Ecography

E7716
Pellissier, L., Alvarez, N., Espíndola, A., Pottier, J., Dubuis, A., Pradervand, J.-N. and Guisan, A. 2012. Phylogenetic alpha and beta diversities of butterfly communities correlate with climate in the western Swiss Alps. – Ecography 35: xxx–xxx.

Supplementary material

Appendix 1

Comparison of plant species richness in surfaces of varying sizes

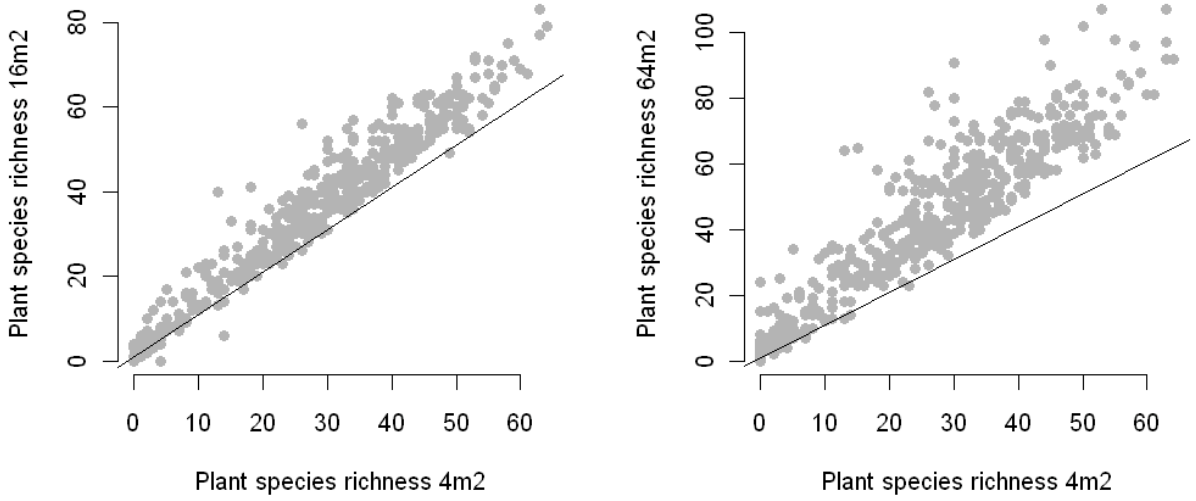

Figure A1. During the summers of 2002-2004, 483 vegetation plots were sampled in the same study area, following a stratified random sampling strategy in open areas such as grasslands, meadows, rock or scree regions. Stratification was defined by considering the elevation, slope and aspect of the sampled area. We recorded the presence of all species based on surfaces of $4m^2$, $16m^2$ and 64 m^2. The plots show the relationships between the plant species richness observed in the $4m^2$ plots and the ones observed in $16m^2$ and 64 m^2. The richness in a surface of $4m^2$ is a good indicator of the richness in the surrounding grassland.

Appendix 2

Phylogenetic inferences

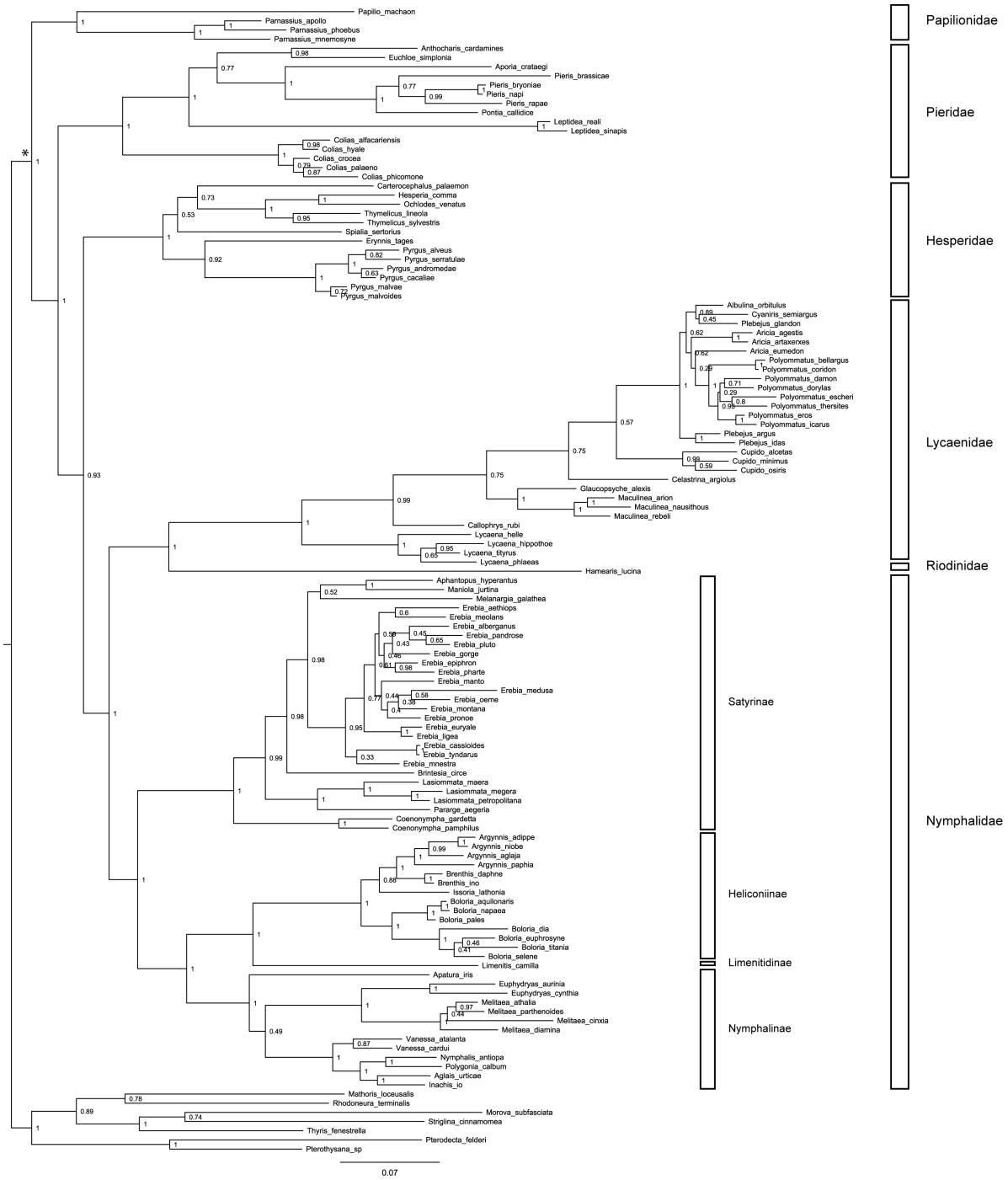

Figure A2. Phylogenetic inference obtained using a Bayesian non-ultrametric approach. Values on nodes indicate Bayesian posterior probabilities (BPP). The star (*) indicates node incongruence between analytical approaches. Lateral bars show taxonomic position of samples.

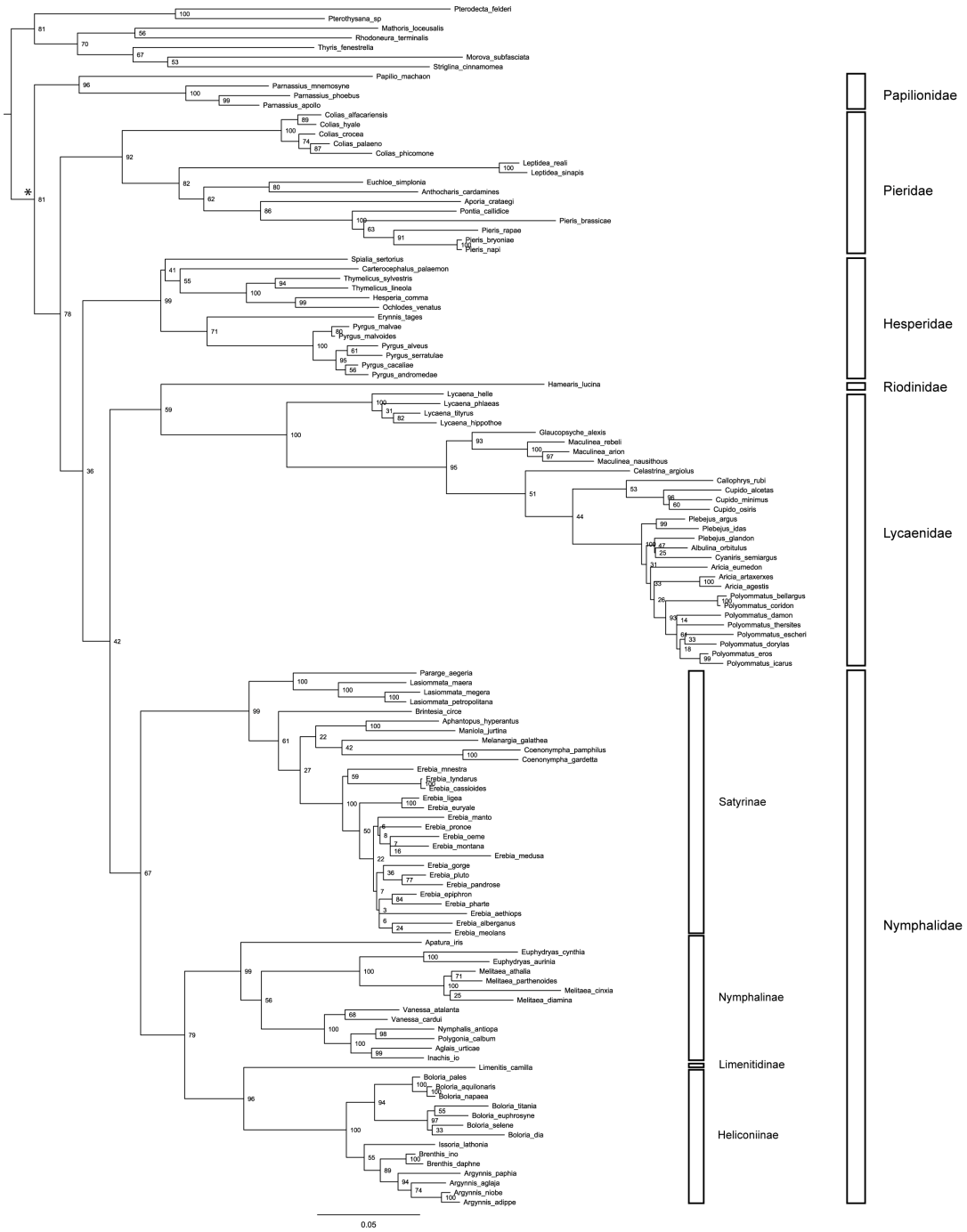

Figure A3. Phylogenetic inference obtained with a Maximum Likelihood approach. Values on nodes indicate bootstrap support. The star (*) indicates node incongruence between analytical approaches. Lateral bars show the taxonomic position of samples.

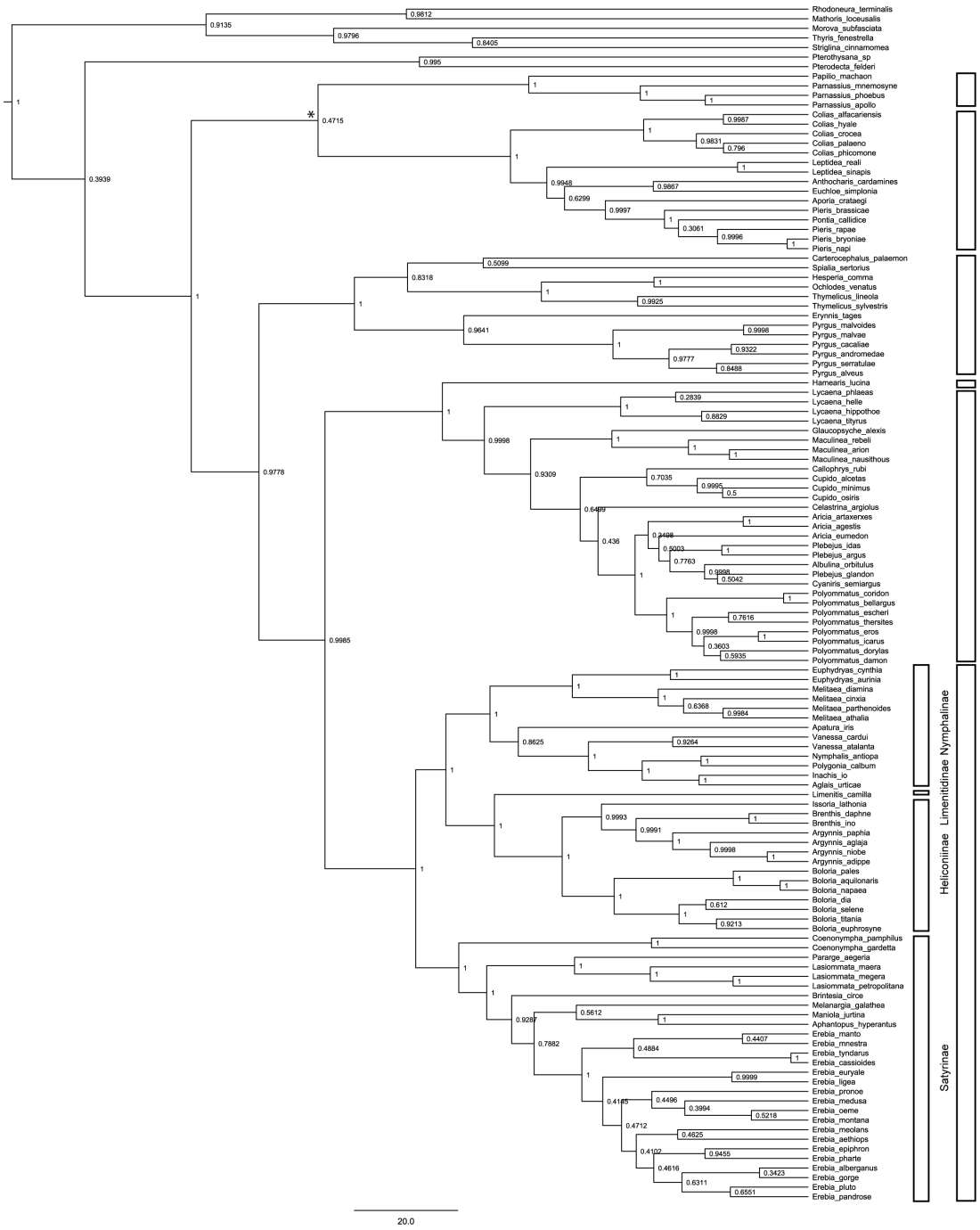

Figure A4. Phylogenetic inference obtained using a Bayesian ultrametric approach. Values on nodes indicate bootstrap support. The star (*) indicates node incongruence between analytical approaches. Lateral bars show the taxonomic position of samples.

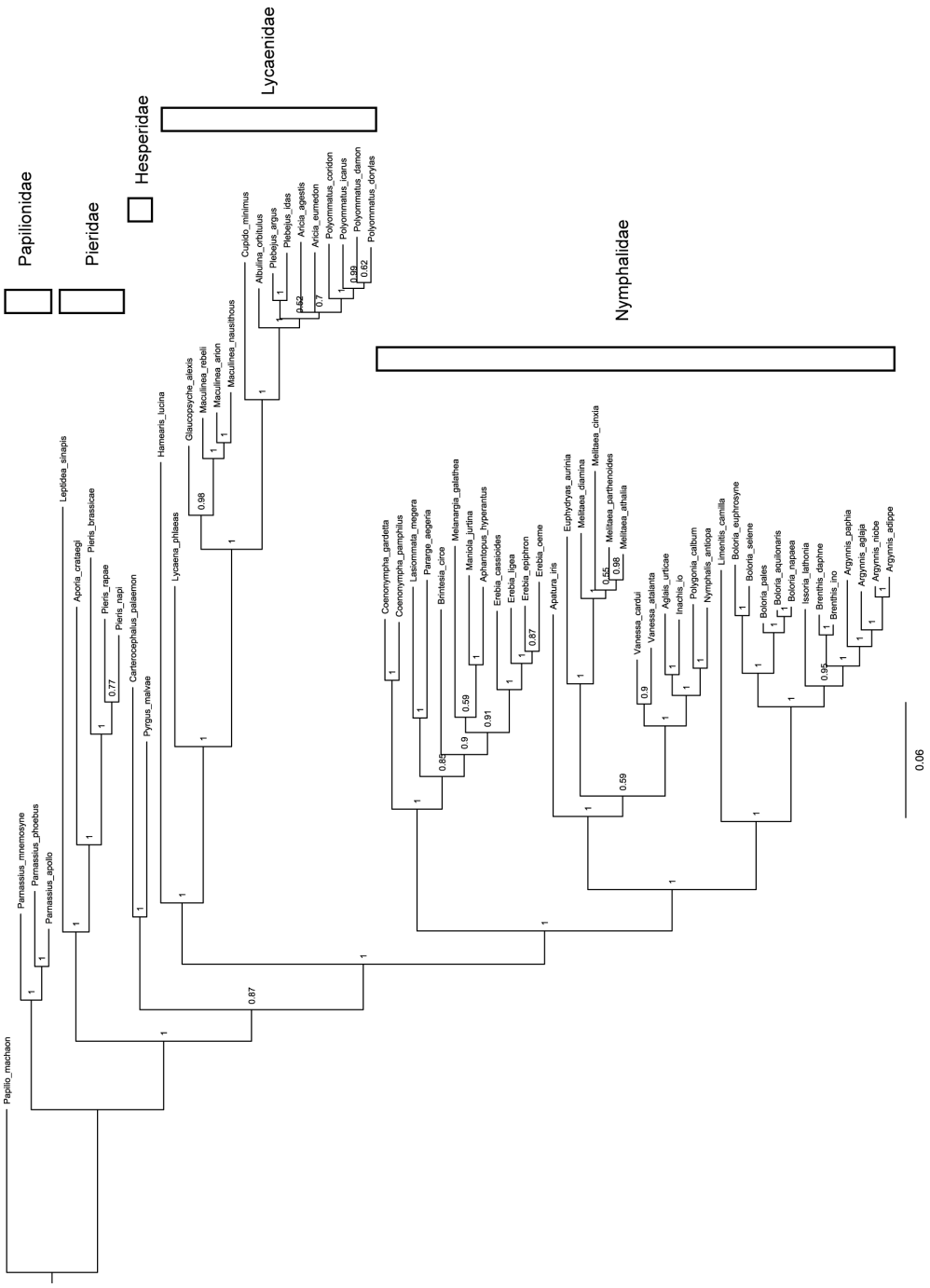

Figure A5. Phylogenetic inference obtained with a Bayesian approach for a reduced dataset comprising only those samples for which more than 50% of the fragments were not unknown. Values on nodes indicate Bayesian posterior probabilities (BPP). Lateral bars show the taxonomic position of samples.

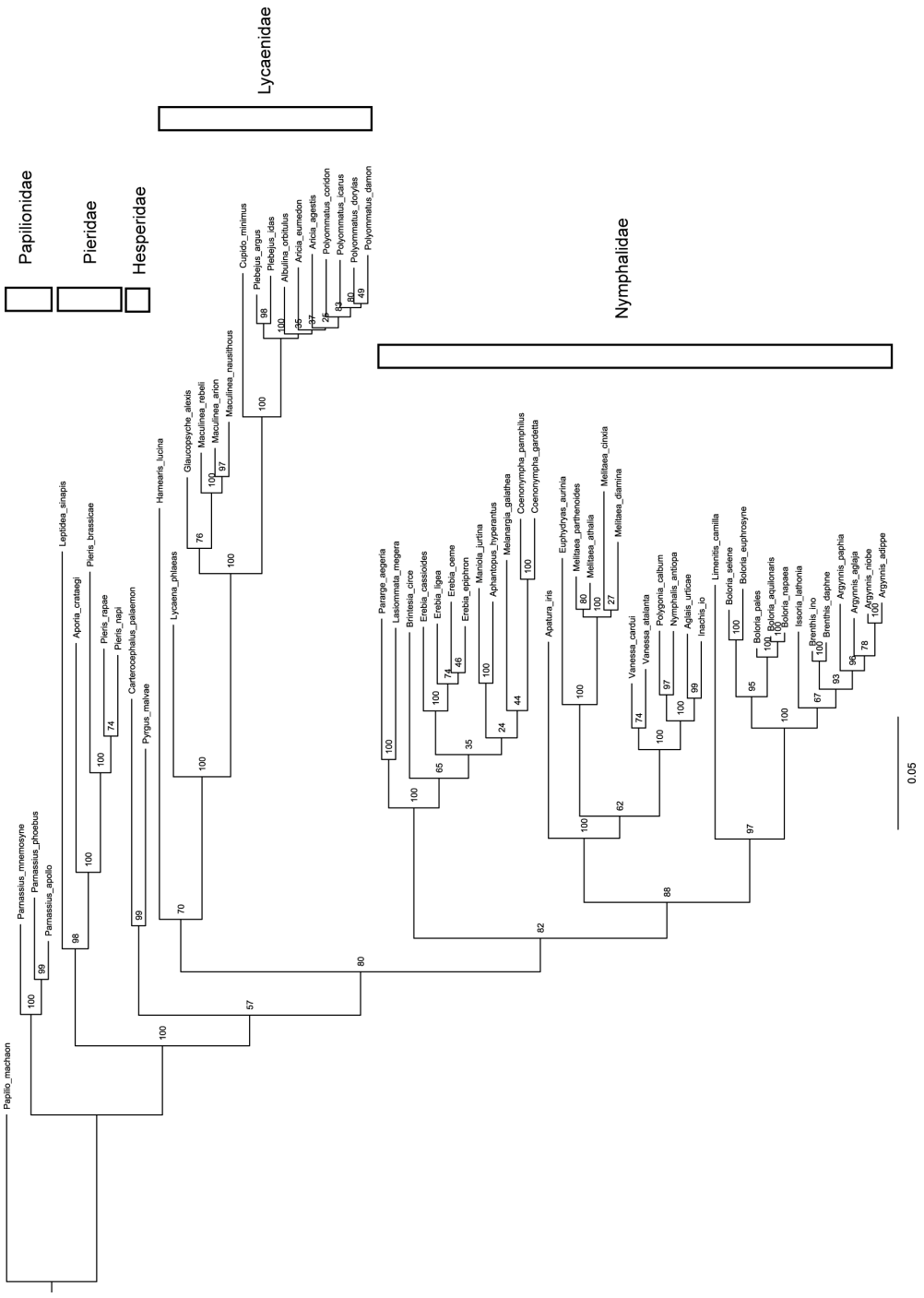

Figure A6. Phylogenetic inference obtained with a Maximum Likelihood approach for a reduced dataset comprising only those samples for which more than 50% of the fragments were not unknown. Values on nodes indicate bootstrap supports. Lateral bars show the taxonomic position of samples.

Table A1. Genbank accession numbers for sequences used in this study.

	16S rRNA	CO1	EF1a	ND1	ND5	Wgl
Aglais urticae	AF214631	HQ003947	AY248811	AF229931	AB107122	AF412777
Albulina orbitulus	NA	GQ128945.1	NA	NA	NA	GQ128842
Anthocharis cardamines	DQ150093	HQ003954	NA	NA	AB107115	NA
Apatura iris	NA	HQ003968	AY090165	NA	NA	AY090132
Aphantopus hyperantus	AF214590	HQ003980	AY090177.PE1	AF229934	NA	AY090144
Aporia crataegi	DQ150067	HQ003987	AY870529	NA	AB044622	DQ082806
Argynnis adippe	NA	HQ004009	DQ922884	NA	NA	DQ922820
Argynnis aglaja	NA	HQ004015	DQ922892	NA	NA	DQ922828
Argynnis niobe	NA	HQ004026	DQ922883	NA	NA	DQ922819
Argynnis paphia	DQ784691	HQ004039	AY090166	NA	AB175868	AF412778
Aricia agestis	NA	HQ004045	AY496824.1	NA	NA	GQ128843
Aricia artaxerxes	NA	HQ004057	NA	AY545788	NA	NA
Aricia eumedon	NA	HQ004470	NA	NA	NA	GQ128851
Boloria aquilonaris	NA	HQ004066	DQ922899	NA	NA	DQ922835
Boloria dia	NA	HQ004071	NA	NA	NA	NA
Boloria euphrosyne	NA	HQ004082	DQ922900	NA	NA	DQ922836
Boloria napaea	NA	EU650044	GQ864840	NA	NA	GQ864434
Boloria pales	NA	HQ004090	DQ922898	NA	NA	DQ922834
Boloria selene	NA	HQ004097	AY090167	NA	NA	AY090134
Boloria titania	NA	HQ004106	NA	NA	NA	NA
Brenthis daphne	NA	HQ004112	DQ922880	NA	NA	DQ922816
Brenthis ino	NA	HQ004129	DQ922879	NA	NA	DQ922815
Brintesia circe	AF214601	HQ004137	DQ339020	AF229946	NA	DQ338729
Callophrys rubi	NA	HQ004146	NA	NA	NA	NA
Carterocephalus palaemon	NA	HQ004188	EU364183	NA	AB100070	EU363990
Celastrina argiolus	NA	HQ004195	NA	AJ505086	AB457783	NA
Coenonympha gardetta	NA	EU920747	EU920781	NA	NA	EU920811
Coenonympha pamphilus	NA	HQ004233	DQ338920	NA	NA	DQ338637
Colias alfacariensis	NA	HQ004252	NA	NA	NA	NA
Colias crocea	NA	HQ004274	NA	NA	NA	NA
Colias hyale	NA	HQ004297	NA	NA	NA	NA
Colias palaeno	NA	GU096741	NA	NA	AB107120	GU829570
Colias phicomone	NA	HM393178.1	NA	NA	NA	NA
Cupido alcetas	NA	HQ004307	NA	NA	NA	NA
Cupido minimus	NA	HQ004328	NA	NA	NA	GQ128845
Cupido osiris	NA	HQ004338	NA	NA	NA	NA
Cyaniris semiargus	NA	HQ004345	AY496847.1	NA	NA	NA
Erebia aethiops	NA	HQ004353	NA	NA	AB324812	NA
Erebia alberganus	AF214593	NA	NA	AF229937	NA	NA
Erebia cassioides	AF214618	HQ004362	NA	AF229963	EU037796	NA
Erebia epiphron	NA	HQ004369	DQ338921	GU001957	NA	DQ338638
Erebia euryale	AF214609	HQ004378	NA	AF229954	NA	NA
Erebia gorge	NA	HQ004392	NA	NA	NA	NA
Erebia ligea	AF214608	HQ004395	DQ338922	AF229953	AB303921	DQ338639
Erebia manto	NA	HQ004405	NA	NA	NA	NA
Erebia medusa	NA	FJ938179	NA	GU001959	NA	NA

Erebia meolans	AF214599	AY346223.COI	NA	AF229944	NA	NA
Erebia mnestra	NA	NA	NA	NA	EU037850	NA
Erebia montana	AF214617	NA	NA	AF229962	NA	NA
Erebia oeme	NA	FJ938192	DQ338923	NA	NA	DQ338640
Erebia pandrose	NA	HQ004431	NA	GU001960	NA	NA
Erebia pharte	AF214610	HQ004435	NA	AF229955	NA	NA
Erebia pronoe	NA	HQ004437	NA	GU001958	NA	NA
Erebia tyndarus	NA	HQ565495.1	NA	NA	EU037805	NA
Erynnis tages	NA	HQ004456	NA	NA	EU442831	EU442875
Euchloe simplonia	NA	FM196457	NA	NA	NA	NA
Euphydryas aurinia	AF153940	HQ004474	NA	AF153961.1	NA	AY788504
Euphydryas cynthia	AF153946	HM393211.1	NA	NA	NA	NA
Glaucopsyche alexis	NA	HQ004490	AY675366	AJ505085	NA	NA
Hamearis lucina	NA	HQ004508	DQ018920	NA	NA	DQ018890
Hesperia comma	NA	HQ004516	NA	NA	NA	AY700706
Inachis io	NA	HQ003941	AY248810	AF412737.1	NA	AF412766
Issoria lathonia	NA	HQ004558	DQ922886	NA	NA	DQ922822
Lasiommata maera	AF214598	HQ004575	NA	AF229943	NA	DQ176328
Lasiommata megera	AF214615	HQ004583	AY090179	AF229960	NA	AY090146
Lasiommata petropolitana	AF214588	DQ176352	NA	NA	NA	DQ176327
Leptidea reali	NA	HQ004594	NA	AF485914.ND1	NA	NA
Leptidea sinapis	DQ150060	HQ004602	AY870573	AF485916.ND1	NA	AY954595
Limenitis camilla	NA	HQ004622	EF643322	NA	AB175869	EU098268
Lycaena helle	NA	HQ004652	NA	NA	NA	NA
Lycaena hippothoe	NA	HQ004658	NA	NA	NA	NA
Lycaena phlaeas	NA	HQ004663	FJ490506	NA	AB197030	NA
Lycaena tityrus	NA	HQ004679	FJ490509	NA	NA	NA
Maculinea arion	NA	HQ004707	AY675355	AJ505081	NA	GQ128928
Maculinea nausithous	NA	HQ004715	AY675356	AJ505077	NA	NA
Maculinea rebeli	NA	AY675415.COI	AY675368	AJ505072	NA	NA
Maniola jurtina	AF214592.1	HQ004730	AY090180.PE1	AF229936.1	NA	AY090147
Mathoris loceusalis	NA	GU828810	GU829115		NA	NA
Melanargia galathea	AF214589	HQ004740	DQ338993	AF229933	NA	DQ338706
Melitaea athalia	AF186857	HQ004748	NA	NA	NA	FJ462171
Melitaea cinxia	AF186865	HQ004774	NA	NA	NA	AY788536
Melitaea diamina	AF186873	HQ004782	NA	NA	NA	FJ462189
Melitaea parthenoides	AF186904	AF186977	NA	NA	NA	FJ462211
Morova subfasciata	NA	GU828853	GU829155		NA	GU829701
Nymphalis antiopa	NA	HQ004856	NA	FJ639542	NA	AF412774
Ochlodes venatus	NA	JF415719.1	NA	NA	AB100058	NA
Papilio machaon	AB186172	HQ004884	AF044819	AB186206	AB013150	AY569124
Pararge aegeria	NA	HQ004891	DQ338913	AF229957	NA	DQ176339
Parnassius apollo	AJ972017	HQ004900	EF485050	AJ972114	AB063355	HM213842
Parnassius mnemosyne	AB186159	HQ004902	EF485081	AB186193	AB095626	NA
Parnassius phoebus	AB186139	AF170872.COI	AF173412	AB186173	AB063354	FJ756881
Pieris brassicae	AM283058	HQ004912	NA	AM283077	AM283091	NA
Pieris bryoniae	NA	HQ004919	NA	NA	NA	NA
Pieris napi	DQ150071	HQ004939	AF173401	DQ351061.1	AB175855.1	AY569041
Pieris rapae	DQ150070	HQ004953	AY870550	NC_015895	AB013161	AF014148
Plebejus argus	NA	HQ004963	AY496828.1	NA	NA	GQ128889

Plebejus glandon	NA	EU330439	NA	NA	NA	NA
Plebejus idas	NA	HQ004992	NA	NA	NA	GQ128871
Polygonia calbum	DQ784716	AY090222	AY090188	FJ639533	NA	AF412771
Polyommatus bellargus	NA	HQ005010	NA	NA	NA	NA
Polyommatus coridon	NA	HQ005020	NA	NA	NA	GQ128874
Polyommatus damon	NA	AY557121.COI	NA	NA	NA	GQ128841
Polyommatus dorylas	NA	HQ005038	NA	AY545804	NA	NA
Polyommatus eros	NA	AY557126.COI	NA	NA	NA	NA
Polyommatus escheri	NA	AY556855.COI	NA	NA	NA	NA
Polyommatus icarus	NA	HQ005046	AY496846.1	AY545798	NA	GQ128891
Polyommatus thersites	NA	HQ005057	NA	AY545795	NA	NA
Pontia callidice	NA	EF584870	AY870548	NA	NA	NA
Pterodecta felderi	NA	GU828769	GU829081		NA	GU829631
Pterothysana sp	NA	GU828545	GU828890		NA	GU829452
Pyrgus alveus	NA	HQ005091	NA	NA	NA	NA
Pyrgus andromedae	NA	HQ005096	NA	NA	NA	NA
Pyrgus cacaliae	NA	HQ005122	NA	NA	NA	NA
Pyrgus malvae	NA	HQ005132	NA	NA	AB100073	GU829483
Rhodoneura terminalis	NA	GU828524	GU828870		NA	GU829431
Spialia sertorius	NA	EU364381.COI	EU364176	NA	NA	EU363983
Striglina cinnamomea	NA	GU828809	GU829114		NA	GU829667
Thymelicus lineola	NA	HQ005222	NA	NA	AB100055	JN204920.1
Thymelicus sylvestris	NA	HQ005228	NA	NA	NA	NA
Thyris fenestrella	NA	GU828761	GU829074		NA	GU829623
Vanessa atalanta	NA	HQ005247	AY090187	U32467	DQ028755	AF246542
Vanessa cardui	EU334572	HQ005256	AY248807	AY327134	DQ028758	AF412770
Pyrgus malvoides	NA	GU677004.1	NA	NA	NA	NA
Pyrgus serratulae	NA	GU677021.1	NA	NA	NA	NA
Erebia pluto	NA	BOLD	NA	NA	NA	NA

Appendix 3

Community analyses and null-models

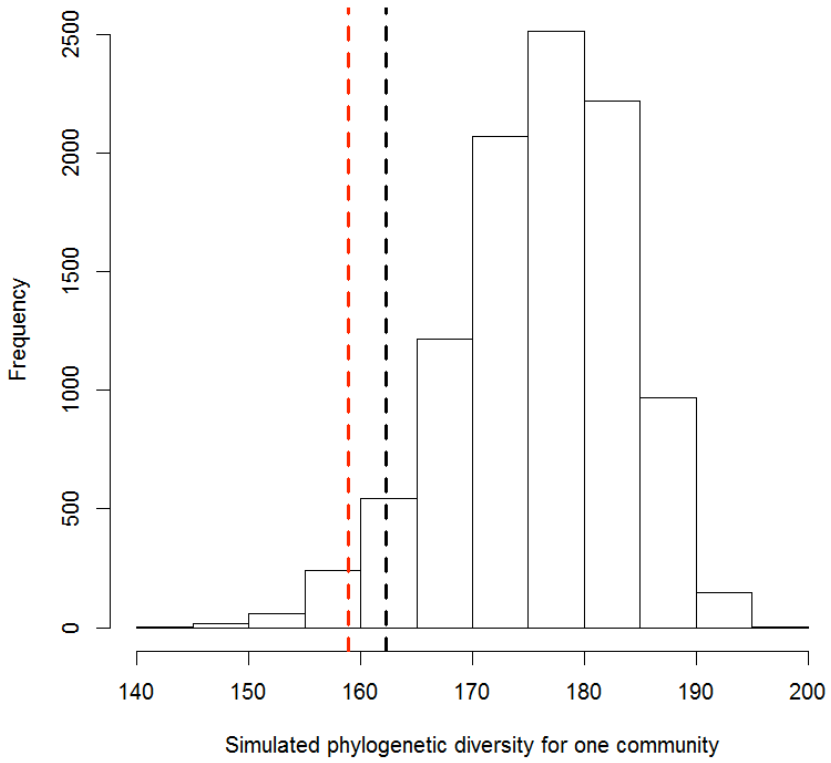

Figure A7. Histogram of the 9999 phylogenetic diversities simulated with the chronogram for one community. The black dashed line corresponds to the 5% threshold and the red dashed line corresponds to the observed phylogenetic diversity.

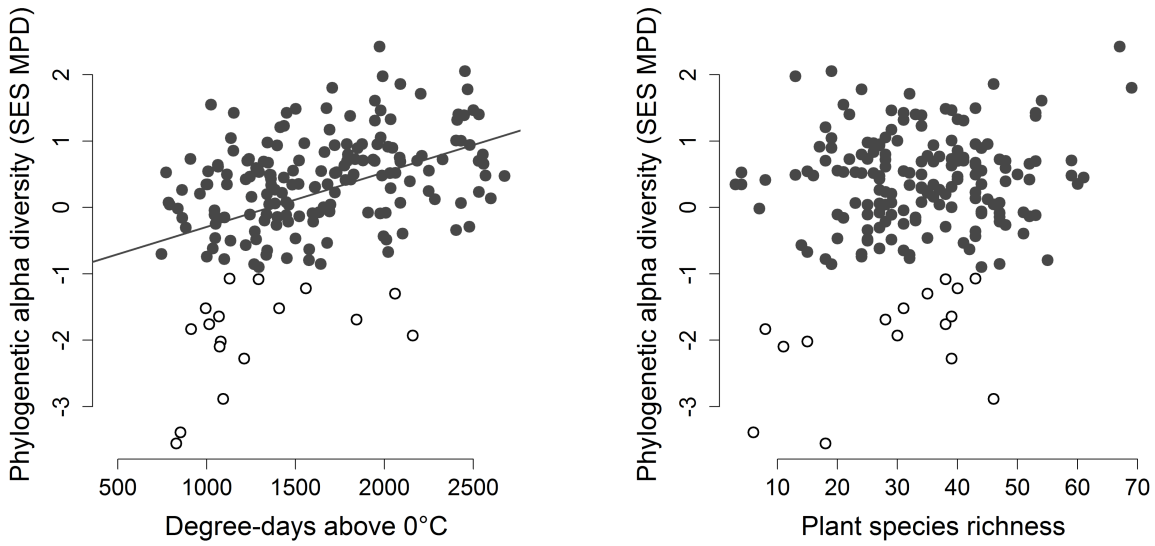

Figure A8. Relationship between the standardised mean phylogenetic distance (SES MPD, equivalent to -1*NRI or net relatedness index) and degree-days (left) as well as plant species richness (richness). The relationship between SES MPD and degree-days was significant ($p<0.0001$ randomization test), but not the residuals with plant species richness.

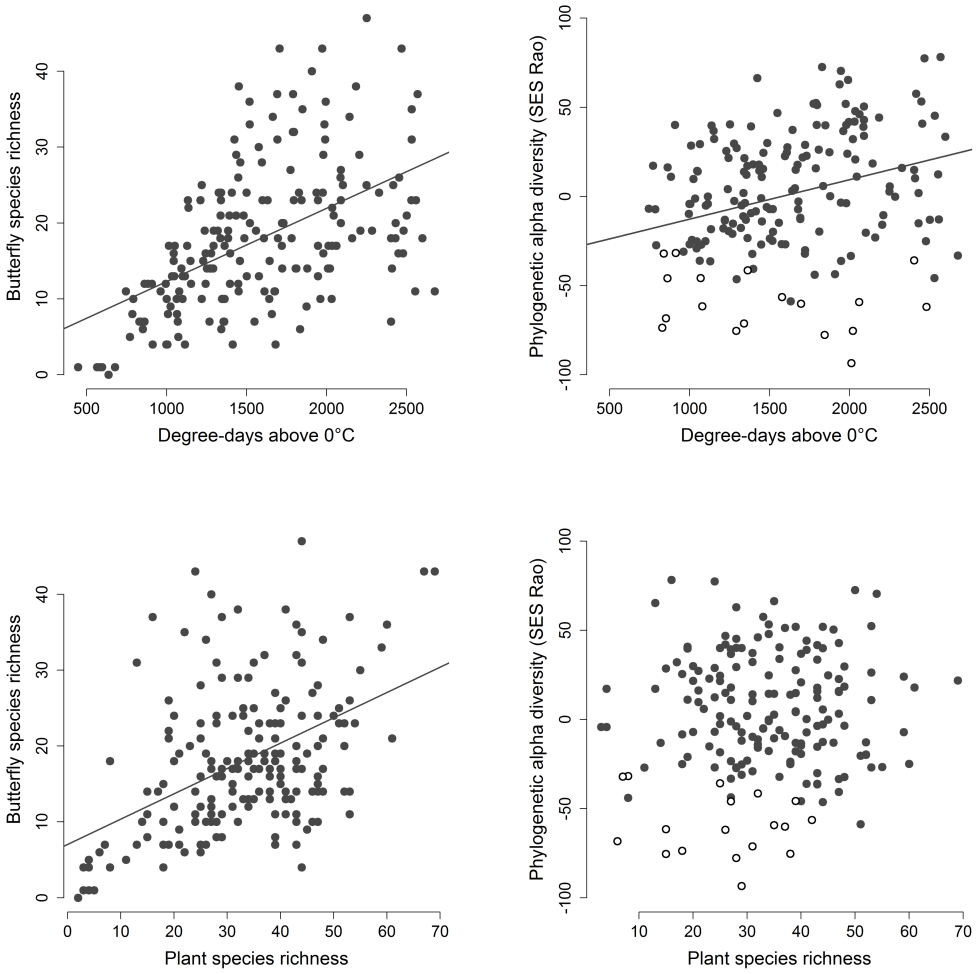

Figure A9. Correlation between degree-days and plant species richness, and butterfly species richness and *SES-Rao* of butterfly phylogenetic diversity calculated using the Bayesian phylogram. Circles represent sampled locations. Empty circles represent significantly clustered communities for that particular variable. The statistical results for α (SES-*Rao*: DDEG: $p<0.0001$, PLRI: $p=0.84$) and β (DDEG: $z=-10.04$, $p<0.0001$, PLRI: $z=0.795$, $p=0.43$) diversities using the Bayesian non-ultrametric approaches are similar to those obtained with the chronogram in the main manuscript. Because the phylogenetic signal was higher with the chronogram, we presented the results with the chronogram in the main manuscript.

Table A2. Species belonging to Papilionoidea sampled across the 192 plots, with the total number of times observed.

Species	Observations
Hesperiidae	
Carterocephalus palaemon	18
Erynnis tages	57
Hesperia comma	34
Ochlodes venatus	29
Pyrgus alveus	34
Pyrgus andromedae	10
Pyrgus cacaliae	10
Pyrgus carlinae	1
Pyrgus malvae	23
Pyrgus malvoides	4
Pyrgus serratulae	35
Spialia sertorius	12
Thymelicus lineola	72
Thymelicus sylvestris	31
Lycaenidae	
Aricia agestis	1
Aricia artaxerxes	45
Aricia eumedon	46
Callophrys rubi	28
Celastrina argiolus	2
Cupido alcetas	1
Cupido minimus	131
Cupido osiris	2
Glaucopsyche alexis	1
Lycaena helle	5
Lycaena hippothoe	35
Lycaena phlaeas	2
Lycaena tityrus	29
Maculinea arion	46
Maculinea nausithous	2
Maculinea rebeli	1
Plebeius glandon	18
Plebeius orbitulus	10
Plebeius argus	20
Plebeius idas	7
Polyommatus damon	27
Polyommatus semiargus	101
Polyommatus bellargus	21
Polyommatus coridon	39
Polyommatus dorylas	9

Polyommatus eros	26
Polyommatus escheri	1
Polyommatus icarus	51
Polyommatus thersites	12
Riodinidae	
Hamearis lucina	11
Nymphalidae	
Aglais urticae	166
Apatura iris	1
Argynnis adippe	18
Argynnis aglaja	73
Argynnis niobe	26
Argynnis paphia	9
Boloria dia	6
Boloria euphrosyne	52
Boloria selene	2
Boloria titania	76
Boloria aquilonaris	2
Boloria napaea	40
Boloria pales	70
Brenthis daphne	7
Brenthis ino	17
Euphydryas aurinia	60
Euphydryas cynthias	3
Inachis io	9
Issoria lathonia	8
Limenitis camilla	1
Melitaea athalia	36
Melitaea parthenoides	8
Melitaea cinxia	5
Melitaea diamina	62
Nymphalis antiopa	1
Polygonia c.album	6
Vanessa cardui	56
Vanessa atalanta	28
Aphantopus hyperantus	36
Brintesia circe	3
Coenonympha gardetta	77
Coenonympha pamphilus	47
Erebia aethiops	83
Erebia alberganus	9
Erebia cassioides	12
Erebia epiphron	26
Erebia eriphyle	5
Erebia euryale	40
Erebia gorge	22
Erebia ligea	47
Erebia manto	79

Erebia medusa	6
Erebia melampus	87
Erebia meolans	9
Erebia montana	6
Erebia oeme	77
Erebia pandrose	38
Erebia pharte	57
Erebia pluto	18
Erebia pronoe	22
Erebia tyndarus	28
Erebia mnestra	1
Lasiommata maera	60
Lasiommata megera	5
Lasiommata petropolitana	35
Maniola jurtina	44
Melanargia galathea	31
Oeneis glacialis	4
Pararge aegeria	8
Papilionidae	
Papilio machaon	86
Parnassius apollo	20
Parnassius mnemosyne	7
Parnassius phoebus	6
Pieridae	
Anthocharis cardamines	46
Aporia crataegi	58
Colias alfacariensis	20
Colias crocea	20
Colias hyale	9
Colias palaeno	6
Colias phicomone	72
Euchloe simplonia	5
Leptidea reali	7
Leptidea sinapis	5
Pieris brassicae	46
Pieris bryoniae	72
Pieris napi	66
Pieris rapae	70
Pontia callidice	12