

Supplementary Table S1. Taxa of wild bees (A) and butterflies (B) recorded in the sampled vineyards and their respective Red-List status according to the Red Lists of Rhineland-Palatinate (RL RLP¹) and the Red Lists of Germany (RL GER²). Red List categories: 1 = threatened with extinction; 2 = strongly endangered; 3 = endangered; V = prewarning list; D = data deficient; G = endangerment of unknown extent; I = non-native breeding species; * = least concern; ◇ = not evaluated; NA = Red List status not applicable to species groups³

Taxon	RL RLP¹	RL GER²
(A) wild bees		
Andrenidae		
<i>Andrena agilissima</i> (SCOPOLI, 1770)	3	3
<i>Andrena combinata</i> (CHRIST, 1791)	3	3
<i>Andrena dorsata</i> (KIRBY, 1802)	*	*
<i>Andrena flavipes</i> (PANZER, 1799)	*	*
<i>Andrena fulvago</i> (CHRIST, 1791)	*	3
<i>Andrena gravaida</i> (IMHOFF, 1832)	*	*
<i>Andrena haemorrhoa</i> (FABRICIUS, 1781)	*	*
<i>Andrena hypopolia</i> (SCHMIEDEKNECHT, 1883)	◇	2
<i>Andrena labialis</i> (KIRBY, 1802)	*	V
<i>Andrena labiata</i> (FABRICIUS, 1781)	*	*
<i>Andrena minutula</i> (KIRBY, 1802)	*	*
<i>Andrena nigroaenea</i> (KIRBY, 1802)	*	*
<i>Andrena nitidiuscula</i> (SCHENCK, 1853)	3	3
<i>Andrena ovatula</i> agg.	NA	NA
<i>Andrena scotica</i> (PERKINS, 1916)	*	*
<i>Andrena subopaca</i> (NYLANDER, 1848)	*	*
<i>Andrena wilkella</i> (KIRBY, 1802)	*	*
<i>Panurgus dentipes</i> (LATREILLE, 1811)	3	3
Anthophoridae		
<i>Anthophora aestivalis</i> (PANZER, 1801)	*	3
<i>Ceratina chalybea</i> (CHEVRIER, 1872)	3	3
<i>Ceratina cucurbitina</i> (ROSSI, 1792)	*	*
<i>Ceratina cyanea</i> (KIRBY, 1802)	*	*
<i>Epeolus variegatus</i> (LINNAEUS, 1758)	*	V
<i>Eucera longicornis</i> (LINNAEUS, 1758)	*	V
<i>Eucera nigrescens</i> (PÉREZ, 1879)	*	*
<i>Nomada flava</i> (PANZER, 1798)	*	*
<i>Nomada fucata</i> (PANZER, 1798)	*	*
<i>Nomada fulvicornis</i> (FABRICIUS, 1793)	*	*
<i>Nomada lathburiana</i> (KIRBY, 1802)	*	*
<i>Nomada succincta</i> (PANZER, 1798)	*	*
<i>Xylocopa violacea</i> (LINNAEUS, 1758)	3	*
Apidae		
<i>Bombus bohemicus</i> (SEIDL, 1838)	*	*
<i>Bombus hortorum</i> agg.	NA	NA

Taxon	RL RLP¹	RL GER²
<i>Bombus humilis</i> (ILLIGER, 1806)	3	3
<i>Bombus hypnorum</i> (LINNAEUS, 1758)	*	*
<i>Bombus lapidarius</i> (LINNAEUS, 1758)	*	*
<i>Bombus pascuorum</i> (SCOPOLI, 1763)	*	*
<i>Bombus pratorum</i> (LINNAEUS, 1761)	*	*
<i>Bombus ruderalis</i> (MÜLLER, 1776)	3	3
<i>Bombus rupestris</i> (FABRICIUS, 1793)	*	*
<i>Bombus soroeensis</i> (FABRICIUS, 1776)	*	V
<i>Bombus terrestris</i> agg.	NA	NA
<i>Bombus veteranus</i> (FABRICIUS, 1793)	3	3
Colletidae		
<i>Colletes cunicularius</i> (LINNAEUS, 1761)	*	*
<i>Colletes daviesanus</i> (SMITH, 1846)	*	*
<i>Colletes hederæ</i> (SCHMIDT & WESTRICH, 1993)	2	*
<i>Colletes similis</i> (SCHENCK, 1853)	*	V
<i>Hylaeus angustatus</i> (SCHENCK, 1861)	*	*
<i>Hylaeus brevicornis</i> (NYLANDER, 1852)	*	*
<i>Hylaeus clypearis</i> (SCHENCK, 1853)	*	*
<i>Hylaeus confusus</i> (NYLANDER, 1852)	*	*
<i>Hylaeus cornutus</i> (CURTIS, 1831)	*	*
<i>Hylaeus difformis</i> (EVERSMANN, 1852)	*	*
<i>Hylaeus dilatatus</i> (KIRBY, 1802)	*	*
<i>Hylaeus duckei</i> (ALFKEN, 1904)	2	3
<i>Hylaeus gredleri</i> (FÖRSTER, 1871)	*	*
<i>Hylaeus nigritus</i> (FABRICIUS, 1798)	*	*
<i>Hylaeus paulus</i> (BRIDWELL, 1919)	◇	*
<i>Hylaeus styriacus</i> (FÖRSTER, 1871)	*	*
Halictidae		
<i>Halictus maculatus</i> (SMITH, 1848)	*	*
<i>Halictus scabiosae</i> (ROSSI, 1790)	*	*
<i>Halictus simplex</i> agg.	NA	*
<i>Halictus subauratus</i> (ROSSI, 1792)	*	*
<i>Halictus tumulorum</i> (LINNAEUS, 1758)	*	*
<i>Lasioglossum calceatum</i> (SCOPOLI, 1763)	*	*
<i>Lasioglossum costulatum</i> (KRIECHBAUMER, 1873)	3	3
<i>Lasioglossum laticeps</i> (SCHENCK, 1868)	*	*
<i>Lasioglossum lativentris</i> (SCHENCK, 1853)	*	V
<i>Lasioglossum leucozonium</i> (SCHRANK, 1781)	*	*
<i>Lasioglossum malachurum</i> (KIRBY, 1802)	*	*
<i>Lasioglossum minutulum</i> (SCHENCK, 1853)	*	3
<i>Lasioglossum morio</i> (FABRICIUS, 1793)	*	*
<i>Lasioglossum nitidiusculum</i> (KIRBY, 1802)	3	V

Taxon	RL RLP¹	RL GER²
<i>Lasioglossum parvulum</i> (SCHENCK, 1853)	*	V
<i>Lasioglossum pauperatum</i> (BRULLÉ, 1832)	2	2
<i>Lasioglossum pauxillum</i> (SCHENCK, 1853)	*	*
<i>Lasioglossum politum</i> (SCHENCK, 1853)	*	*
<i>Lasioglossum punctatissimum</i> (SCHENCK, 1853)	*	*
<i>Lasioglossum pygmaeum</i> (SCHENCK, 1853)	3	G
<i>Lasioglossum smeathmanellum</i> agg.	*	*
<i>Lasioglossum tricinctum</i> (SCHENCK, 1874)	3	3
<i>Lasioglossum villosulum</i> (KIRBY, 1802)	*	*
<i>Sphecodes albilabris</i> (FABRICIUS, 1793)	*	*
<i>Sphecodes ephippius</i> (LINNAEUS, 1767)	*	*
<i>Sphecodes gibbus</i> (LINNAEUS, 1758)	*	*
<i>Sphecodes hyalinatus</i> (VON HAGENS, 1882)	*	*
<i>Sphecodes monilicornis</i> (KIRBY, 1802)	*	*
<i>Sphecodes reticulatus</i> (THOMSON, 1870)	*	*
<i>Sphecodes rubicundus</i> (VON HAGENS, 1875)	3	3
<i>Sphecodes rufiventris</i> (PANZER, 1798)	3	*
Megachilidae		
<i>Anthidium manicatum</i> (LINNAEUS, 1758)	*	*
<i>Anthidium punctatum</i> (LATREILLE, 1809)	*	V
<i>Coelioxys afra</i> (LEPELETIER, 1841)	3	3
<i>Coelioxys inermis</i> (KIRBY, 1802)	3	*
<i>Coelioxys mandibularis</i> (NYLANDER, 1848)	*	*
<i>Megachile centuncularis</i> (LINNAEUS, 1758)	*	V
<i>Megachile lagopoda</i> (LINNAEUS, 1761)	2	2
<i>Megachile pilidens</i> (ALFKEN, 1924)	3	3
<i>Megachile versicolor</i> (SMITH, 1844)	*	*
<i>Osmia adunca</i> (PANZER, 1798)	*	*
<i>Osmia aurulenta</i> (PANZER, 1799)	*	*
<i>Osmia bicornis</i> (LINNAEUS, 1758)	*	*
<i>Osmia brevicornis</i> (FABRICIUS, 1798)	3	G
<i>Osmia caerulea</i> (LINNAEUS, 1758)	*	*
<i>Osmia campanularum</i> (KIRBY, 1802)	*	*
<i>Osmia claviventris</i> (THOMSON, 1872)	*	*
<i>Osmia gallarum</i> (SPINOLA, 1808)	3	V
<i>Osmia leucomelana</i> (KIRBY, 1802)	*	*
<i>Osmia tridentata</i> (DUFOUR & PERRIS, 1840)	*	3
<i>Osmia truncorum</i> (LINNAEUS, 1758)	*	*
(B) butterflies		
Hesperiidae		
<i>Carcharodus alceae</i> (ESPER, 1780)	3	*
<i>Pyrgus malvae</i> (LINNAEUS, 1758)	V	V

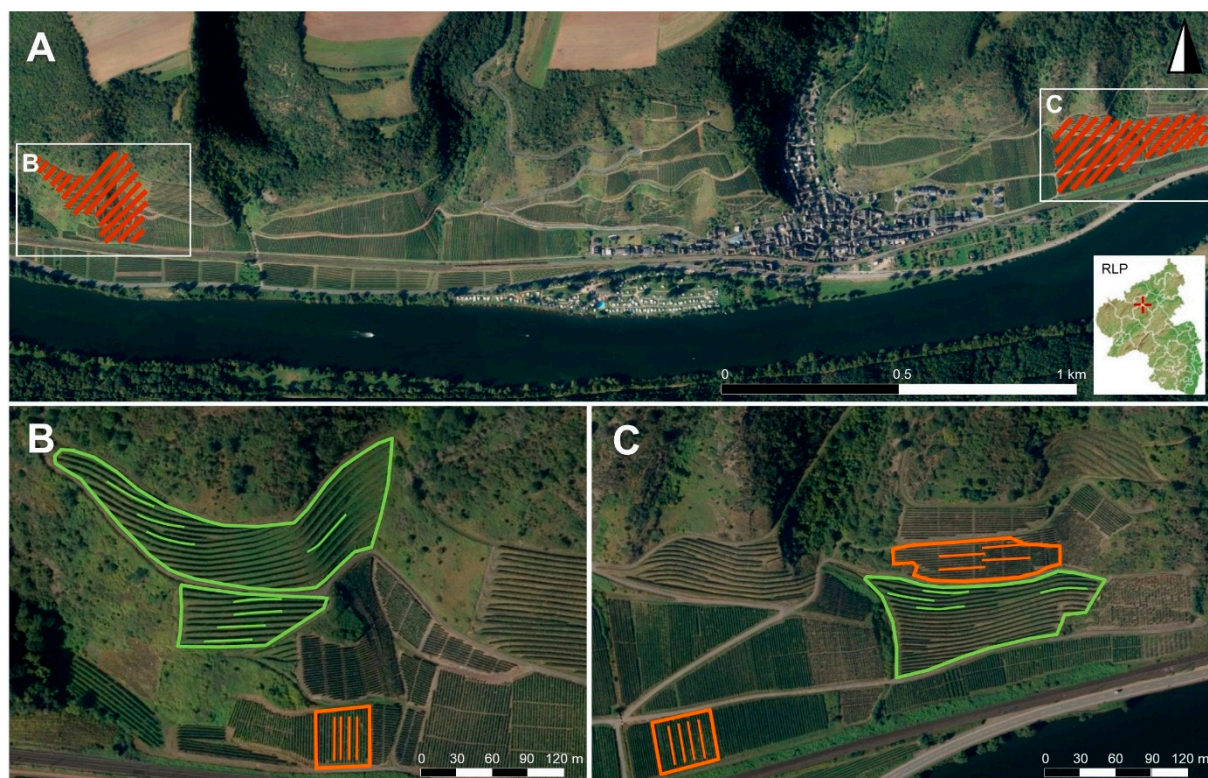
Taxon	RL RLP¹	RL GER²
<i>Thymelicus sylvestris</i> (PODA, 1761)	*	*
Papilionidae		
<i>Ipheclides podalirius</i> (LINNAEUS, 1758)	1	3
<i>Papilio machaon</i> (LINNAEUS, 1758)	V	*
Pieridae		
<i>Anthocharis cardamines</i> (LINNAEUS, 1758)	*	*
<i>Aporia crataegi</i> (LINNAEUS, 1758)	V	*
<i>Colias croceus</i> (FOURCROY, 1785)	I	*
<i>Gonepteryx rhamni</i> (LINNAEUS, 1758)	*	*
<i>Leptidea sinapis/reali</i> (LINNAEUS, 1758)	V	D
<i>Pieris brassicae</i> (LINNAEUS, 1758)	*	*
<i>Pieris mannii</i> (MAYER, 1851)	D	◇
<i>Pieris napi</i> (LINNAEUS, 1758)	*	*
<i>Pieris rapae</i> (LINNAEUS, 1758)	*	*
Lycaenidae		
<i>Lycaena phlaeas</i> (LINNAEUS, 1761)	*	*
<i>Lycaena tityrus</i> (PODA, 1761)	V	*
<i>Polyommatus icarus</i> (ROTTEMBURG, 1775)	*	*
<i>Satyrrium acaciae</i> (FABRICIUS, 1787)	2	V
<i>Satyrrium spini</i> (DENIS & SCHIFFERMÜLLER, 1775)	2	3
Nymphalidae*		
<i>Aglais io</i> (LINNAEUS, 1758)	*	*
<i>Aglais urticae</i> (LINNAEUS, 1758)	*	*
<i>Issoria lathonia</i> (LINNAEUS, 1758)	V	*
<i>Melitaea didyma</i> (ESPER, 1779)	2	2
<i>Nymphalis polychloros</i> (LINNAEUS, 1758)	3	V
<i>Polygonia c-album</i> (LINNAEUS, 1758)	*	*
<i>Vanessa atalanta</i> (LINNAEUS, 1758)	*	*
Satyridae		
<i>Coenonympha pamphilus</i> (LINNAEUS, 1758)	*	*
<i>Lasiommata megera</i> (LINNAEUS, 1767)	*	*
<i>Maniola jurtina</i> (LINNAEUS, 1758)	*	*
<i>Melanargia galathea</i> (LINNAEUS, 1758)	*	*
<i>Pyronia tithonus</i> (LINNAEUS, 1771)	V	*

¹Bees: Schmid-Egger et al. (1995), butterflies: Schmidt (2013); ²bees: Westrich et al. (2011), butterflies: Reinhardt & Bolz (2011); ³sixteen species belonging to five closely related species groups, difficult to distinguish morphologically (e.g. no clear morphological differences in females), were pooled similarly to Krahner et al. (2021): *Andrena ovatula* agg., comprising *Andrena ovatula*, *A. wilkella*, *A. intermedia*, *A. similis* and *A. gelgiae*; *Bombus terrestris* agg., comprising *Bombus cryptarum*, *B. lucorum*, *B. magnus* and *B. terrestris*;

Bombus hortorum agg., comprising *Bombus hortorum* and *B. ruderatus*; *Lasioglossum smeathmanellum* agg., comprising *Lasioglossum nitidulum* and *L. smeathmanellum*; *Halictus simplex* agg., comprising *Halictus eurygnathus*, *H. langobardicus* and *H. simplex*.

Supplementary Table S2. Detected species and individuals of wild bees: (A) total data set and (B) data set reduced for taking spatial autocorrelation into account.

family	species	species [%]	individuals	individuals [%]
(A) total data				
Andrenidae	18	16.4	137	13.5
Anthophoridae	13	11.8	97	9.6
Apidae	12	10.9	209	20.6
Colletidae	16	14.5	130	12.8
Halictidae	31	28.2	369	36.4
Megachilidae	20	18.2	71	7.0
total	110	100.0	1013	100.0
(B) reduced data				
Andrenidae	14	15.9	72	12.7
Anthophoridae	9	10.2	55	9.7
Apidae	10	11.4	119	21.0
Colletidae	14	15.9	83	14.6
Halictidae	27	30.7	195	34.3
Megachilidae	14	15.9	44	7.7
total	88	100.0	568	100.0



Supplementary Figure S1. Map of the study area . **A:** Location of the investigated vineyards (red shaded areas) around Pommern (Rhineland-Palatinate, southwestern Germany). **B-C:** Location of the 24 line transects west (**B**) and east (**C**) of Pommern. Two differently managed vineyard types were studied: vineyards with greened embankments (GEV, green) and vineyards without such embankments (NEV, brown). Source of aerial photographs and geodata: LVerGeo (2022). The study area consists mainly of Cambisols and (Lithic) Leptosols (MU & LUG, 1993). Climatically it is imbedded within the Rhenish Slate Mountains (Hembach & Cölln, 1996; MU & LUG, 1993). Average annual temperatures (at 2 m height) were 10.2 – 11.8 °C, total annual precipitation 635 – 782 mm, and total annual hours of sunshine 1580 – 1736 h (weather station Pommern, DLR RNH 2022).

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