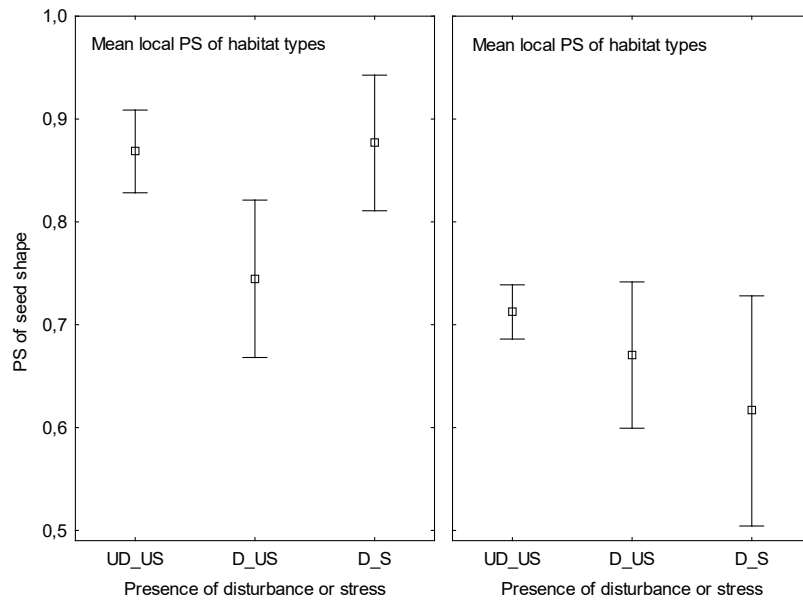
Notes S12: Relationship between disturbance or stress regime of habitat types and the phylogenetic signal (PS) of traits

Relationship between disturbance regime (UD, undisturbed vs D, disturbed) or stress regime (US, unstressed vs S, stressed) of habitat types and the phylogenetic signal (PS) of all traits except of reproduction type (which is given in Fig. 3). PS is quantified either within local communities and the mean is calculated within each habitat type (left) or across the entire species pool of each habitat type within the study region (right). N=18 habitat types. Per category of habitat types, means and 95% confidence limits are given. Mean local phylogenetic signal of reproduction type in a habitat type (left) tends to decrease with disturbance (“D” vs “UD”) and to increase with stress (“S” to “US”) (corresponding to significant effects in Table 3). At the level of habitat species pools (right) these relationships to disturbance and stress tend to disappear (corresponding to significant interaction terms of either disturbance or stress with “mean local” in Table 4). Disturbance and stress regime were ranked based on observations, i.e. names of habitat types, representing three of the possible combinations of stress and disturbance. See Notes S7 for analyses using continuous gradients of stress and disturbance inferred from species ranks in disturbance and stress tolerance, and yielding similar results in particular for disturbance.

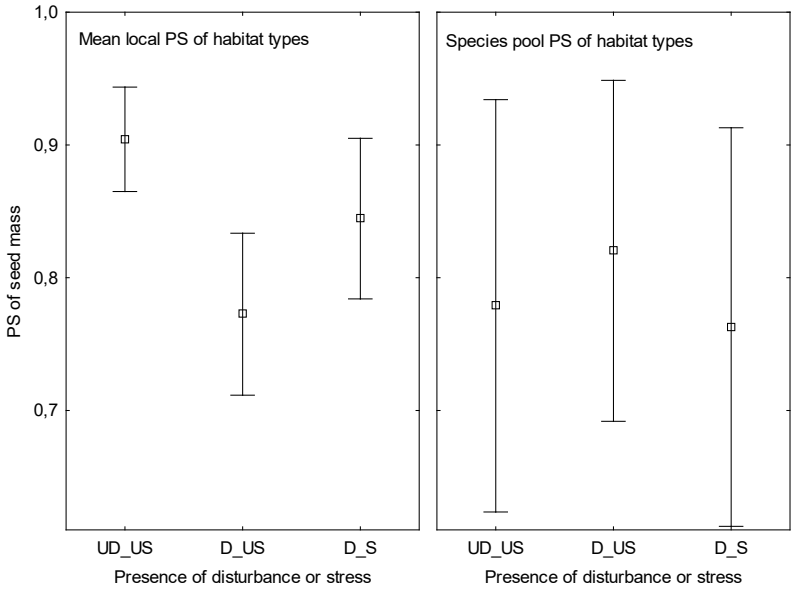
Plant height



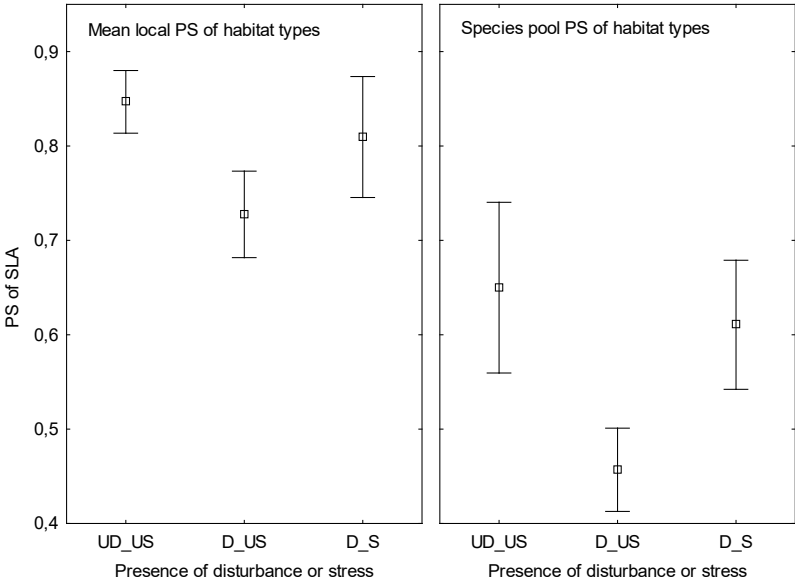
Seed shape



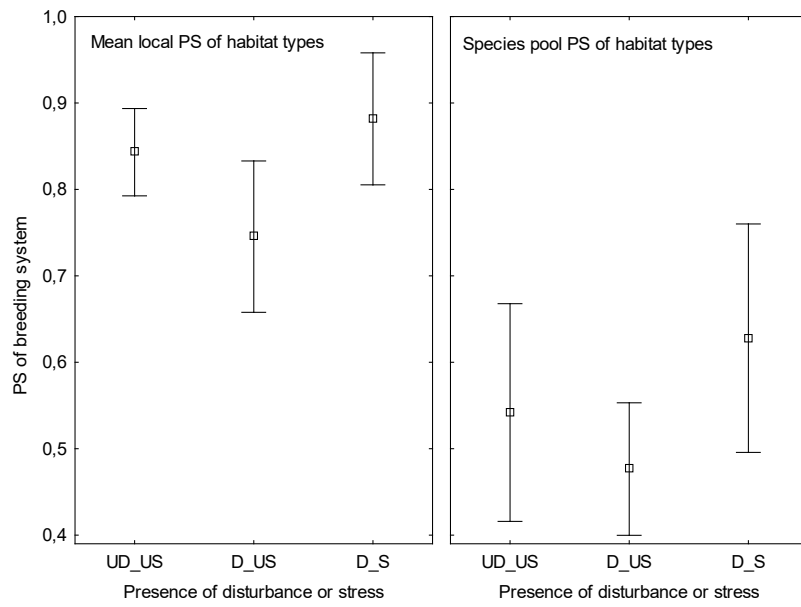
Seed mass



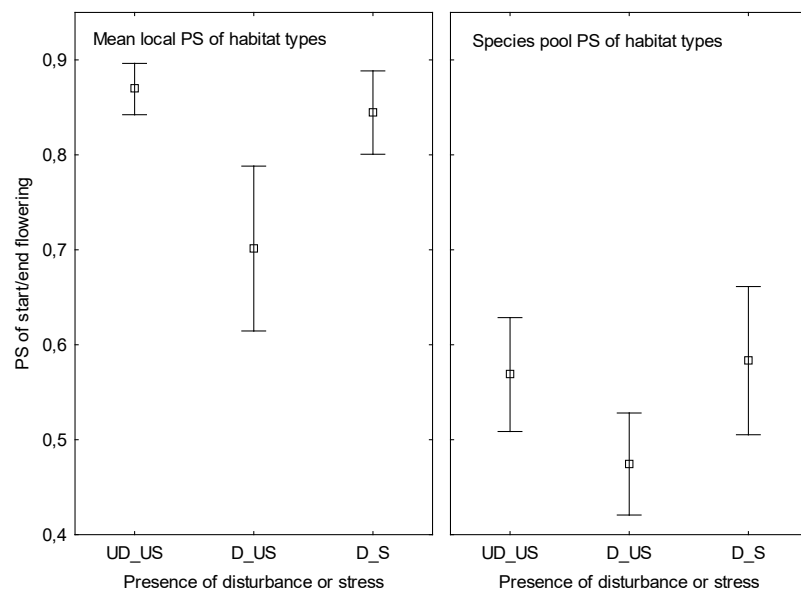
SLA



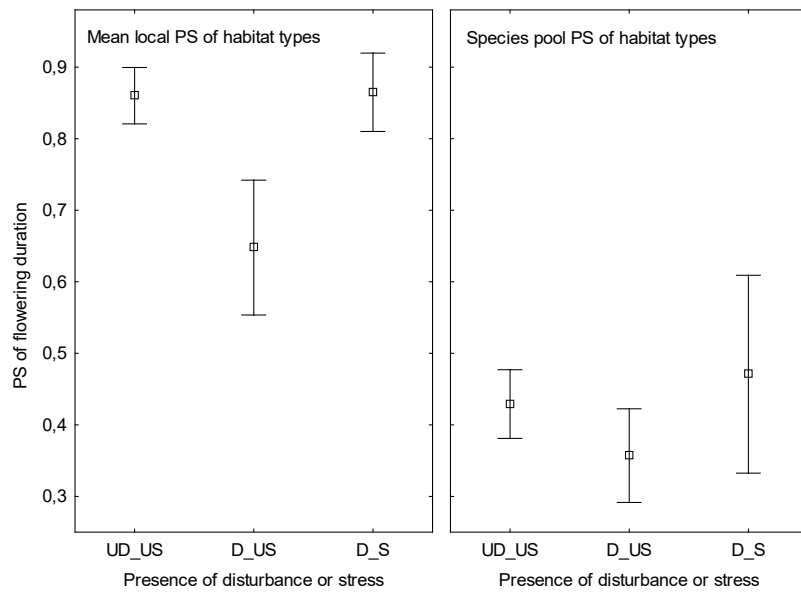
Breeding system



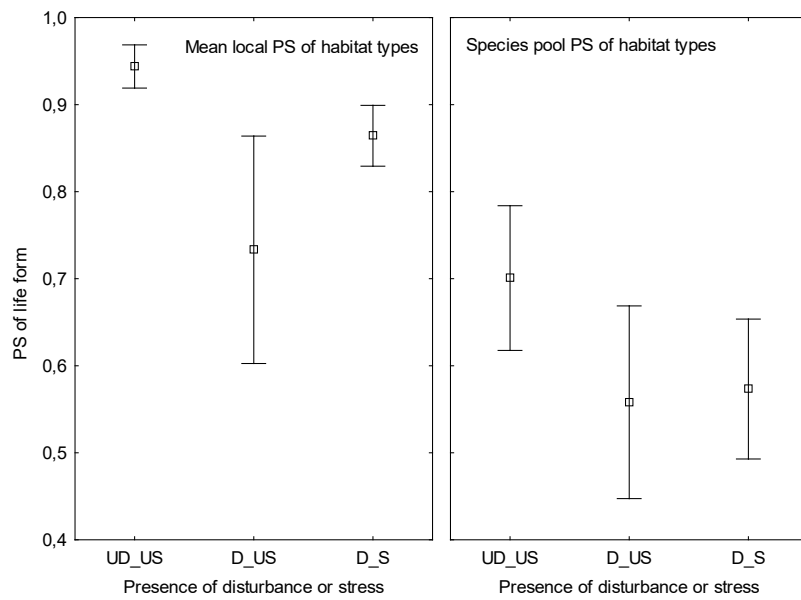
Start/end flowering



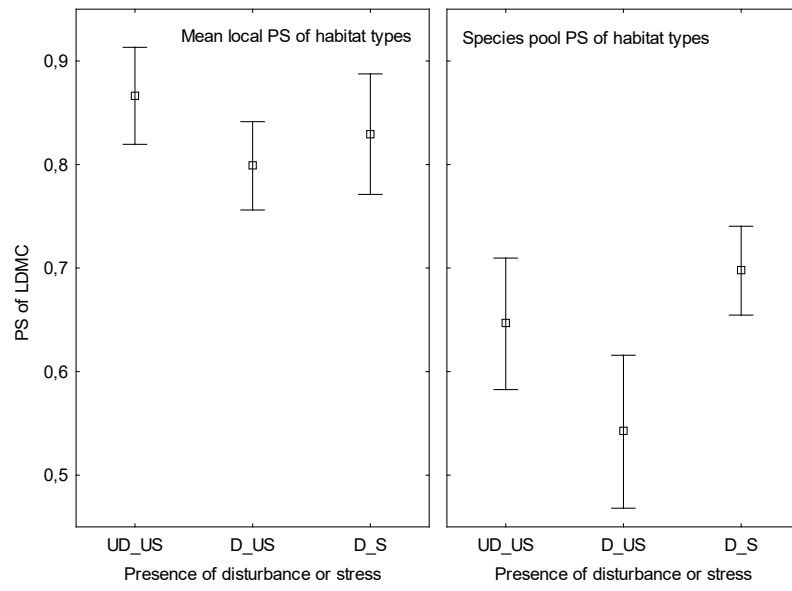
Flowering duration



Life form

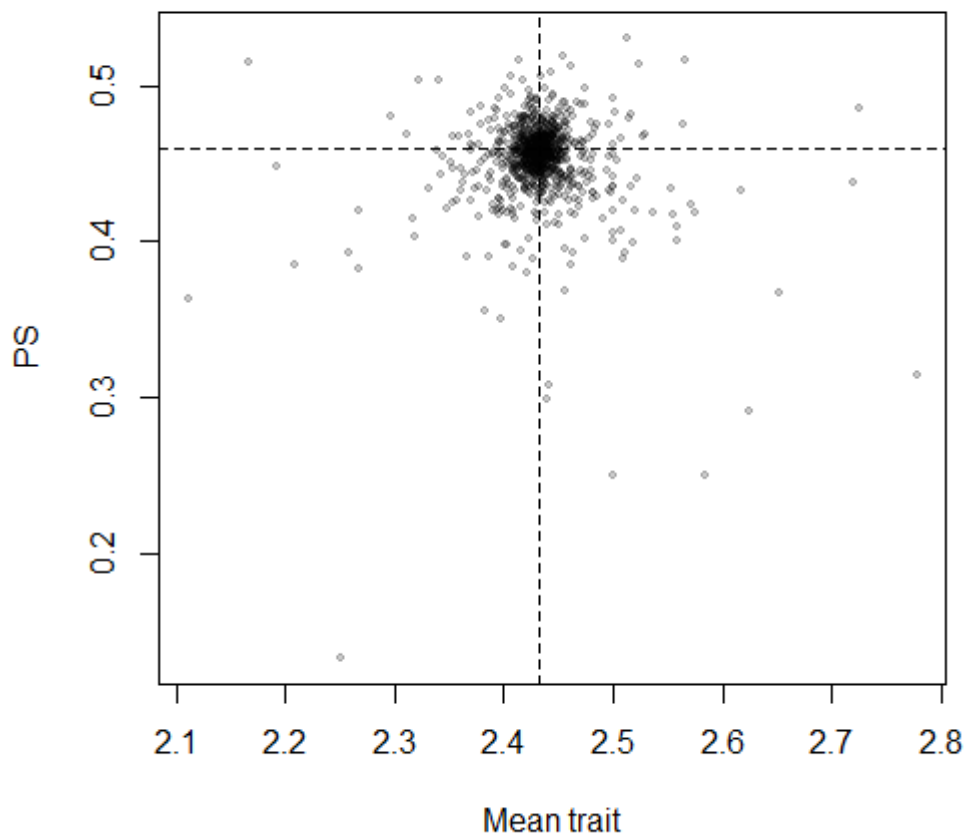


LDMC



Notes S13: Effect of trait means on trait phylogenetic signal (PS) in randomly sampled communities.

In our dataset, 977 species had a known value for the reproduction type. We randomly drew X species from the pool of 977 species with X drawn randomly between 4 and 977. We calculated the mean trait value and the phylogenetic signal in the set of X species. We repeated this process 1000 times. Random sampling of 1000 communities of five or more species with known value of reproduction type gives only a very weak relationship between means and PSs of these communities: $r = -0.038$ (opposite to the very minor relationship to trait mean observed in Table 3). We note that this is less than for two alternative measures of PS in the literature such as Blomberg's K or K^* (Blomberg et al. 2003) which score $r = 0.094$ and 0.086 , respectively. The below figure shows the relationship between mean of reproduction type and PS across 1000 communities.



Blomberg SP, Garland T, Ives AR. 2003. Testing for phylogenetic signal in comparative data: behavioral traits are more labile. *Evolution* **57**: 717-745.