Surprising recovery of saplings to severe drought in temperate deciduous forests
Beloiu et al.

Supplement 1: Climatic variables and vitality of tree saplings per species.

Files in this Data Supplement:
Figure S1 a-d
Table S1
Figure S2
Figure S3

Figures S1a and b show precipitation and temperature from 1970 to 2019. Figures S1c and d report a focus on the data presented in Figures S1a and b. Therefore, only the data between 2000 and 2019 are displayed.

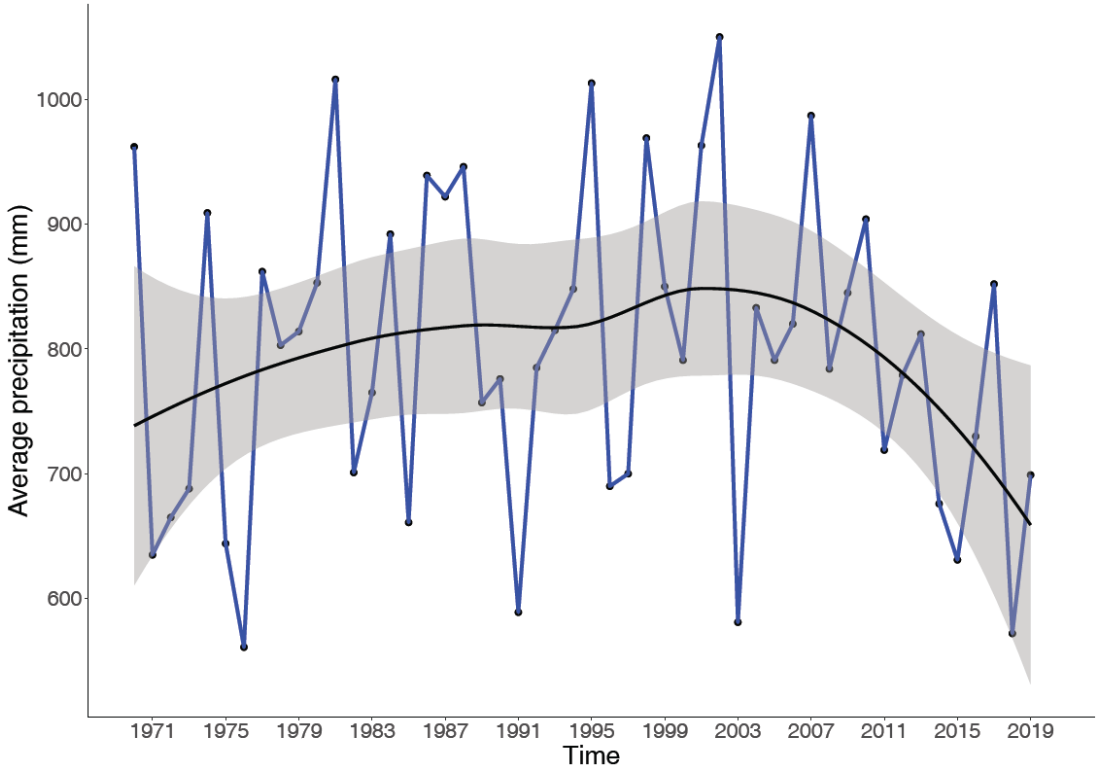

Figure S1a. Local weighted regression (LOESS) lines of average precipitation (mm) between 1970 and 2019 for the study area. Climatic data extracted from the raster data set (1 x 1 km) of the German Meteorological Service.

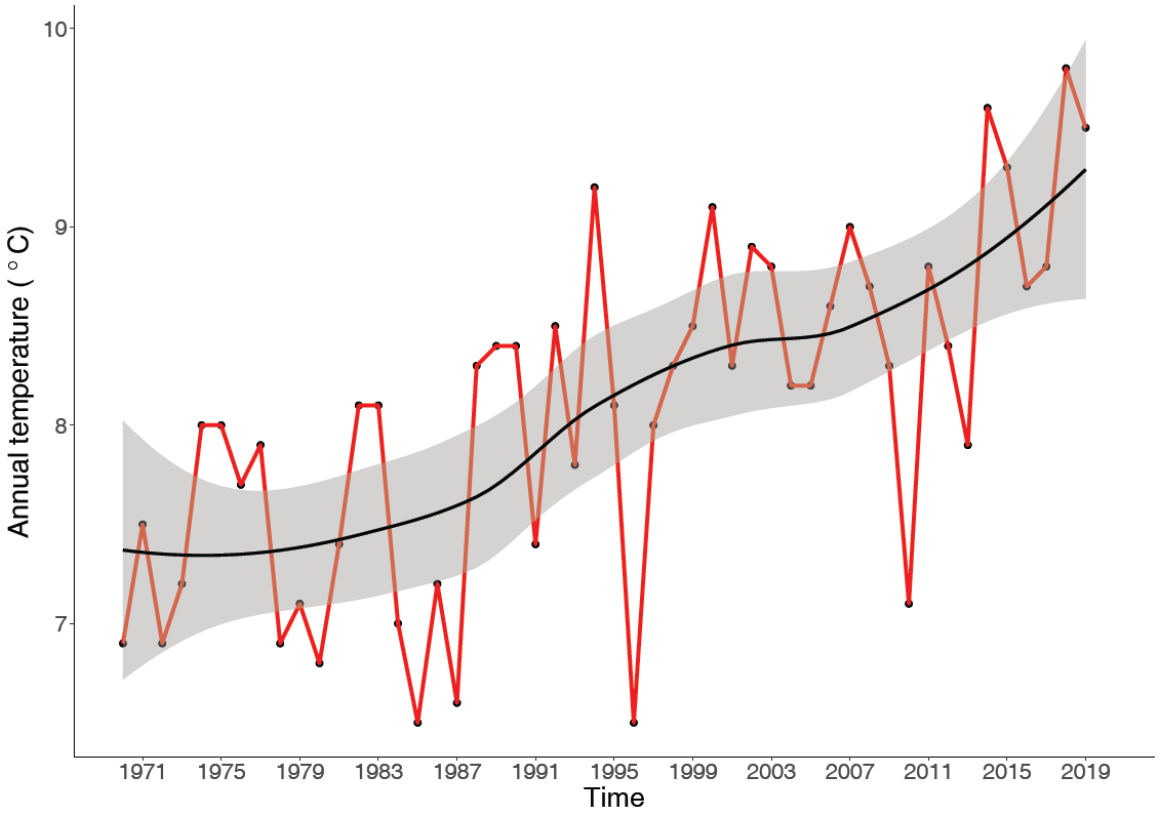

Figure S1b. Local weighted regression (LOESS) lines of mean annual temperature (°C) between 1970 and 2019 for the study area. Climatic data extracted from the raster data set (1 x 1 km) of the German Meteorological Service.

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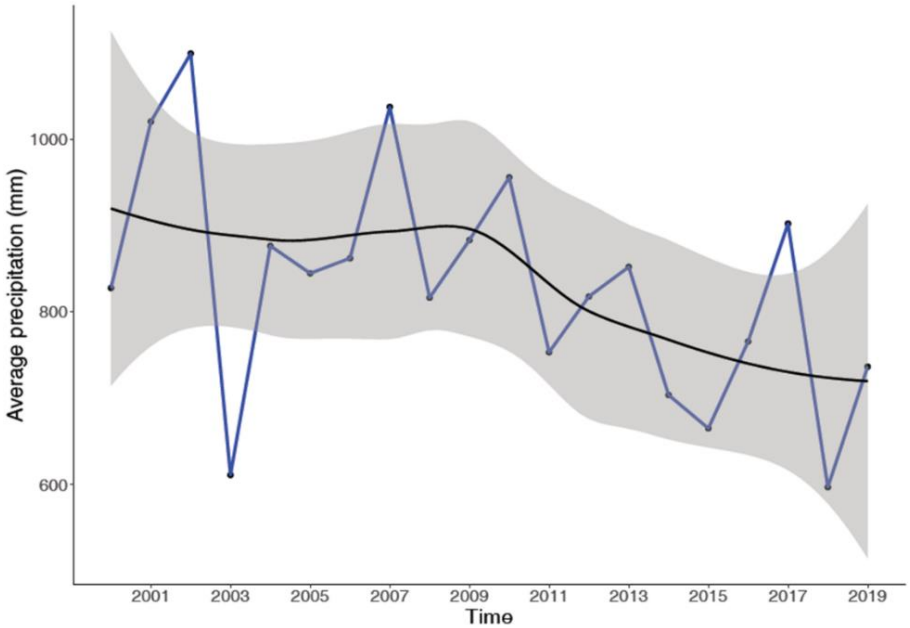


Figure S1c. Local weighted regression (LOESS) lines of average precipitation (mm) between 2000 and 2019 for the study area. Climatic data extracted from the raster data set (1 x 1 km) of the German Meteorological Service.

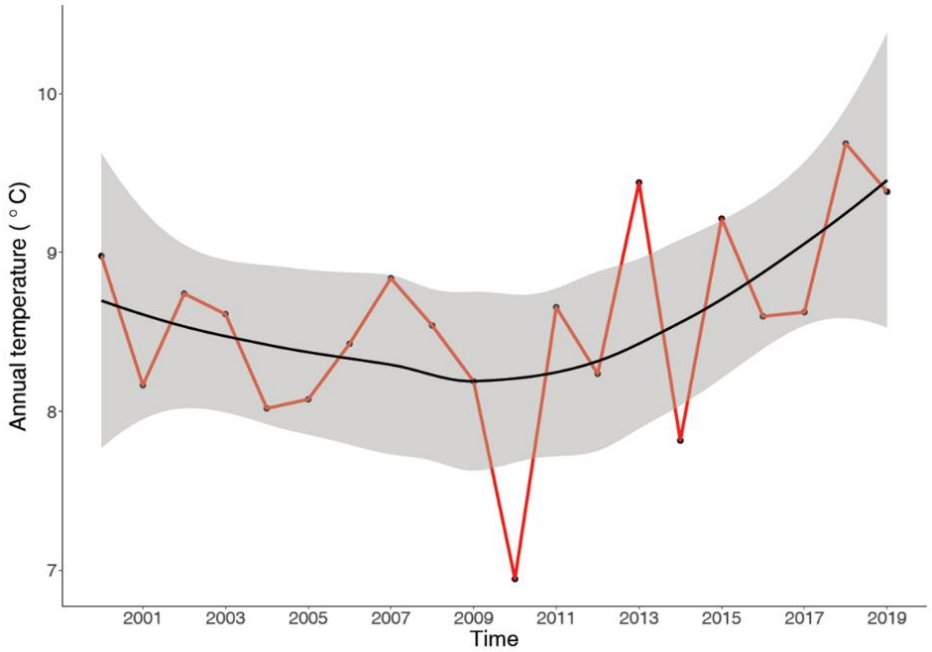
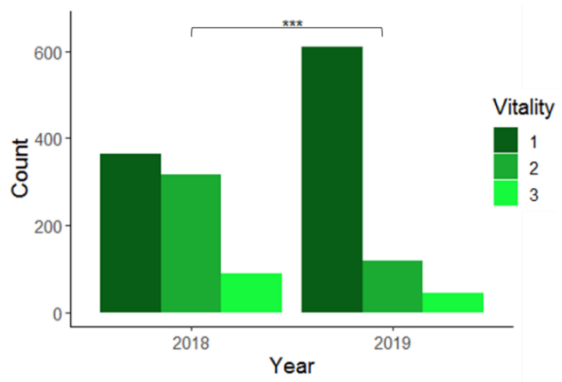


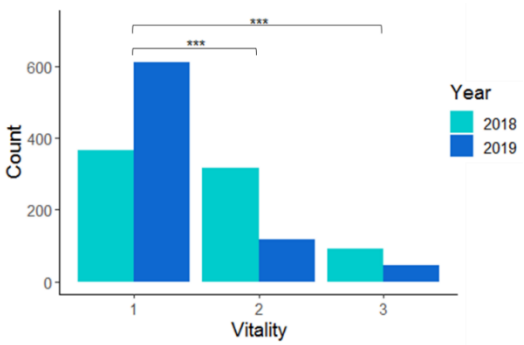
Figure S1d. Local weighted regression (LOESS) lines of mean annual temperature (°C) between 2000 and 2019 for the study area. Climatic data extracted from the raster data set (1 x 1 km) of the German Meteorological Service.

Table S1. Contingency table for sapling vitality during the drought of 2018 and one year later. Vitality 1 = undamaged, 2 = damaged, 3 = completely damaged sapling.

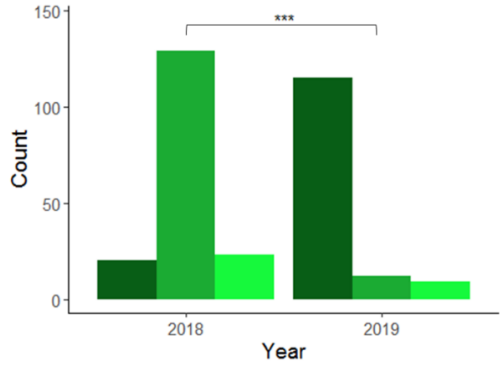
Vitality	**2019**			
2018	**1**	**2**	**3**	**Sum**
1	**632**	79	7	718
2	756	**270**	23	1049
3	92	97	**95**	284
Sum	1480	446	125	2051

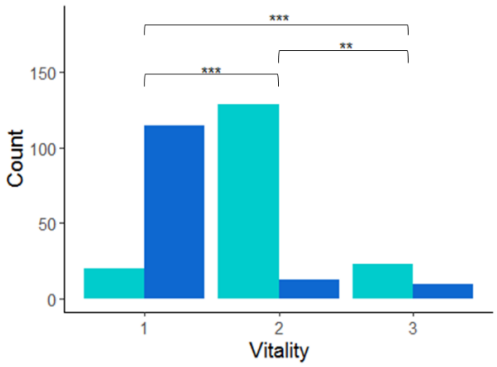
McNemar's Chi-Squared test for count data was applied to the data from Table 1. McNemar's test indicated a significant difference between the vitality classes (chi-squared = 667.51, p-value < 2.2e-16). Pairwise comparison showed that the number of undamaged saplings in 2019 is higher than that of damaged saplings and completely damaged saplings (1/1 : 2/2 p-value < 0.001, 1/1 : 3/3 p-value < 0.001). Also, the number of damaged saplings was significantly greater than that of the completely damaged saplings (2/2 : 2/3 p-value < 0.001).



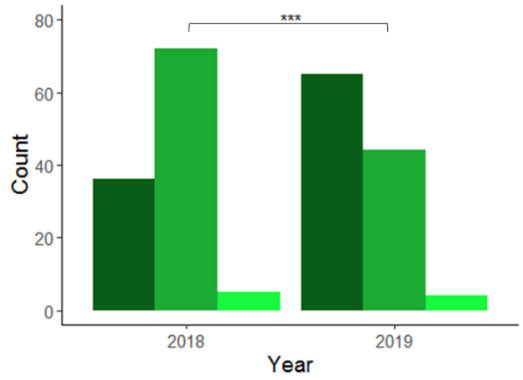


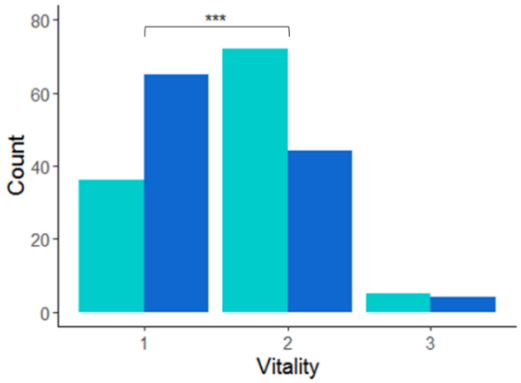
Fagus sylvatica N=772



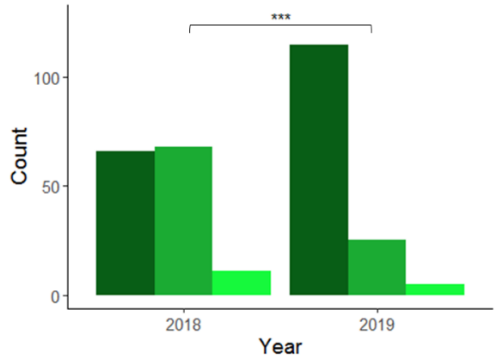


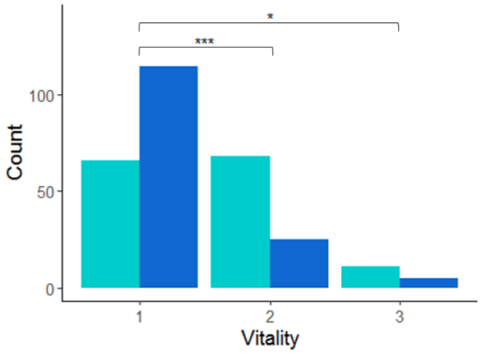
Carpinus betulus, N=172



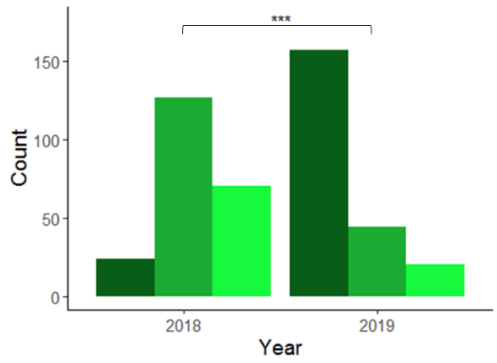


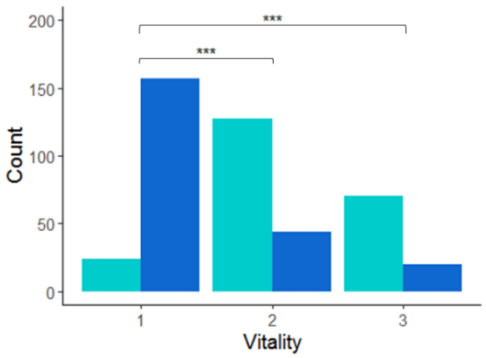
Quercus spp., N=113



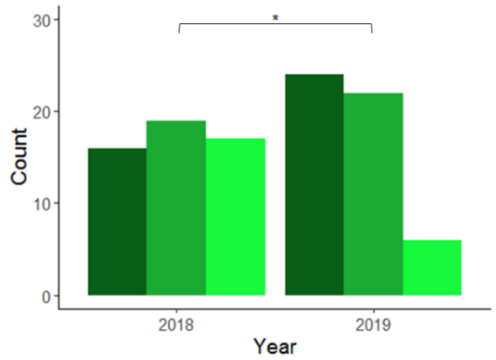


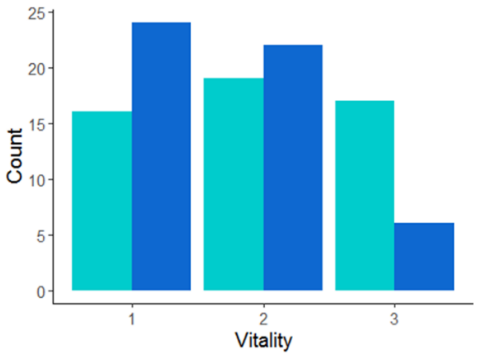
Betula pendula, N=145



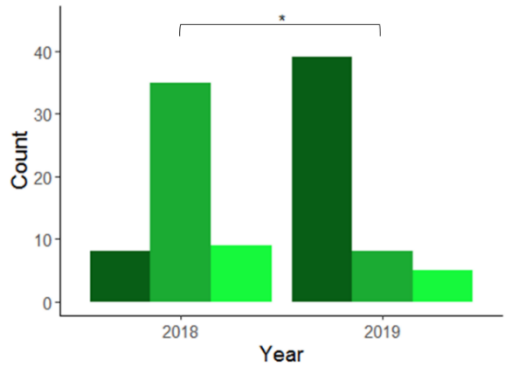


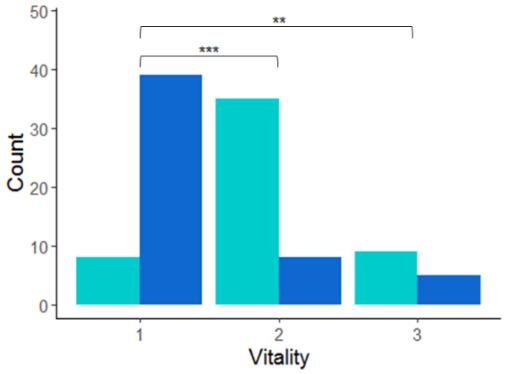
Sorbus aucuparia, N=221



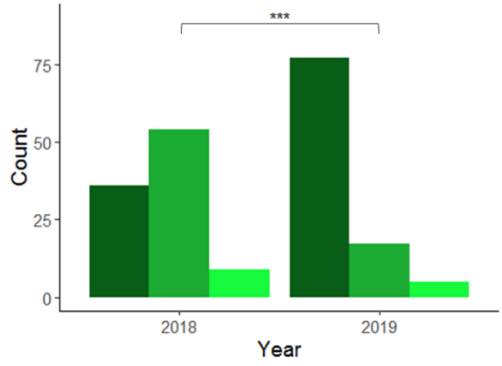


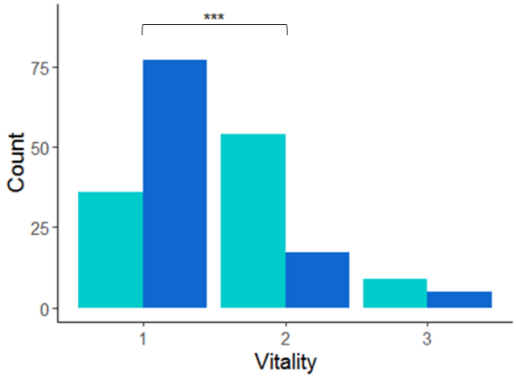
Sambucus nigra, N=52



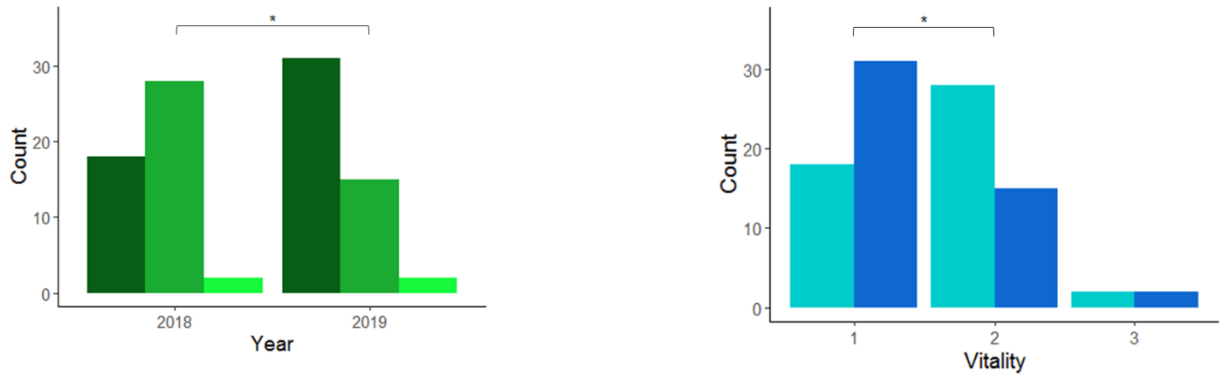


Frangula alnus, N=52

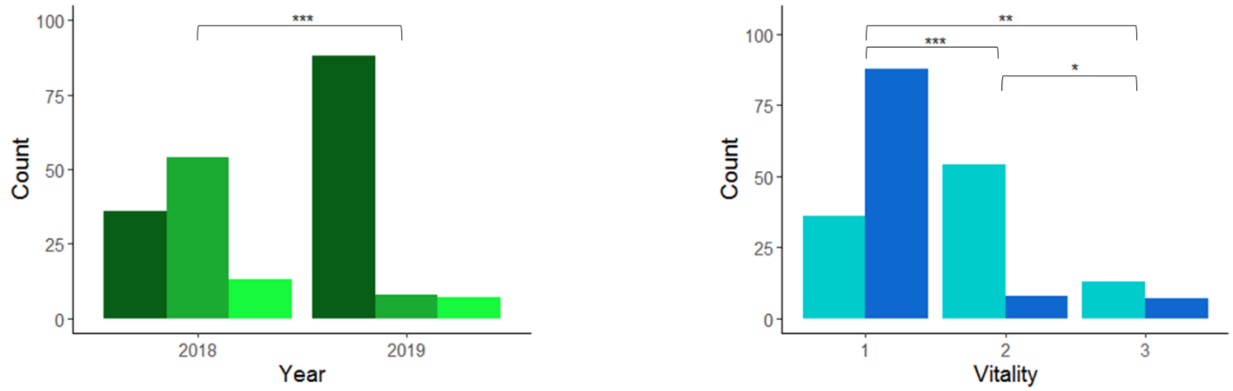




Corylus avellana, N=99

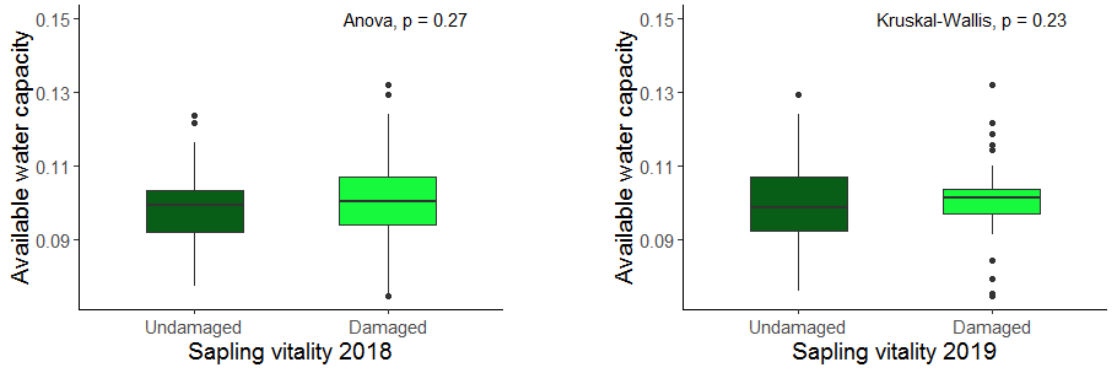


Crataegus spp., N= 48



Acer pseudoplatanus, N= 103

Figure S2. Vitality of most abundant species (*Fagus sylvatica* (n=772), *Carpinus betulus* (n=172), *Quercus* spp. (n=113), *Betula pendula* (n=145), *Sorbus aucuparia* (n=221), *Sambucus nigra* (n= 52), *Frangula alnus* (n=52), *Corylus avellana* (n=99), *Crataegus* spp. (n=48), and *Acer pseudoplatanus* (n = 103)). The left graphs show the difference in terms of vitality between the two years (2018 and 2019) and the right graphs show the difference between the vitality classes (1, 2, and 3). Vitality 1 = undamaged, 2 = partly damaged, 3 = completely damaged sapling.



a) b)

Figure S3. Available water capacity (AWC) and sapling vitality per plot in 2018 (a) and in 2019 (b). a) 53 plots undamaged and 160 damaged in 2018; b) 159 plots with saplings undamaged and 54 plots with saplings damaged in 2019.

Supplement 2: Vitality of the tree saplings corresponding to the soil type.

Files in this Data Supplement:
Table S1, S2, and S3

Table S1. Forest stand characteristics (213 plots). BA = basal area.

Forest type	**No. plots**	**Shannon diversity (mean)**	**BA m^2ha^{-1} (mean)**	**Soil type (no. plots)**			
				Cambisol	**Luvisol**	**Podzol**	**Rendzina**
Deciduous	47	1.21	19	26	3	11	7
Mixed forest	133	1.21	25	66	5	45	17
Conifers	38	1.14	23	25	2	7	4

Table S2. Number of the tree species found on each soil type in 2018 and 2019 (1777 individuals).

Species	Cambisol	Luvisol	Podzol	Rendzina
Fagus sylvatica	444	21	230	77
Sorbus aucuparia	140	17	59	5
Carpinus betulus	97	14	49	12
Betula pendula	102	0	42	1
Quercus spp.	35	12	65	1
Acer pseudoplatanus	50	13	15	25
Corylus avellana	51	1	21	26
Frangula alnus	19	1	26	6
Sambucus nigra	31	0	8	13
Crataegus spp.	17	0	20	11

Table S3. Pairwise comparisons using Fisher's exact test for count data to test the hypothesis of no difference in undamaged/damaged saplings between soil types (cambisol, luvisol, podzol, and rendzina).

a) Sapling classification (undamaged/damaged) corresponding to the soil types. Fisher's Exact Test for Count Data, p-value = 0.007

Soil	Undamaged 2018	Damaged 2018	Undamaged 2019	Damaged 2019
Cambisol	382	705	802	285
Luvisol	**18**	**80**	65	**33**
Podzol	227	390	449	168
Rendzina	91	158	164	85

b) Comparison of soil types between undamaged and damaged saplings (2018 and 2019).

	Cambisol: Luvisol	Cambisol: Podzol	Cambisol: Rendzina	Luvisol: Podzol	Luvisol: Rendzina	Podzol: Rendzina
Undamaged 2018: Damaged 2018	**0.01**	0.71	0.86	**0.01**	**0.01**	1.00
Undamaged 2018: Undamaged 2019	0.16	0.77	0.52	0.15	0.11	0.77

Undamaged 2018: Damaged 2019	**0.03**	1.00	0.38	**0.03**	0.16	0.38
Damaged 2018: Undamaged 2019	0.16	1.00	0.69	0.16	0.42	0.68
Damaged 2018: Damaged 2019	1.00	0.77	0.16	1.00	0.55	0.38
Undamaged 2019: Damaged 2019	0.29	0.81	0.09	0.38	1.00	0.16

Table S4. Contingency table for undamaged and damaged sapling during the drought of 2018 and after it (2019) for the following soil types: a) cambisol, b) luvisol, c) podzol, and d) rendzina. McNemar's Chi-Squared test for count data was applied to each soil type

a)

Cambisol	**2019**		
2018	**Undamaged**	**Damaged**	**Sum**
Undamaged	345	**37**	382
Damaged	**457**	248	705
Sum	802	285	1087

McNemar's chi-squared = 355.39, p-value < 2.2e-16

b)

Luvisol	**2019**		
2018	**Undamaged**	**Damaged**	**Sum**
Undamaged	17	**1**	18
Damaged	**48**	32	80
Sum	65	33	98

McNemar's chi-squared = 43.184, p-value = 4.983e-11

c)

Podzol	**2019**		
2018	**Undamaged**	**Damaged**	**Sum**
Undamaged	195	**32**	227
Damaged	**254**	136	390
Sum	449	168	617

McNemar's chi-squared = 170.77, p-value < 2.2e-16

d)

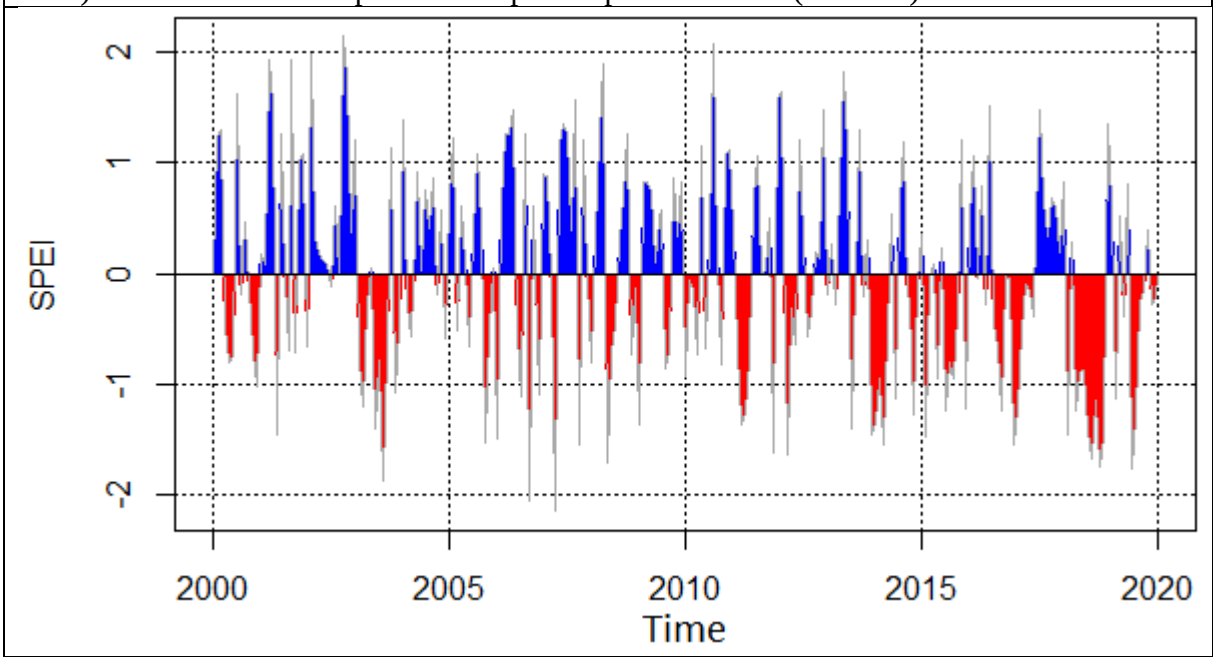
Rendzina	**2019**		
2018	Undamaged	Damaged	Sum
Undamaged	75	**16**	91
Damaged	**89**	69	158
Sum	164	85	249

McNemar's chi-squared = 49.371, p-value = 2.118e-12

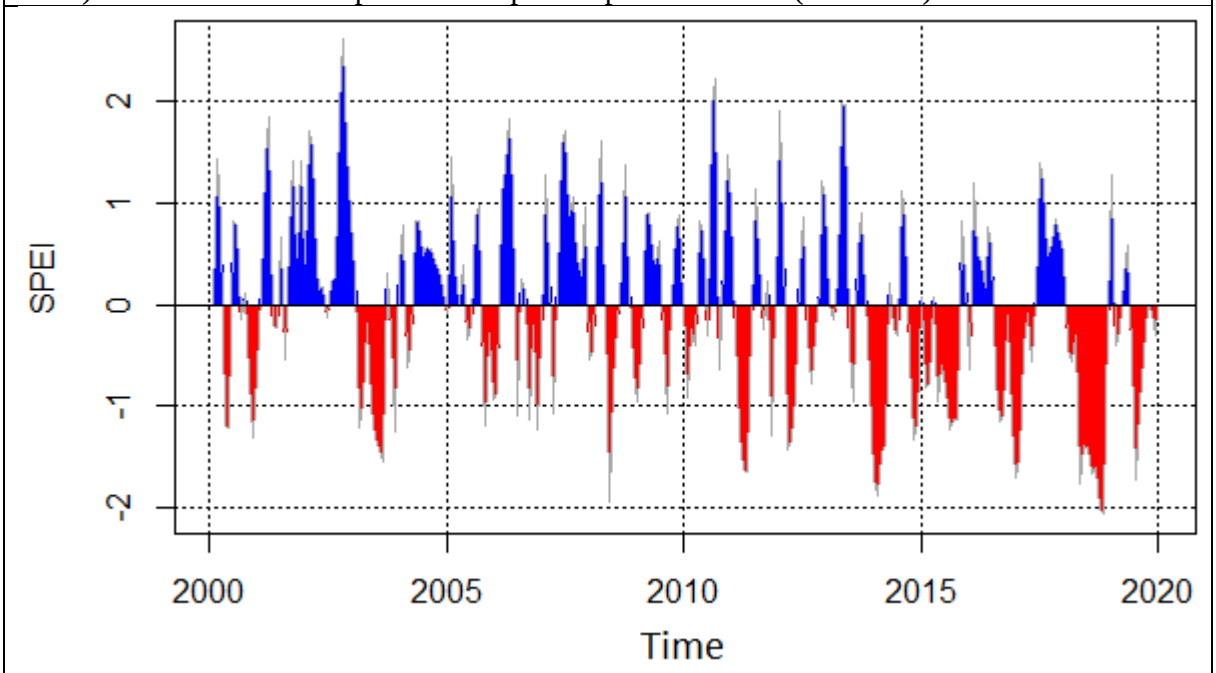
Supplement 3: Standardized Precipitation Evapotranspiration Index (SPEI) for the study area.

Files in this Data Supplement:
Figure S1 a, b, c, d, e

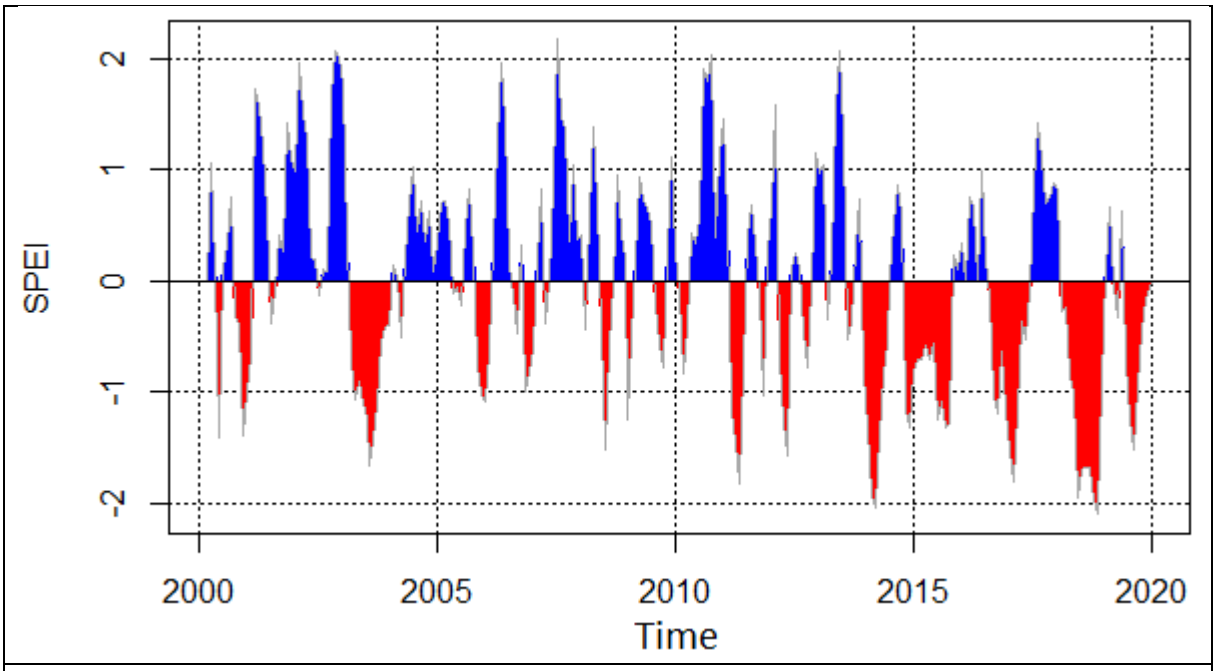
a) Standardized Precipitation Evapotranspiration Index (1 month)



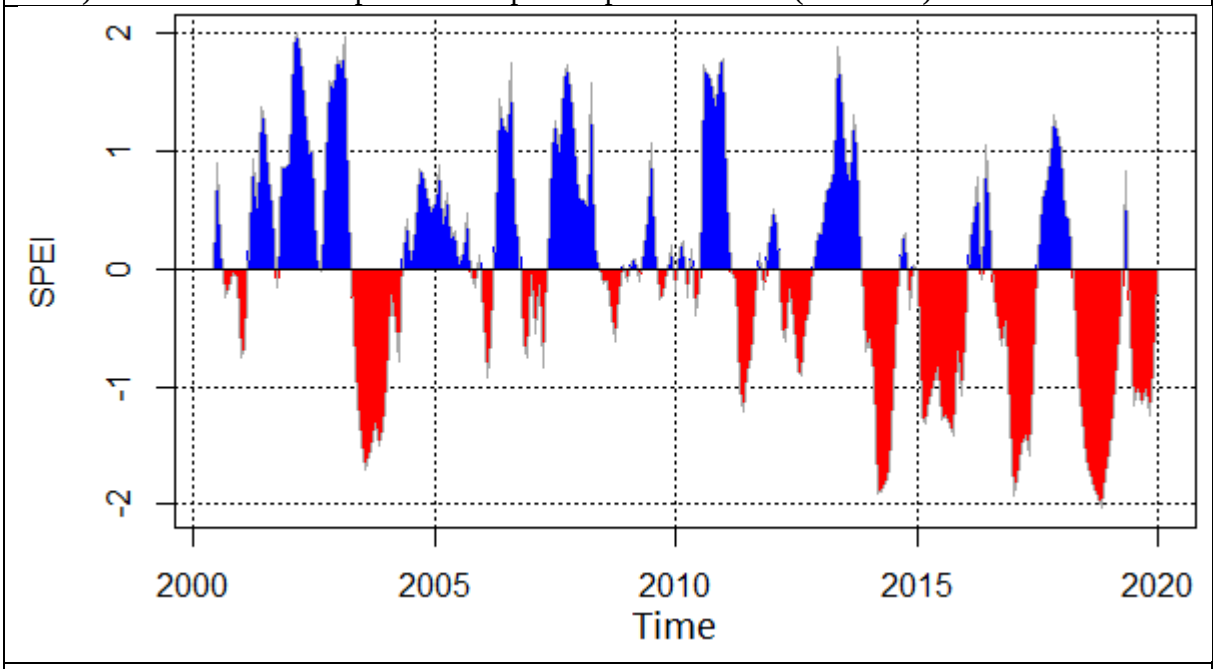
b) Standardized Precipitation Evapotranspiration Index (2 months)



c) Standardized Precipitation Evapotranspiration Index (3 months)



d) Standardized Precipitation Evapotranspiration Index (6 months)



e) Standardized Precipitation Evapotranspiration Index (12 months)

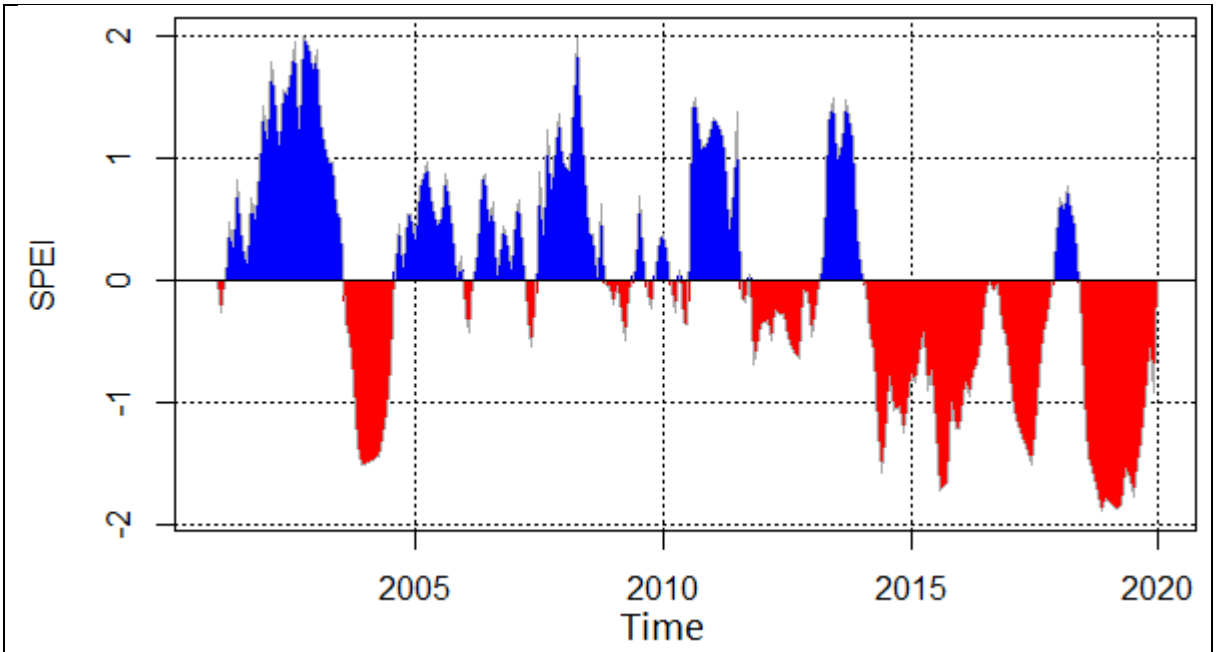


Figure S1. Standardized Precipitation Evapotranspiration Index (SPDI) between 2000 and 2019 for the sample plots (218 plots). Red = negative values (drought), blue = positive values (wet). Value: (−1.00, 1.00) = no drought, (−1.50, −1.00) = moderate drought, (−2.00, −1.50) = severe drought, (≤−2.00) = extreme drought, (1.00, 1.50) = moderate wet, (1.50, 2.00) = severe wet, (≥2.00) severe wet). Climatic data (temperature and precipitation) extracted from the raster data set (1 x 1 km) of the German Meteorological Service. Potential evapotranspiration was calculated based on Thornthwaite equation.