Supplementary 1

New synthesis of European Relative Pollen Productivities (RPPs) and RPP values used in the second generation of REVEALS reconstruction for Europe

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S1 Introduction (Fig. S1)

We present a new synthesis of the relative pollen productivity (RPP) estimates and their standard deviations (SDs) available for Europe. This synthesis was motivated by the necessity of performing a new REVEALS reconstruction of Holocene plant cover in Europe for the purpose of a research project on land-cover change as climate forcing over the Holocene in Europe (PI: M.-J.). RPP estimates are necessary to implement the modelling approach for pollen-based reconstruction of past plant abundance known as the Landscape Reconstruction Algorithm (LRA), developed by Sugita (2007a&b). The LRA includes the application of models of pollen dispersal and deposition requiring values of relative pollen productivity for the major plants of the past. The most common method to estimate RPPs involves the application of the Extended R-Value (ERV) model on datasets of modern pollen assemblages and related vegetation cover. A summary of the ERV model and its assumptions, and an extensive description of standardised field methods for the purpose of RPP studies are found in (Bunting et al., 2013b). Estimation of RPPs in Europe started around 2000 with the studies by Sugita in 1999 and then Broström in 2004 (Broström et al., 2004; Sugita et al., 1999) in Southern Sweden, and Nielsen (2004) in Denmark. The first tests of the RPP in pollen-based reconstructions of plant cover using the LRA's REVEALS (REgional VEgetation Abundance from Large Sites) model (Sugita, 2007a) were published by Soepboer et al., (2007) in Switzerland and in South Sweden (Hellman et al., 2008a, 2008b). Over the last 15 years, a large number of RPP studies have been undertaken in Europe North of the Alps, but it is only recently that RPP studies were initiated in the Mediterranean area ((Grindean et al., 2019); Mazier et al., unpublished). Two earlier syntheses of RPPs in Europe were published by Broström (Broström et al., 2008) and Mazier (Mazier et al., 2012). From 2012 onwards, these RPP values have been used in numerous applications of the LRA's two models REVEALS and LOVE (LOcal Vegetation Estimates) (Sugita, 2007a, 2007b) to reconstruct regional and local plant cover in Europe (Cui et al., 2013; Fyfe et al., 2013; Mazier et al., 2015; Nielsen et al., 2012; Nielsen and Odgaard, 2010; Trondman et al., 2015). Recently, Wieczorek and Herzschuh (2020) published a synthesis of the RPPs available for the Northern Hemisphere; it includes new mean RPP values for Europe that were produced independently from the synthesis we present here. Therefore, we compare our mean RPP values for Europe with those of Wieczorek and Herzschuh (2020) and discuss causes for dissimilarities.

S2 Methods

S2.1 Selection of RPP studies (Fig. S1, Table S1)

The synthesis of mean RPPs presented here was produced in 2018 and applied in REVEALS reconstructions 2018-2020. Of nineteen RPP studies available (in July 2021), we selected fifteen published between 1998 and 2018 and one unpublished study in 2018 (now published as Grindean et al., 2019). The sixteen study regions are distributed in twelve European countries (Fig. S1) and detailed in Table S1.

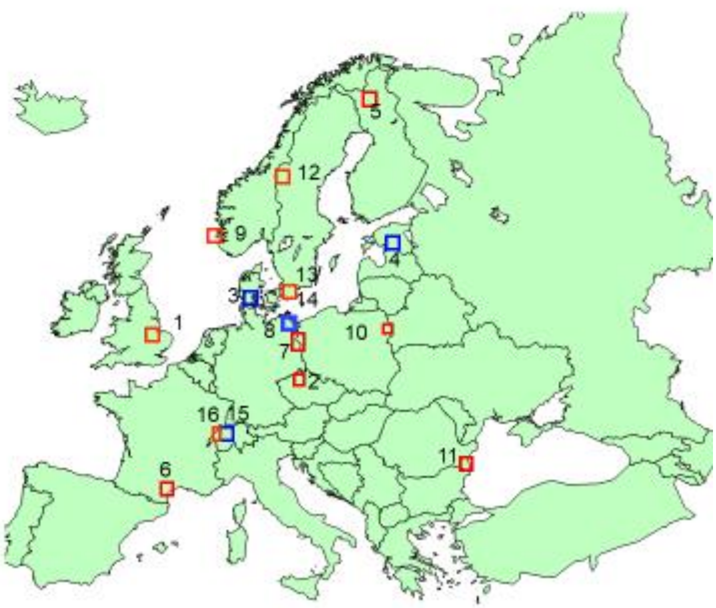

Figure S1: Location of the selected studies of relative pollen productivities (RPP) in Europe. 1. Britain, Bunting et al., (2005); 2. Czech Republic, (Abraham and Kozáková, 2012); 3. Denmark, (Nielsen, 2004); 4. Estonia, (Poska et al., 2011); 5. Finland. (Räsänen et al., 2007); 6. France, Mazier et al., unpublished; 7. Germany, (Matthias et al., 2012); 8. Germany, (Theuerkauf et al., 2013); 9. Norway, (Hjelle, 1998); 10. Poland, Baker et al., (2016); 11. Romania, Grindean et al., (2019); 12. Sweden, (von Stedingk et al., 2008); 13. Sweden, Sugita et al., (1999); 14. Sweden, Broström et al., (2004); 15. Switzerland, (Soepboer et al., 2007); 16. Switzerland, (Mazier et al., 2008).

Table S1: Selection of studies for the synthesis of relative pollen productivity (RPP) estimates. For explanation of symbols, see captions below the Table. Emphasized in bold: additional, new studies compared to the studies included in the synthesis of Mazier et al., (2012).

Country	Region	No sites	Site distrib.	Pollen sample[1]	ERV sub-model	Distance weighting model[2]	Reference taxon	No taxa[3]	Reference
Britain	East Anglian: Norfolk woodlands	(34 + 19)^	selected	M	1	GPM Prentice's bog	*Quercus* Poaceae**	6	Bunting et al., 2005
Czech Republic	**Central Bohemia: agricultural landscape**	54	stratified random	M	1	GPM Prentice's bog	Poaceae	13	**Abraham & Kózaková 2012**
Denmark	Ancient agricultural landscape[+]	30	selected	L[++]	1	GPM Sugita's lake	Poaceae	7	Nielsen 2004
Estonia	Hemi-boreal forest zone: mixed woodland - agricultural landscape	40	selected	L	3	GPM Sugita's lake	Poaceae	10	Poska et al., 2011
Finland	N Finland	24	stratified random	M	3	GPM Prentice's bog	Poaceae	6	Räsänen et al., 2007
France	**Mediterranean region:**	23	random	M	3	GPM Prentice's bog	Poaceae	11	**Mazier et al., unpubl.**
Germany	**Eastern Germany: Brandenburg, agricultural landscape**	49	selected	L	3	GPM Sugita's lake	*Pinus* Poaceae*	16	**Matthias et al., 2012**
	NE Germany: agricultural landscape	27	selected	L	3	LSM GPM Sugita's Lake[2]	*Pinus* Poaceae*	11 (15)[3]	**Theuerkauf et al., 2013**
Norway	SW Norway: Hordaland and Sogn og Fjordane, mown or grazed grass-land and heath	39	selected	M	1	None[#]	Poaceae	17	Hjelle et al., 1998
Poland	**NE Poland: Bialowieza Forest**	18	stratified random	M	3	GPM Prentice's bog	Poaceae	8	**Baker et al., 2016**
Romania	**SE Romania: Forest-steppe region**	26	random	M & S	3	GPM Prentice's bog	Poaceae	13	**Grindean et al., 2019**

Sweden	West- Central Sweden: Forest-tundra ecotone	30	random	M	3	GPM Prentice's bog	Poaceae	10	von Stedingk et al., 2008
	S Sweden: ancient cultural landscapes	114	selected	M	3	None[#]	*Juniperus* Poaceae*	14 (17)[3]	Sugita et al., 1999
	S Sweden: unfertilized mown or grazed grasslands	42	selected	M	3	GPM Prentice's bog	Poaceae	11	Broström et al., 2004
Switzerland	Lowland: agricultural landscape	20	selected	L	3	GPM Prentice's bog	Poaceae	13	Soepboer et al., 2007
	Jura Mountain: pasture woodlands	20	(stratified) random^^	M	1	GPM Prentice's bog	Poaceae	11	Mazier et al., 2008

[1] L=lakes; M=moss pollsters; S=surface soil

[2] Other distance-weighting models were used in most studies, including the Gaussian Plume Model (GPM), $1/d$, $1/d^2$ (d=distance) and the Lagrangian Stochastic Model (LSM). The GPM is used in both the model developed for (Parsons and Prentice, 1981; Prentice and Parsons, 1983) and lakes (Sugita, 1993). For this RPP synthesis, we chose the results from the analyses using GPM rather than $1/d$ or $1/d^2$. Note: In the study of Theuerkauf et al., (2013) the LSM was used. For this synthesis, Theuerkauf recalculated his RPPs using the lake model developed by Sugita (1993).

[3] Number of plant taxa for which RPP was estimated, including the reference taxon. Note: In the study by Theuerkauf et al., (2013) RPPs were estimated for 17 taxa using LSM. The RPPs were recalculated using the lake model (Sugita, 1993) for 15 taxa (see note under [2] above) for this synthesis. In the study of Sugita et al., (1999) RPPs were calculated for 14 trees and 3 herbs. We used only the values for the 14 trees in this synthesis, following the syntheses by Broström et al., (2008) and Mazier et al., (2012).

^ Britain: the study includes two areas (a and b) in which RPP estimates were calculated for different sets of taxa and the two areas have different numbers of sites: a. Calthorpe (34), 5 taxa; b. Wheatfen (17), same 5 taxa and *Corylus* (6 taxa in total)

^^ random distribution of sites in areas with existing vegetation maps (therefore not truly random) (Mazier et al., 2008)

[+] Vegetation data from historical maps around 1800 CE

[+ +] lake sediments dated to ca. 1800

* The reference taxon used in the original study is different from Poaceae. For this synthesis the RPPs were converted to values relative to Poaceae.

** The study of Bunting et al., (2005) does not include a RPP for Poaceae. In order to calculate the RPPs relative to Poaceae, it was assumed that the RPP of *Quercus* was equal to the mean of RPPs from three other studies in Europe (see Mazier et al., 2012 for details). Although we have included new RPP values for *Quercus* in this synthesis, we did not recalculate the RPPs from Bunting et al., (2005) with a new mean value for *Quercus*, but used the same values as in Mazier et al., (2012). For comparison, the mean value for *Quercus* using the RPPs of the additional studies included in this synthesis is 4.28 (instead of

5.83 in Mazier et al., 2012). This would imply slightly lower RPPs in Britain also for *Alnus, Betula, Corylus, Fraxinus* and *Salix*.

No distance weighting used for vegetation data because there was no information about vegetation with increasing distance from the pollen sample (Hjelle et al., 1998; Sugita et al., 1999). In the Swedish study, vegetation data within a 10^2 m^2 (herb taxa) and 10^3 m^2 quadrat (tree taxa) centred on the pollen sample was used (Sugita et al., 1999).

Three studies are not included in our synthesis: Britain (Twiddle et al., 2012) because of the absence of Poaceae in the calculated RPPs, curves of likelihood function scores exhibiting departures from theoretically correct curves, and doubts expressed by the authors on the reliability of the values; Greenland (Bunting et al., 2013a) because it is not considered in our reconstruction of Holocene plant cover in Europe; and Czech Republic (Kuneš et al., 2019) because the study was not ready when we finalized our synthesis. However, we compare the RPP values from these three studies with the mean RPP values in this synthesis (Table S5).

All studies used the ERV model to calculate RPPs, and all but one study used modern pollen assemblages and vegetation; only Nielsen (2004; Denmark) used historical pollen and vegetation data. Eleven studies used pollen assemblages from moss pollsters, five studies from lake sediments. Grindean et al., (2019; Romania) also used some pollen assemblages from surface soil samples. All studies used distance-weighted vegetation except two, Hjelle et al., (1998; SW Norway) and Sugita et al., (1999; S Sweden). The Gaussian Plume Model (GPM) was used for pollen dispersal and deposition to distance-weight vegetation, i.e. the Prentice's bog model (Parsons and Prentice, 1981; Prentice and Parsons, 1983) in studies using pollen from moss pollsters, and the Sugita's lake model (Sugita, 1993) in studies using pollen from lake sediments (see also caption of Table S1). In the case of the study by Theuerkauf et al., (2013), the published RPP values were calculated using the Lagrangian Stochastic Model. For the purpose of this synthesis, Theuerkauf recalculated the RPPs using the GPM bog model in the application of the ERV model. The distribution of sites for collection of pollen samples and vegetation data within the study regions is random or random stratified in seven of the eleven studies using moss pollsters; the five remaining studies used selected sites (or systematic distribution). Studies using lake sediments normally result in a systematic site distribution. (Broström et al., 2005) and Twiddle et al., (2012) showed that random distribution of sites provided better estimates of "relevant source area of pollen" (RSAP; *sensu* Sugita, 1994) and thus RPPs, given that the reliable RPPs are those obtained for the RSAP distance, i.e. the RPPs are based on the relationship between pollen and distance weighted vegetation within the RSAP distance. Both studies indicated that systematic distribution of sites have the tendency to result in curves of likelihood function scores that do not follow the theoretical behaviour, i.e. an increase of the scores with distance until the values reach an asymptote. However, the difference in RPPs between systematic and random sampling is generally not very large. Nonetheless, systematic sampling may lead to uncertainty in terms of reliability of RPPs and random distribution of sites is recommended and has generally been used in studies using moss pollsters or soil samples published from 2008 and onwards.

S2.2 Selection of RPP values and calculation of the mean RPPs and their SDs (Tables S2 and S3)

Tables S2 (Boreal and Temperate Europe) and 3 (Mediterranean Europe) list the RPP values from the 16 selected studies according to the information on models used provided in Table S1 (with further explanations in the section on selection of RPP studies, above). We followed similar procedures and rules as Mazier et al., (2012) and Li et al., (2018) to produce a new standard RPP dataset for Europe. We consider that there are still too few RPP values per taxon to disentangle variability in the RPP values for a particular taxon due to methodological issues, landscape characteristics, land use, or climate. We therefore use the mean of selected RPP values for each taxon in the new standard RPP dataset, following Broström et al., (2008) and Mazier et al., (2012) (Table S4). In boreal and temperate Europe, the number of RPP values per taxon varies between one and nine (*Betula*) (Table S2 A and B), and in Mediterranean Europe, there is only one value per taxon (Table S3).

Table S2: Europe (Mediterranean area excluded): RPP estimates and their SDs (in brackets) with the total number of taxa per study indicated and in brackets the number of taxa with selected RPP estimates. A. Studies using moss pollsters as pollen samples. B. Studies using surface lake sediments as pollen samples. For explanation of symbols, see captions below Table B.

A

Type of pollen sample	Moss polsters							
Region	Finland	C Sweden	S Sweden#	Norway	England##	Swiss Jura	Czech Rep*	Poland**
ERV submodel	ERV 3	ERV 3	ERV 3	ERV 1	ERV 1	ERV 1	ERV 1	ERV 3
HERB TAXA								
Poaceae (Reference taxon)	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)
Apiaceae				0.26 (0.009)				
Artemisia							2.77 (0.39)	
Calluna vulgaris		0.30 (0.03)	4.70 (0.69)	1.07 (0.03)				
Cerealia-t			3.20 (1.14)				0.0462 (0.0018)	
Chenopodiaceae							4.28 (0.27)	
Comp. SF. Cichorioideae			0.24 (0.06)	0.06 (0.004)				
Cyperaceae	0.002 (0.0022)	0.89 (0.03)	1.00 (0.16)	0.29 (0.01)		0.73 (0.08)		
Empetrum	0.07 (0.06)	0.11 (0.03)						
Ericaceae		0.07 (0.04)						
Filipendula			2.48 (0.82)	3.39 (0.00)				
Leucanthemum (*Anthemis*)-t				0.10 (0.008)				
Plantago lanceolata			12.76 (1.83)	1.99 (0.04)			3.70 (0.77)	
Plantago media						1.27 (0.18)		
Plantago montana						0.74 (0.13)		
Potentilla -t			2.47 (0.38)	0.14 (0.005)		0.96 (0.13)		
Ranunculus acris -t			3.85 (0.72)	0.07 (0.004)				
Rubiaceae			3.95 (0.59)	0.42 (0.01)		3.47 (0.35)		
Rumex acetosa -t			4.74 (0.83)	0.13 (0.004)				
Secale			3.02 (0.05)					
Trollius						2.29 (0.36)		
Urtica							10.52 (0.31)	
Vaccinium	0.01 (0.01)							
TREE TAXA								
Abies						3.83 (0.37)		
Acer			1.27 (0.45)			0.32 (0.10)		
Alnus			4.20 (0.14)		8.74 (0.35)		2.56 (0.32)	15.95 (0.6622)
Betula	4.6 (0.70)	2.24 (0.20)	8.87 (0.13)		6.18 (0.35)			13.94 (0.2293)
Carpinus			2.53 (0.07)					4.48 (0.0301)
Corylus			1.40 (0.04)		1.51 (0.06)			1.35 (0.0512)
Fagus			6.67 (0.17)			1.20 (0.16)		
Fraxinus			0.67 (0.03)		0.70 (0.06)		1.11 (0.09)	
Juniperus		0.11 (0.45)	2.07 (0.04)					
Picea		2.78 (0.21)	1.76 (0.00)			8.43 (0.30)		
Pinus	8.40 (1.34)	21.58 (2.87)	5.66 (0.00)				6.17 (0.41)	23.12 (0.2388)
Populus								
Quercus			7.53 (0.08)		5.83 (0.00)##		1.76 (0.20)	18.47 (0.1032)
Salix		0.09 (0.03)	1.27 (0.31)		1.05 (0.17)		1.19 (0.12)	
Sambucus nigra -t							1.30 (0.12)	
Tilia			0.80 (0.03)				1.36 (0.26)	0.98 (0.0263)
Ulmus			1.27 (0.05)					
Total number of taxa 40 (39)	6 (4)	10 (7)	26 (25)	12 (8)	7 (7)	11(10)	13(12)	8 (5)

B

Type of pollen sample			lake surface sediment		
Region	Estonia	Denmark	Swiss Plateau	Germany***	Germany ****
ERV submodel	ERV 3	ERV 1	ERV 3	ERV 3	
HERB TAXA					
Poaceae (Reference taxon)	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)	1.00 (0.00)
Apiaceae					
Artemisia	3.48 (0.20)				5.56 (0.020)
Calluna vulgaris		1.10 (0.05)			
Cerealia-t	1.60 (0.07)	0.75 (0.04)	0.00076 (0.0019)	9.00 (1.92)	0.08 (0.001)
Chenopodiaceae					
Comp. SF. Cichorioideae			0.17 (0.03)		
Cyperaceae	1.23 (0.09)				
Empetrum					
Ericaceae					
Filipendula	3.13 (0.24)				
Leucanthemum (*Anthemis*)-t					
Plantago lanceolata		0.90 (0.23)	0.24 (0.15)		2.73 (0.043)
Plantago media					
Plantago montana					
Potentilla -t					
Ranunculus acris -t					
Rubiaceae					
Rumex acetosa -t		1.56 (0.09)			2.76 (0.022)
Secale				4.08 (0.96)	4.87 (0.006)
Trollius					
Urtica					
Vaccinium					
TREE TAXA					
Abies			9.92 (2.86)		
Acer					
Alnus	13.93 (0.15)			15.51 (1.25)	13.68 (0.049)
Betula	1.81 (0.02)		2.42 (0.39)	9.62 (1.92)	19.70 (0.117)
Carpinus			4.56 (0.85)	9.45 (0.51)	
Corylus			2.58 (0.39)		
Fagus		5.09 (0.22)	0.76 (0.17)	5.83 (0.45)	9.63 (0.008)
Fraxinus			1.39 (0.21)	6.74 (0.68)	1.35 (0.012)
Juniperus					
Picea	4.73 (0.13)	1.19 (0.42)	0.57 (0.16)	1.58 (0.28)	5.81 (0.007)
Pinus	5.07 (0.06)		1.35 (0.45)	5.66 (0.00)	5.39 (0.222)
Populus				2.66 (1.25)	
Quercus	7.39 (0.20)		2.56 (0.39)	2.15 (0.17)	17.85 (0.049)
Salix	2.31 (0.08)				
Sambucus nigra -t					
Tilia				1.47 (0.23)	12.38 (0.101)
Ulmus					11.51 (0.101)
Total number of taxa (selected values) 40 (39)	11 (11)	7 (7)	13 (9)	13 (10)	15 (11)

RPPs for herbs from Broström et al., (2004); RPPs for trees from Sugita et al., (1999) (reference taxon *Juniperus*), converted to Poaceae as reference taxon by Broström et al., (2004).

Bunting et al., (2005), reference taxon *Quercus* and no RPP for Poaceae; RPPs relative to Poaceae calculated by Mazier et al., (2012) assuming that the RPP of *Quercus* relative to Poaceae is the same as the mean RPP of *Quercus* from three other studies in NW Europe.

* New RPPs from the Czech Republic (Abraham & Kozáková, 2012).

** New RPPs from Poland. Poaceae as reference taxa (see text for more details)

*** New RPPs from Germany (Matthias et al., 2012), reference taxon *Pinus*. RPPs converted to Poaceae as reference taxon. We selected the RPP estimates obtained with the dataset of vegetation cover including only the trees that had reached their flowering age (allFIDage) (for more information, see Matthias et al., 2012).

**** New RPPs from Germany (Theuerkauf et al., 2013); in the original publication, the ERV analysis was performed with the Lagrangian Stochastic Model (LSM) for dispersal of pollen and with *Pinus* as reference taxon. For this synthesis, Martin Theuerkauf redid the analysis with the Gaussian Plume Model for dispersal of pollen (Parsons and Prentice, 1981; Prentice and Parsons, 1983) and with Poaceae as reference taxon.

Green: selected RPP estimates to be included in the mean RPP values.

Red: RPP estimates excluded because SE ≥ RPP.

Orange: RPP estimates excluded because of a too large difference with the other available estimates and their mean, (less than half or more than double the mean RPP).

Light blue: RPP estimates excluded due to its extreme high value compared to the other available estimates, i.e. from the study at Bialowice forest (Poland, Baker et al., 2016) for *Betula*, *Pinus* and *Quercu*s, Central Sweden for *Pinus*, and Germany**** for *Betula*, *Quercus*, *Tilia*, and *Ulmus*.

In general, all three sub-models of the ERV model were used in the RPP studies. We selected the RPP values obtained with the ERV sub-model considered by the authors to have provided the best results (Li et al., 2018) (Table S1). The latter is usually evaluated by the shape of the curve of likelihood function scores (LFS), or log likelihood (LL), see e.g. Twiddle et al., 2012) and the LFS and LL values themselves. All RPPs selected for this synthesis are expressed relative to Poaceae (RPP=1). In studies that used another reference taxon and calculated a RPP for Poaceae, the RPPs were recalculated relative to Poaceae. In studies that did not include a RPP value for Poaceae, it was assumed that the reference taxon had a RPP related to Poaceae equal to the mean of the RPP values for that taxon in the other studies (e.g. Mazier et al., 2012). For simplicity, we used the value of *Quercus* (5.83) calculated by Mazier et al., (2012) for the study by Bunting et al., (2005) (*Quercus* as reference taxon, no RPP value for Poaceae). We could also have used the new mean RPP for *Quercus* (4.54) using our selected RPPs (five values, instead of three in Mazier et al., (2012)). The latter would not have changed our results significantly; the mean RPP for *Quercus* would have been 4.28 instead of 4.54 (Table S4). For the study by Baker et al., (2016), we used the RPP values obtained with Poaceae as the reference taxon, given that the RPPs relative to *Quercus* or *Pinus* were almost identical when

ERV submodel 3 was used. The selection of RPP values in boreal and temperate Europe for the calculation of the mean RPP values of each taxon (values emphasized in green in Table S2A and B) is based on the following rules:

1. We excluded the RPP values that were not significantly different from zero considering the lower bound of its SE, and values that were considered as uncertain by the authors of the original publications (e.g., *Vaccinium* for Finland (Räsänen et al., 2007), *Pinus* for Central Sweden (von Stedingk et al.,2008)). Moreover, some RPP values were excluded as they were assumed to be outliers or unreliable based on experts' knowledge on the plants involved, the pollen-vegetation dataset, and the field characteristics of the related studies. For example, the RPPs for Cyperaceae, *Potentilla*-t and Rubiaceae obtained in SW Norway (Hjelle, 1998) and those for *Salix* and *Calluna vulgaris* from Central Sweden (von Stedingk et al., 2008) were assumed to be too low compared to the values obtained in other study areas (Mazier et al., 2012).
2. (i) when five or more RPP estimates of pollen productivity (N≥5) were available for a pollen type, the largest and the smallest RPP values (generally outlier values) were excluded, and the mean was calculated using the remaining three or more RPP estimates; (ii) when N=4, the most deviating value was excluded, and the mean calculated using the other three RPP values; (iii) when N=3, the mean was based on all values available except if one value was strongly deviating from the other two; and (iv) when N=2, the mean was based on the two values available; an exception is *Ulmus* for which we excluded the value from Germany (Theuerkauf et al., 2013) given that several of the RPPs in this study are considerably higher than most values in the other available studies, i.e. for *Betula* (18.7), *Quercus* (17.85) and *Tilia* (12.38). The latter values were also excluded from the mean RPP, as well as the unusually high values found by Baker et al., (2016) for *Betula* (13.94), *Pinus* (23.12) and *Quercus* (18.47). Baker et al., (2016) argue that the high RPP values might be characteristic of temperate deciduous forests that were little impacted by human activities. More studies in this type of wooded environments would be needed to confirm this assumption. In the absence of such studies we consider these values as outliers.

The SDs for the mean RPP values were calculated using the delta method (Stuart. and Ord., 1994), a mathematical solution to the problem of calculating the mean of individual SDs (Li et al., 2020).

Table S3: Mediterranean area: RPP estimates and their SDs from two available studies, and mean RPPs for northern and temperate Europe (Table S2, A and B), for comparison. The single RPPs emphasized in green were used in the new REVEALS reconstruction for Europe. The plant taxa emphasized in bold are sub-Mediterranean and/or Mediterranean plant species and genera. The values emphasized with grey shadow are the mean RPPs that were used for entire Europe (Mediterranean area included). See Method section for more details. Mean RPP values and SEs for * Cereals (*Secale* excluded) and for Secale (in bracket), ** *Carpinus betulus*, * *Juniperus communis*, ^ Ericaceae (*Calluna* and *Empetrum* excluded), ^^ *Fraxinus excelsior*, and ^^^ *Quercus* spp (deciduous), for comparison. '**

Study reference	Mazier et al. (unpubl.)		Grindean et al. (2019)		This paper (synthesis 2A, 2B)	
	RPP	SD	RPP	SD	RPP	SD
HERB TAXA						
Poaceae (reference taxon)	1.00	0.00	1.00	0.00	1.00	0.00
Apiaceae			5.91	1.23	**0.26**	**0.01**
Artemisia			5.89	3.16	**3.94**	**0.14**
Cerealia (Cerealia type, *Secale* included)			0.22	0.12	**1.85 (3.99)***	**0.38 (0.32)***
Plantago lanceolata			0.58	0.32	**2.33**	**0.20**
TREE/SHRUB TAXA						
Buxus sempervirens	**1.89**	**0.068**				
Carpinus orientalis			**0.24**	**0.07**	4.52**	0.43**
Castanea sativa	**3.258**	**0.059**				
Corylus avellana	3.44	0.89			**1.71**	**0.10**
Cupressaceae (*Juniperus communis* , ***J. phoenica, J. oxycedrus***)	**1.618**	**0.16**			**2.07*** **	**0.04*** **
Ericaceae (***Arbutus unedo* , *Erica arborea*** , *E. cinerea* , ***E. multiflora***)	**4.265**	**0.094**			0.07^	0.04^
Fraxinus (*F. excelsior* , ***F. ornus***)			2.99	0.88	**1.04^^**	**0.02^^**
Phillyrea	**0.512**	**0.075**				
Pistacia	**0.755**	**0.201**				
***Quercus* evergreen (*Q. ilex* , *Q. coccifera*)**	**11.043**	**0.261**				
Quercus deciduous (*Q.* spp, *Q. peduncularis* dominant)			1.10	0.35	**4.54^^^**	**0.09^^^**
Total number of taxa	9		8			

S3 Results (Table S4)

Table S4 presents the new mean RPPs based on the selected RPP values in Table S2 (emphasized in green) for 39 plant taxa of boreal and temperate Europe (Mediterranean area excluded), of which 22 (Poaceae included) are herbs or low shrubs. The number of selected RPP values (n) for Poaceae included in the three synthesis is larger than the total number of RPP (tn), i.e. n = nt + 1 in our synthesis and those by Mazier et al., (2012) and Wieczorek and Herzschuh (2020). This is because the study of Bunting et al., in 2005 (Bunting et al., 2005) does not include a value for Poaceae and the RPP values are related to *Quercus* and the RPPs related to Poaceae were calculated by assuming a RPP value related to Poaceae for *Quercus*. For details, see the Methods section. The ranking of RPPs for the 17 tree taxa, from the largest (13.56) to the smallest (0.8), is as follows: *Alnus*> *Abies alba*> *Pinus*> *Fagus sylvatica*> *Picea abies*> *Betula*> *Quercus*> *Carpinus betulus*> *Populus*> *Juniperus*> *Corylus avellana*> *Sambucus*

Table S4: New synthesis of European RPPs, Mediterranean RPPs excluded: mean RPPs with their SDs in brackets, and mean RPPs from the syntheses by Mazier et al., (2012) and Wieczorek and Herzschuh (2020), for comparison. This synthesis: values in bold are new mean RPPs compared to Mazier et al., (2012). The values emphasized in grey are the mean RPPs used in the new REVEALS reconstruction for Europe (see Introduction section and main article). The values of fall speed of pollen (FSP) are from Mazier et al., (2012) except those in italic, i.e. FSPs for Chenopodiaceae, *Urtica* and *Sambucus nigra*-t. (Abraham and Kozáková, 2012), and *Populus* (Wieczorek and Herzschuh, 2020)**. For the three syntheses, the number of selected RPP values (n) included in the calculation of the mean RPP estimate is indicated with the total number of RPP values (tn) in brackets. The number of selected RPP values (n) for Poaceae included in the three synthesis is larger than the total number of RPP (tn), see text, Result section, for details. For explanation of symbols, see captions below the Table.**

Study	**This paper, synthesis**			**Mazier et al. 2012 St 3**		**Wieczorek & Herzschuh 2020 Europe version 2**		
n (tn), FSP, RPP	**n (tn)**	**FSP**	**RPP (SE)**	**n (tn)**	**RPP (SE)**	**n(tn)**	**RPP (SE)**	**Notes**
HERB TAXA								
Poaceae (Reference taxon)	16(15)	0.035	1.00 (0.00)	9(8)	1.00 (0.00)	14(12)	1.00 (0.00)	
Herb taxa								
Apiaceae	1(1)	0.042	0.26 (0.01)	1(1)	0.26 (0.01)	3(3)	2.13 (0.41)	
Artemisia	3(3)	0.025	**3.94 (0.14)**	1(1)	3.48 (0.20)	2(2)	4.33 (1.59)	
*Calluna vulgaris**	2(4)	0.038	1.09 (0.03)	2(4)	1.09 (0.03)			see Ericales all*
Cerealia-t**	3(7)	0.06	**1.85 (0.38)**	2(4)	1.18 (0.04)	4(6)	2.36 (0.42)	**Cereals all****
Chenopodiaceae	1(1)	***0.019***	**4.28 (0.27)**	none	none	1(1)	4.28 (0.27)	Same value as in this synthesis
Comp. SF. Cichorioideae***	3(3)	0.051	0.16 (0.02)	3(3)	0.16 (0.02)	8(10)	0.22 (0.02)	**Asteraceae all*****
Cyperaceae	4(6)	0.035	**0.96 (0.05)**	4(6)	0.83 (0.04)	6(8)	0.56 (0.02)	
*Empetrum**	1(2)	0.038	0.11 (0.03)	1(2)	0.11 (0.03)			see Ericales all*
Ericaceae*	1(1)	0.038	0.07 (0.04)	1(1)	0.07 (0.04)	7(9)	0.44 (0.02)	**Ericales all***
Filipendula^	3(3)	0.006	**3.00 (0.28)**	2(3)	2.81 (0.43)	4(6)	0.97 (0.11)	**Rosaceae all ^**
Leucanthemum (Anthemis) -t***	1(1)	0.029	0.10 (0.01)	1(1)	0.10 (0.01)			see Asteraceae all***
Plantago lanceolata^^	4(6)	0.029	**2.33 (0.20)**	3(4)	1.04 (0.09)	8(10)	2.49 (0.11)	**Plantaginaceae all^^**
Plantago media^^	1(1)	0.024	1.27 (0.18)	1(1)	1.27 (0.18)			see Plantaginaceae all^^
Plantago montana^^	1(1)	0.030	0.74 (0.13)	1(1)	0.74 (0.13)			see Plantaginaceae all^^
Potentilla -t^	2(3)	0.018	1.72 (0.20)	2(3)	1.72 (0.20)			see Rosaceae all^
Ranunculus acris -t^^^	2(2)	0.014	1.96 (0.36)	2(2)	1.96 (0.36)	3(5)	0.99 (0.12)	**Ranunculaceae all^^^**
Rubiaceae	2(3)	0.019	3.71 (0.34)	2(3)	3.71 (0.34)	3(5)	1.56 (012)	
Rumex acetosa -t	3(4)	0.018	**3.02 (0.28)**	3(3)	0.85 (0.05)	3(4)	0.58 (0.03)	
Secale **	3(3)	0.06	**3.99 (0.32)**	1(1)	3.02 (0.05)			see Cereals all**
Trollius ^^^	1(1)	0.013	2.29 (0.36)	1(1)	2.29 (0.36)			see Ranunculaceae all^^^
Urtica	1(1)	***0.007***	**10.52 (0.31)**	none	none	1(1)	10.52 (0.31)	Same value as in this synthesis
TREE TAXA								
Abies alba	2(2)	0.12	6.88 (1.44)	2(2)	6.88 (1.44)	2(2)	6.88 (1.44)	Same value as in this synthesis
Acer spp	2(2)	0.056	0.80 (0.23)	2(2)	0.80 (0.23)	3(3)	0.23 (0.04)	
Alnus spp	5(7)	0.021	**13.56 (0.29)**	3(3)	9.07 (0.10)	4(6)	8.49 (0.22)	
Betula (mainly *B. pubescens* , *B. pendula*)	7(9)	0.029	**5.11 (0.30)**	6(6)	3.99 (0.17)	6(8)	4.94 (0.44)	
Carpinus betulus	2(4)	0.042	**4.52 (0.43)**	2(2)	3.55 (0.43)	3(5)	3.09 (0.28)	
Corylus avellana	4(4)	0.025	**1.71 (0.10)**	3(3)	1.99 (0.20)	3(4)	1.05 (0.33)	
Fagus sylvatica	3(6)	0.057	**5.86 (0.18)**	4(4)	3.43 (0.09)	3(3)	2.35 (0.11)	
Fraxinus excelsior	5(6)	0.022	**1.04 (0.02)**	3(3)	1.03 (0.11)	5(5)	2.97 (0.25)	
Juniperus communis	1(2)	0.016	2.07 (0.04)	1(2)	2.07 (0.04)	1(1)	7.94 (1.28)	
Picea abies	4(8)	0.056	**5.44 (0.10)**	4(6)	2.62 (0.12)	4(6)	1.65 (0.15)	
Pinus (mainly *P. sylvestris*)	6(9)	0.031	**6.06 (0.24)**	3(5)	6.38 (0.45)	4(6)	10.86 (0.80)	
Popul us spp	1(1)	***0.025***	**2.66 (1.25)**	none	none	1(1)	3.42 (1.60)	
Quercus (mainly *Q. robur* , *Q. petraea*)	6(8)	0.035	**4.54 (0.09)**	4(4)	5.83 (0.15)	5(7)	2.42 (0.10)	
Salix spp	5(5)	0.022	**1.18 (0.08)**	3(4)	1.79 (0.16)	3(4)	0.39 (0.06)	
Sambucus nigra -t	1(1)	***0.013***	**1.30 (0.12)**	none	none	1(1)	1.30 (0.12)	Same value as in this synthesis
Tilia spp	4(5)	0.032	**1.21 (0.12)**	1(1)	0.80 (0.03)	3(4)	0.93 (0.09)	
Ulmus spp	1(2)	0.032	1.27 (0.05)	1(1)	1.27 (0.05)	none		

* Separate mean RPP values for *Calluna vulgaris*, *Empetrum*, and Ericaceae (*Calluna* and *Empetrum* excluded) in this synthesis, a single mean RPP values for all Ericales in Wieczorek and Herzschuh (2020)

** Separate mean RPP values for Cerealia type (*Secale* excluded) and *Secale* in this synthesis, a single mean RPP for all cereals in Wieczorek and Herzschuh (2020)

*** Separate mean RPP values for Compositae SF Cichoriodae and *Leucanthemum* (*Anthemis*) type in this synthesis, a single mean RPP for all Asteraceae in Wieczorek and Herzschuh (2020). Note that there are no RPP for Asteraceae (Compositae SF Cichoriodae and *Leucanthemum* (*Anthemis*) type excluded) in our synthesis

^ Separate mean RPP values for *Filipendula* and *Potentilla* type in this synthesis, a single mean RPP for all Rosaceae in Wieczorek and Herzschuh (2020); note that there are no RPP for Rosaceae (*Filipendula* and *Potentilla-t*. excluded) in our synthesis; moreover *Filipendula* and *Potentilla*-t. are classified as herbs, while Rosaceae is classified as tree in Wieczorek and Herzschuh (2020)

^^ Separate mean RPP values for *Plantago lanceolata*, *P. media* and *P. montana* in this synthesis, a single mean RPP for all Plantaginaceae in Wieczorek and Herzschuh (2020); note that there are no RPP for Plantaginaceae (*Plantago lanceolata*, *P. media* and *P. montana* excluded) in our synthesis

^^^ Separate mean RPP values for *Ranunculus acris* type and *Trollius* in this synthesis, a single mean RPP for all Ranunculaceae in Wieczorek and Herzschuh (2020); note that there are no RPP for Ranunculaceae (*Ranunculus acris*-t and *Trollius* excluded) in our synthesis

nigra-t.> *Ulmus*> *Tilia*> *Salix*> *Fraxinus*> *Acer*. All tree taxa have mean RPPs larger than 1 except *Acer* (0.8). For four taxa, only one RPP was available (*Populus*, *Sambucus nigra*-t.) or selected from two values (*Juniperus*, *Ulmus*). The ranking of RPPs for the 22 herb and low shrub taxa, from the largest (10.52) to the smallest (0.07), is as follows: *Urtica*> Chenopodiaceae> *Secale*> *Artemisia*> Rubiaceae> *Rumex acetosa*-t.> *Filipendula*> *Plantago lanceolata*> *Trollius*> *Ranunculus acris*-t.> Cerealia-t.> *Potentilla*-t.> *Plantago media*> *Calluna vulgaris*> **Poaceae (1)**> Cyperaceae> *Plantago montana*> Apiaceae> Compositae SF. Cichorioideae> *Empetrum*> *Leucanthemum* (*Anthemis*)-t.> Ericaceae. All RPPs of herbs are lower than 4, except Chenopodiaceae (4.28) and *Urtica* (10.52). Seven herb taxa have RPPs lower than 1. Note that among the 17 tree taxa, eight have values larger than 4: *Alnus*, *Abies alba*, *Pinus*, *Fagus sylvatica*, *Picea*, *Betula*, *Quercus*, and *Carpinus betulus*. For nine taxa, only one RPP was available (Apiaceae, Chenopodiaceae, Ericaceae, *Leucanthemum* (*Anthemis*)-t., *Plantago media*, *Pantago montana*, *Trollius*, *Urtica*) or selected from two values (*Empetrum*).

The two studies in the Mediterranean area provide single RPP values for 16 taxa, five herb taxa (Poaceae included) and 11 tree taxa of which six are sub-Mediterranean and/or Mediterranean, and three include both temperate and Mediterranean taxa (Cupressaceae, Ericaceae, *Fraxinus*) (Table S3). The RPP of herb taxa are significantly different between the study of Grindean et al., (2019) and our synthesis, except for *Artemisia* (5.89 and 3, 94, respectively). The RPP of *Corylus avellana* from the study of Mazier et al., (unpublished) (3.44) is double as large as the mean RPP in our synthesis (1.71), and the mean RPP of *Quercus* (deciduous species) in our synthesis (4.54) is four times as large as the RPP from the study of Grindean et al., (2019) (1.10).

Table S5: Comparison of the mean RPPs in this synthesis with the RPP estimates from Twiddle et al., (2012; Britain), Bunting et al., (2013b; Greenland) and Kuneš et al., (2019; Czech Republic). Explanations for symbols in the taxa list, see caption below Table S4. + The original paper does not provide a RPP for Poaceae and values of standard deviations (SDs) for the RPPs. We extracted the RPP values related to *Picea* from Table 5 in Twiddle et al., (2012). RPPs related to Poaceae (1.00+) were then calculated by assuming that the RPP of *Picea* was equal to the mean RPP of *Picea* in Europe (this synthesis) (in bold). ++ The RPPs and their SDs are not listed in the original paper, we therefore read the values from Fig. 4 (Bunting et al., 2013b) and the decimals are approximate. +++ Kuneš et al., (2019): we chose the RPP values that were considered best by the authors, i.e. using the lake dataset (pollen from lake sediment), ERV sub-model 1 and the Lagrangian Stochastic Model (see text, Discussion section, for details). # value for *Plantago maritima* and ## two values for *Rumex acetosa* and *Rumex acetosella*, respectively (Bunting et al., 2013b), for comparison with *Plantago* spp. and *Rumex acetosa*-t. (This paper). Underlined RPPs are close to mean RPPs (this synthesis).

	This paper, synthesis RPP (SE)	*Twiddle et al. (2012)+ RPP ERV3 random GPM*	*Bunting et al. (2013b)++ RPP (SE) ERV1 GPM*	*Kunes et al (2019)+++ RPP-R ERV1 LSM (SE)*
HERB TAXA				
Poaceae (Reference taxon)	1.00 (0.00)	1.00+	1.00 (0.00)	1.00 (0.00)
Herb taxa				
*Calluna vulgaris**	1.09 (0.03)	11.42		
Chenopodiaceae	**4.28 (0.27)**			1.58 (0.74)
Comp. SF. Cichorioideae***	0.16 (0.02)			1.04 (0.64)
Cyperaceae	**0.96 (0.05)**		0.95 (0.05)	2.10 (0.88)
Leucanthemum (Anthemis) -t***	0.10 (0.01)			0.94 (0.43)
Plantago lanceolata^^	**2.33 (0.20)**		5.8 (0.3)#	2.24 (0.71)
Potentilla -t^	1.72 (0.20)		0.4 (0.03)	
Ranunculus acris -t^^^	1.96 (0.36)		2.0 (0.1)	1.38 (1.13)
Rubiaceae	3.71 (0.34)			1.03 (0.74)
Rumex acetosa -t	**3.02 (0.28)**		3.5 (0.3)/ 2.0 (0.1)##	1.94 (1.35)
Urtica	**10.52 (0.31)**			1.16 (0.52)
TREE TAXA				
Abies alba	6.88 (1.44)			1.08 (0.99)
Acer spp	0.80 (0.23)			1.25 (0.75)
Alnus spp	**13.56 (0.29)**			2.44 (0.73)
Betula (mainly *B. pubescens*, *B. pendula*)	**5.11 (0.30)**	13.16	3.75 (0.4)	2.53 (0.91)
Carpinus betulus	**4.52 (0.43)**			1.36 (0.36)
Corylus avellana	**1.71 (0.10)**			2.31 (1.13)
Fagus sylvatica	**5.86 (0.18)**			0.88 (0.25)
Fraxinus excelsior	**1.04 (0.02)**			0.79 (0.37)
Picea abies	**5.44 (0.10)**	**5.44**		2.39 (0.93)
Pinus (mainly *P. sylvestris*)	**6.06 (0.24)**	16.32		1.55 (0.44)
Quercus (mainly *Q. robur*, *Q. petraea*)	**4.54 (0.09)**			2.08 (0.46)
Salix spp	**1.18 (0.08)**		0.7 (0.03)	1.43 (0.62)
Tilia spp	**1.21 (0.12)**			2.30 (1.24)
Ulmus spp	1.27 (0.05)			0.96 (0.77)

S4 Discussion and conclusions

S4.1 Comparison of the new synthesis with two earlier syntheses (Tables S4)

Of the 39 plant taxa for which we have a mean RPP in our new synthesis (N), 21 have a new mean RPP value compared to the earlier synthesis of Mazier et al., (2012) (M), 18 taxa have the same mean RPPs in both syntheses. There are three new taxa for which there were no RPP in M, i.e. Chenopodiaceae, *Sambucus nigra*-t. and *Urtica*. The mean RPPs are comparable between the two syntheses N and M, except for *Plantago lanceolata* (2.33 in N/1.04 in M), *Rumex acetosa*-t. (3.02/0.85), *Alnus* (13.56/9.07), *Betula* (5.11/3.99), *Carpinus betulus* (4.52/3.55), *Fagus* (5.86/3.43), *Picea* (5.44/2.62) and *Quercus* (4.54/5.83).

Abies alba has the same RPP in all three syntheses. Chenopodiaceae, *Sambucus nigra*-t. and *Urtica* have the same single RPP values in the synthesis of Wieczorek and Herzschuh (2020) (W&H) and N. N and W&H also have comparable mean RPP values for *Artemisia*, Cereals (Cereals, *Secale* excluded in N, all Cereals in W&H), Compositae (SF Cichorioidae in N, all Asteraceae in W&H), Cyperaceae, *Plantago* (*P. lanceolata* in N, all Plantaginaceae in W&H), *Betula*, *Corylus*, *Populus* and *Tilia*. There are relatively large differences in mean RPPs in W&H and N for 16 plant taxa, although the ranking of the plant taxa in terms of their mean RPPs is almost the same. Mean RPP is larger in W&H than in N for Apiaceae (2.13/0.26), Ericales (0.44 in W&H) – *Empetrum* (0.11) and Ericaceae (0.07) in N, *Fraxinus* (2.97/1.04), *Juniperus* (7.94/2.07), *Pinus* (10.86/6.06). Mean RPP is smaller in W&H than in N for *Filipendula* (0.97/3.00), Rubiaceae (1.56/3.71), *Rumex acetosa* (0.58/3.02), *Acer* (0.23/0.80), *Alnus* (8.49/13.56), *Carpinus* (3.09/4.52), *Fagus* (2.35/5.86)), *Picea* (1.65/5.44), *Quercus* (2.42/4.54) and *Salix* (0.39/1.18).

The larger differences between the mean RPPs in N and W&H than between N and M have not been examined in detail. It is due to a slightly different selection of studies, i.e. the study of Theuerkauf et al., (2013) is not included in W &H and we did not include in N (boreal and temperate Europe, Mediterranean area excluded) the studies of Bunting et al., (2013b), Kuneš et al., (2019) and Grindean et al., (2020). Another important influencing factor is the selection of RPP values for calculation of the mean RPP. Although the rules used to select RPP values are very similar between the syntheses, there are obvious differences between N and W&H that are sometimes very significant (e.g. *Juniperus*).

S4.2 Comparison of the new synthesis with three additional individual studies (Tables S5)

The RPPs from Twiddle et al., (2012) (T) for *Pinus*, *Betula* and *Calluna* are considerably larger than the mean RPPs in our synthesis (N) (Table S5). This is probably due to the assumption made on the RPP of *Picea* related to Poaceae. The RPP of *Picea* varies greatly between the selected studies in N, from 0.57 to 8.43 (eight values available). If we assumed that the RPP of *Picea* related to Poaceae in the study region of T was the mean RPP of the five smallest RPPs, i.e. 1.57, the RPP of the three taxa would be 4.8 for *Pinus*, 3.4 for *Betula*, and 3.3 for *Calluna*, which is more comparable to the mean RPPs in N.

Three taxa in Bunting et al., (2013b) (B) have a RPP comparable to the mean RPP in N, i.e. for Cyperaceae, *Ranunculus acris*-t., and *Rumex acetosa*-t. (*R. acetosa* in B). The other taxa have a RPP in B smaller than the mean RPP in N, except *Plantago maritima* that has a larger RPP (5.8) in B than the mean RPP for *P. lanceolata* in N.

Of nine taxa, three have a RPP in Kuneš et al., (2019) (K) that is comparable to the mean RPP in N, i.e. for *Plantago lanceolata*, *Ranunculus acris*-t. and *Rumex acetosa*-t.. The other six taxa have a RPP larger than the mean RPP in N (Compositae SF Cichorioideae, Cyperaceae and *Leucanthemum* (*Anthemis*)-t., or smaller (Chenopodiaceae, Rubiaceae) to considerably smaller (*Urtica*). Of the 14 tree taxa, only four have a RPP in K comparable to the mean RPP in N, i.e. for *Corylus*, *Fraxinus*, *Salix*, and *Ulmus*. For the other 10 tree taxa, the RPP in K is much smaller than the mean RPP in N for *Abies alba*, *Alnus*, *Carpinus*, *Fagus*, *Picea*, *Pinus*, smaller for *Quercus*, and larger for *Acer* and *Tilia*.

Nevertheless, most of the RPP values of the three studies T, B and K are in the range of the values selected from the studies included in our synthesis (N) except for *Urtica*, *Abies alba*, *Carpinus*, and *Pinus* in K. The Lagrangian Stochastic Model is used in K instead of the Gaussian Plume Model in N, which may be one of the factors behind the lower RPPs in K, in particular (but not only) for taxa with heavy pollen grains.

S4.3 Use of the new RPP datasets

The new RPP datasets for Europe can be used in different ways. Tables S3 (Mediterranean area) and 4 (boreal and temperate Europe) can be used in combination for entire Europe, including entomophilous taxa or not, and including all values from the Mediterranean area or only the values for the strictly sub-Mediterranean and/or Mediterranean taxa. If one uses all RPPs from the Mediterranean area, the values for plant taxa that are also characteristic of boreal and temperate Europe need to be used only for the Mediterranean area. This is not straightforward to achieve, because the northern border of this region shifted over the Holocene, but it can be approximated. We chose to use only the RPPs for the sub-Mediterranean and/or Mediterranean taxa (including Ericaceae) (Table S3), and for all other taxa we used the mean RPP dataset for boreal and temperate Europe (Table S4). The major issue with this choice is the RPP value of Ericaceae. In both the Mediterranean area and boreal-temperate Europe there is only one reliable value available, one large and one small, respectively. Using only the large value may lead to an under-representation of Ericaceae (*Calluna* excluded), in particular in boreal Europe, but perhaps also in temperate Europe. This is one of the major weaknesses of the new REVEALS reconstruction of Holocene plant-cover change in entire Europe (main article). The latter reconstruction uses a RPP dataset that does not exclude the RPPs of all entomophilous taxa.

The excluded taxa are Compositae SF Cichoriodae, *Leucanthemum* (*Anthemis*)-t., *Potentilla*-t., *Ranunculus acris*-t., and Rubiaceae. The included entomophilous taxa have also some anemophily, e.g. *Artemisia*, Chenopodiaceae, Rubiaceae, *Plantago lanceolata*. We excluded plant taxa with only one RPP value except Chenopodiaceae, *Urtica*, *Juniperus*, and *Ulmus*. Until we have more RPP values for each taxon, it is not possible to disentangle the effect of all factors influencing the estimation of RPPs and to separate the effect of methodological factors from those of factors such as vegetation type, climate and land use. It is therefore not possible either to decide whether the selection of RPPs for calculation of a mean RPP is better in one synthesis than in the other. The only way to evaluate the reliability of a RPP dataset is to test it with modern pollen assemblages and related plant cover. Such a test has not been performed yet with the synthesis of W & H and our new datasets. We argue that RPP values of certain taxa may not vary substantially within a taxon (family, genus), while they might be variable for other taxa, depending on the characteristics of the flowers and inflorescences in different species of a genera and different genera of a family, and of their number per plant. Therefore, we propose that it is still preferable to make compilations of RPPs at a continental or sub-continental scale, rather than mix the RPPs from several sub-regions (as the Mediterranean, temperate and boreal regions in Europe) or continents (as the entire North Hemisphere in W & H, dataset not shown here).

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