Electronic appendices

Wiezik M. et al.: Western-Carpathian mountain spruce woodlands at their southern margin: natural or anthropogenic origin?

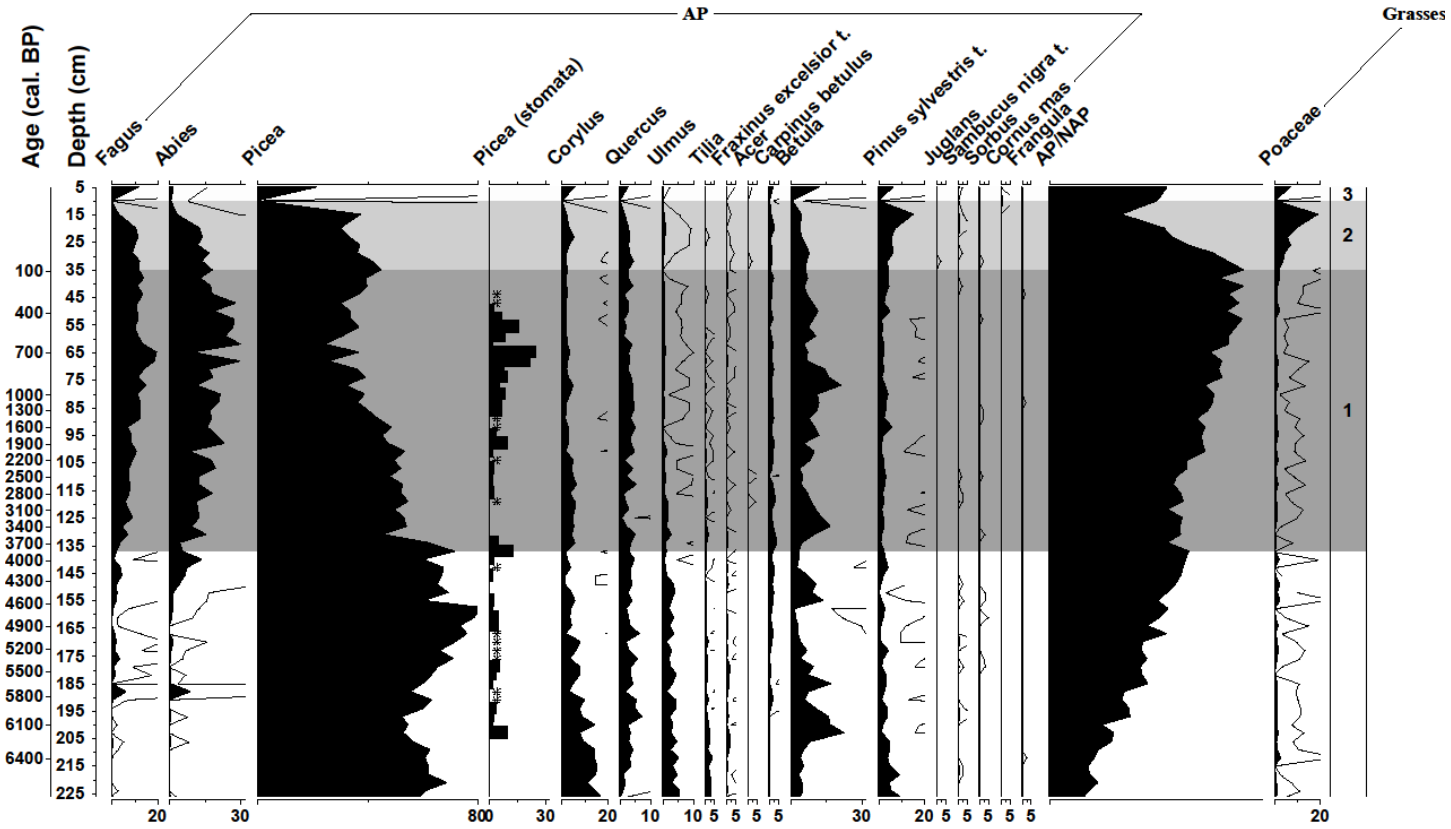
Electronic Appendix 1. Results of the radiocarbon dating for sequences used in the study

Locality	Samples	Depth (cm)	^{14}C BP	Dating method	Dated material	Agreement of model
Pohorelská Maša	UG-21142	78.5–81.5	958	AMS	seeds (*Carex*), mosses, spindles	
Pohorelská Maša	UG-18782	141–144	4122	AMS	wood (*Picea*)	A= 79
Pohorelská Maša	UG-21143	182.5–185.5	5626	AMS	seeds (*Rubus, Sambucus*), mosses, *Picea* needles	
Pohorelská Maša	UG-15942	224.5–227.5	6514	AMS	seeds (*Rubus, Sambucus*) *Abies* needles	
Zbojská	UG-21148	31–33	730	AMS	seeds (*Rubus*), mosses, *Picea* needles	
Zbojská	UG-18790	61–63	1300	AMS	seeds (*Rubus*)	A= 92
Zbojská	UG-21149	81–83	4780	AMS	seeds (*Rubus*), mosses	
Zbojská	UG-15952	99–102	5820	AMS	*Picea* and *Abies* needles	
Turček	Gd-12126	65–66	740	AMS	undefined	
Turček	Gd-10899	94–96	3370	AMS	undefined	A= 65
Pálenica	DeA-10237	29–31	320	AMS	seeds	
Pálenica	DeA-10236	59–61	1668	AMS	*Picea* needles, seeds	A= 98
Pálenica	DeA_11178	77–75	1611	AMS	*Picea* needles	
Pálenica	UG-17165	89–91	1500	AMS	seeds (*Carex*, *Scirpus*), *Abies* needles	
Kláťa	DeA-10213	29–31	85	AMS	seeds	

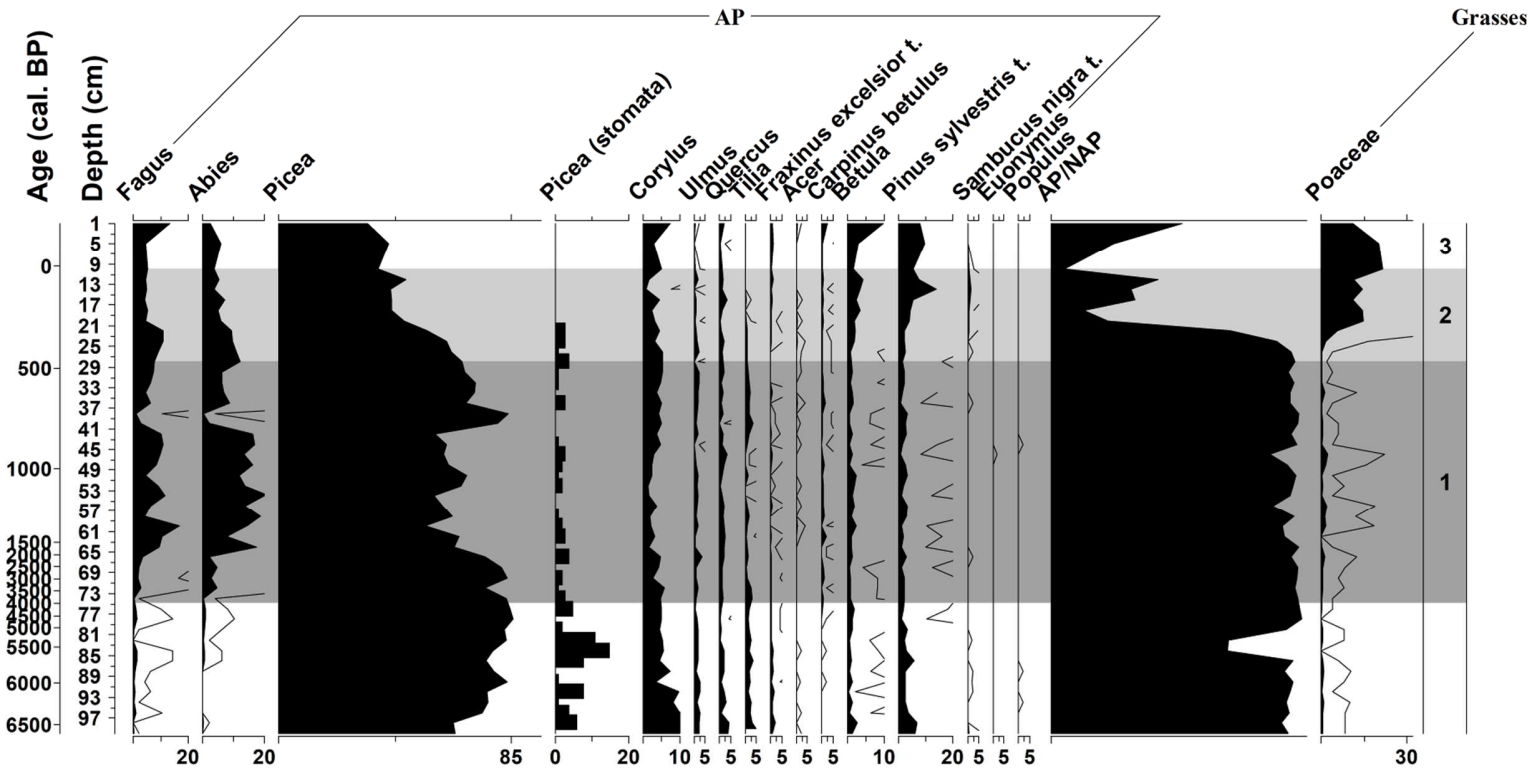
Kláťa	DeA-10212	51–53	162	AMS	wood, seeds	A= 96
Kláťa	UG-17164	83–85	760	AMS	seeds *(Picea*, *Carex*, *Caltha*), *Abies* needles	
Bykovo	DeA-16171	38–36	531	AMS	seeds (*Rubus*)	A= 92
Bykovo	DeA-13500	70–68	5611	AMS	*Picea* needles	
Bykovo	DeA-13499	100–98	7006	AMS	*Picea* needles	
Biele skaly						
Biele skaly	DeA-19264	68	1712	AMS	*Picea* needles	
Biele skaly	DeA-16480	100	3766	AMS	seeds (Rubus), *Picea* needles	
Žliebky	UG-15943	81–83	1186	AMS	mosses (*Bryum*, *Call cusp*) + *Picea* needles	A= 93
Žliebky	UG-18783	101–103	2223	AMS	mosses, seeds	
Žliebky	UG-15944	121–119	5246	AMS	seeds + *Picea* needles	
Žliebky	UG-18784	127–129	8002	AMS	seeds	

Electronic Appendix 2. Percentage pollen diagrams for main tree taxa, supplemented by evidence from macro-remains and stomata. The grey shading indicates individual study periods: 1. The period of climazonal woodlands; 2. The period of systematic human interventions to woodlands 3. The period of modern development of spruce monocultures.

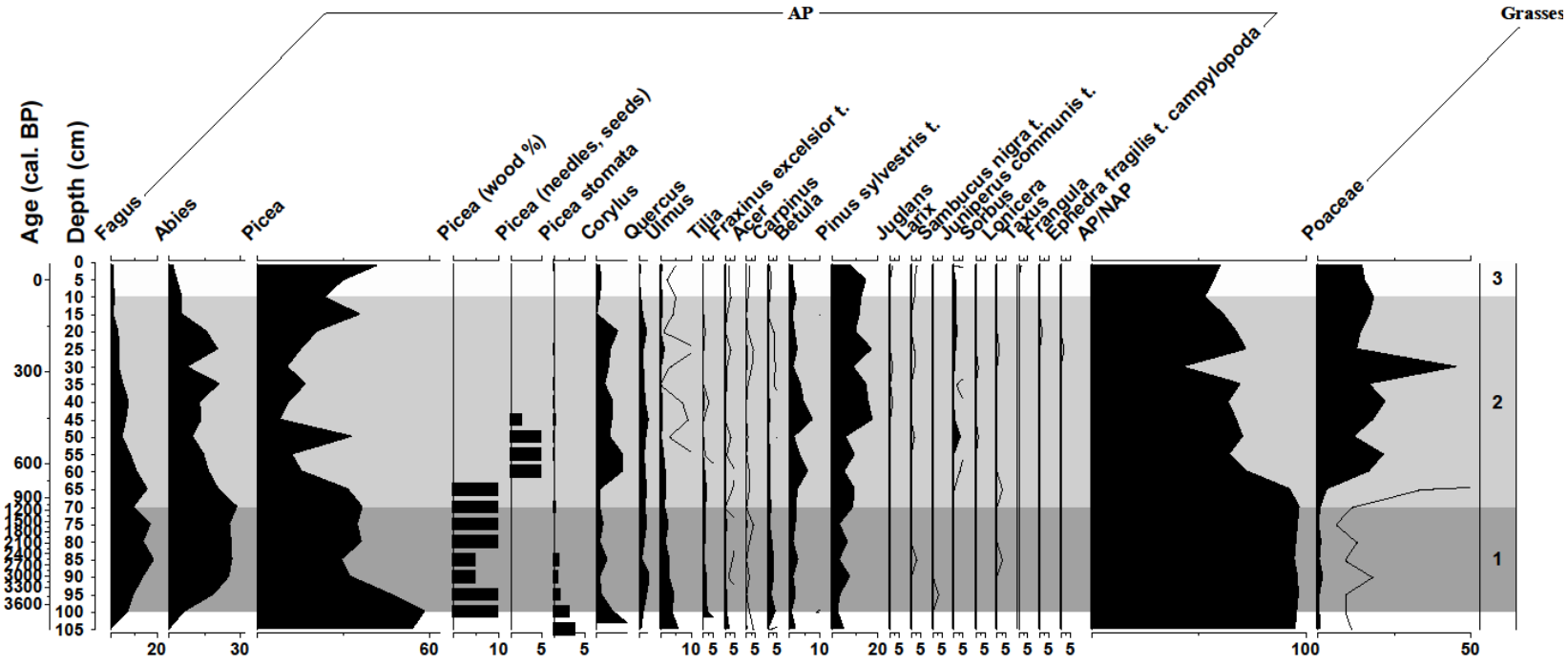
Pohorelská Maša



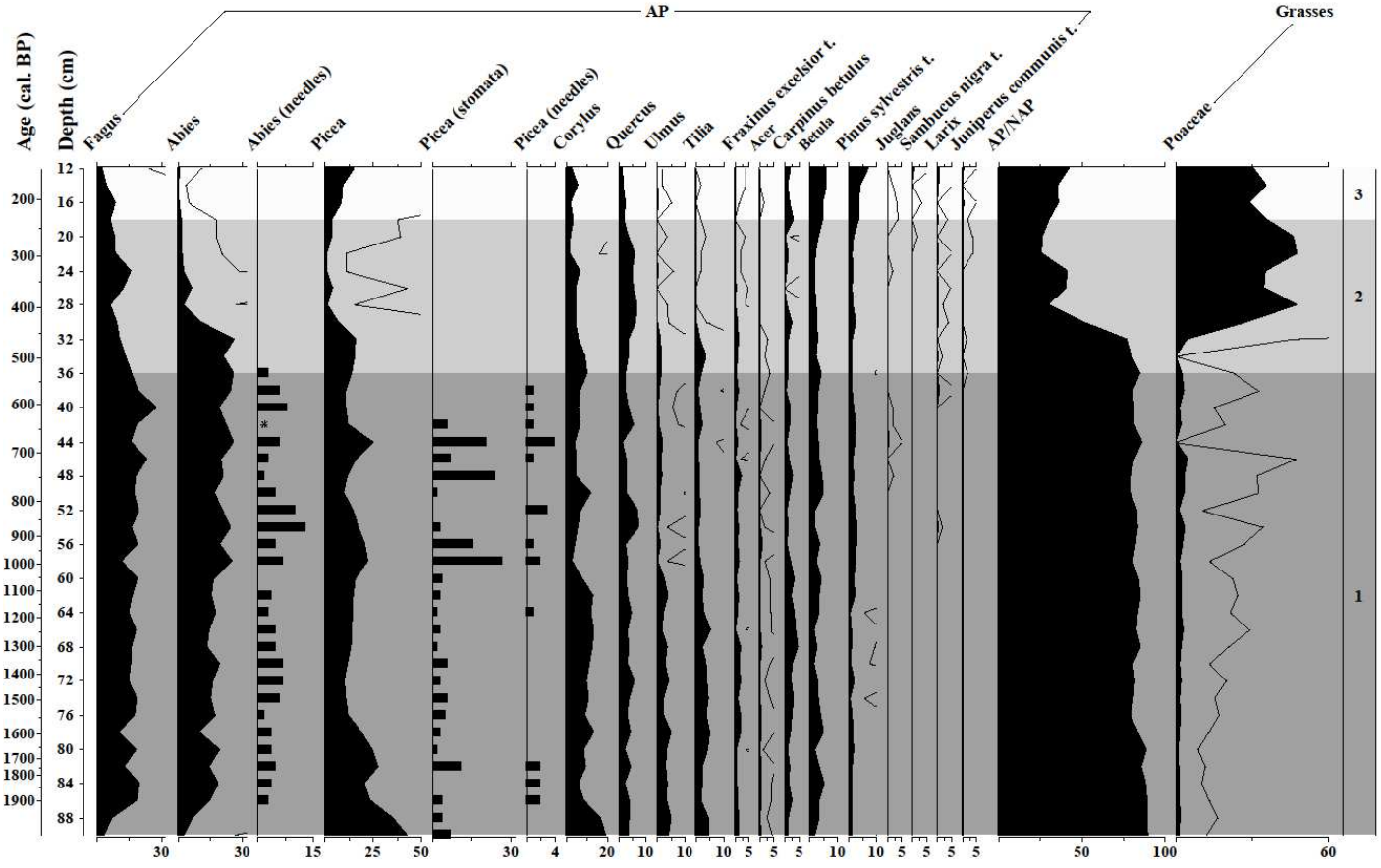
Zbojská


AP
Grasses
Age (cal. BP)
Depth (cm)
Fagus
Abies
Picea
Picea (stomata)
Corylus
Ulmus
Quercus
Tilia
Fraxinus excelsior t.
Acer
Carpinus betulus
Betula
Pinus sylvestris t.
Sambucus nigra t.
Euonymus
Populus
AP/NAP
Poaceae
0
500
1000
6500
3
2
1
20
20
85
0
20
10
30

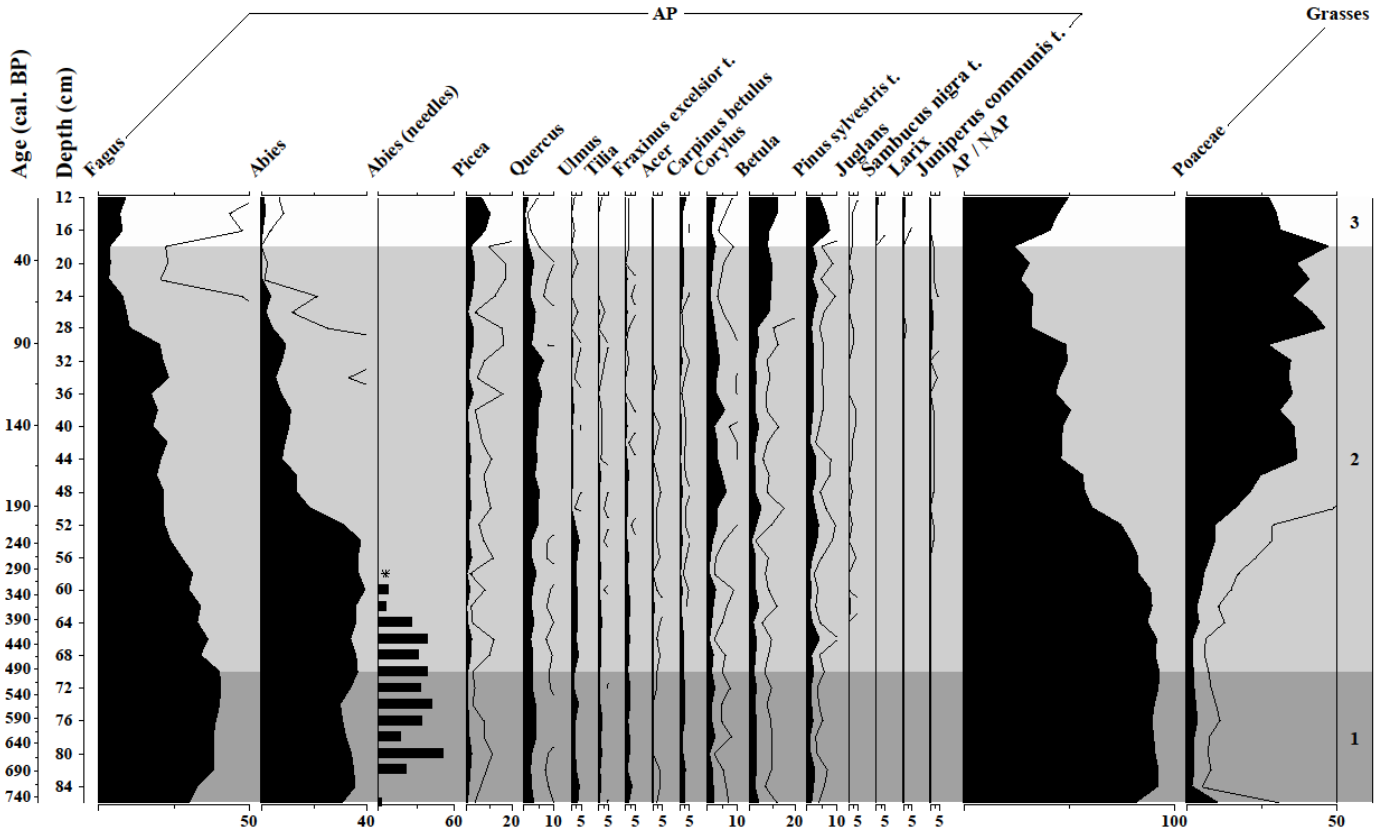
Turček


AP
Grasses
Age (cal. BP)
Depth (cm)
Fagus
Abies
Picea
Picea (wood %)
Picea (needles, seeds)
Picea stomata
Corylus
Quercus
Ulmus
Tilia
Fraxinus excelsior t.
Acer
Carpinus
Betula
Pinus sylvestris t.
Juglans
Larix
Sambucus nigra t.
Juniperus communis t.
Sorbus
Lonicera
Taxus
Frangula
Ephedra fragilis t. campylopoda
AP/NAP
Poaceae
0
300
600
900
1200
1500
1800
2100
2400
2700
3000
3300
3600
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70
75
80
85
90
95
100
105
3
2
1
20
30
60
10
5
5
10
5
5
5
5
10
20
5
5
5
5
5
5
5
5
5
100
50

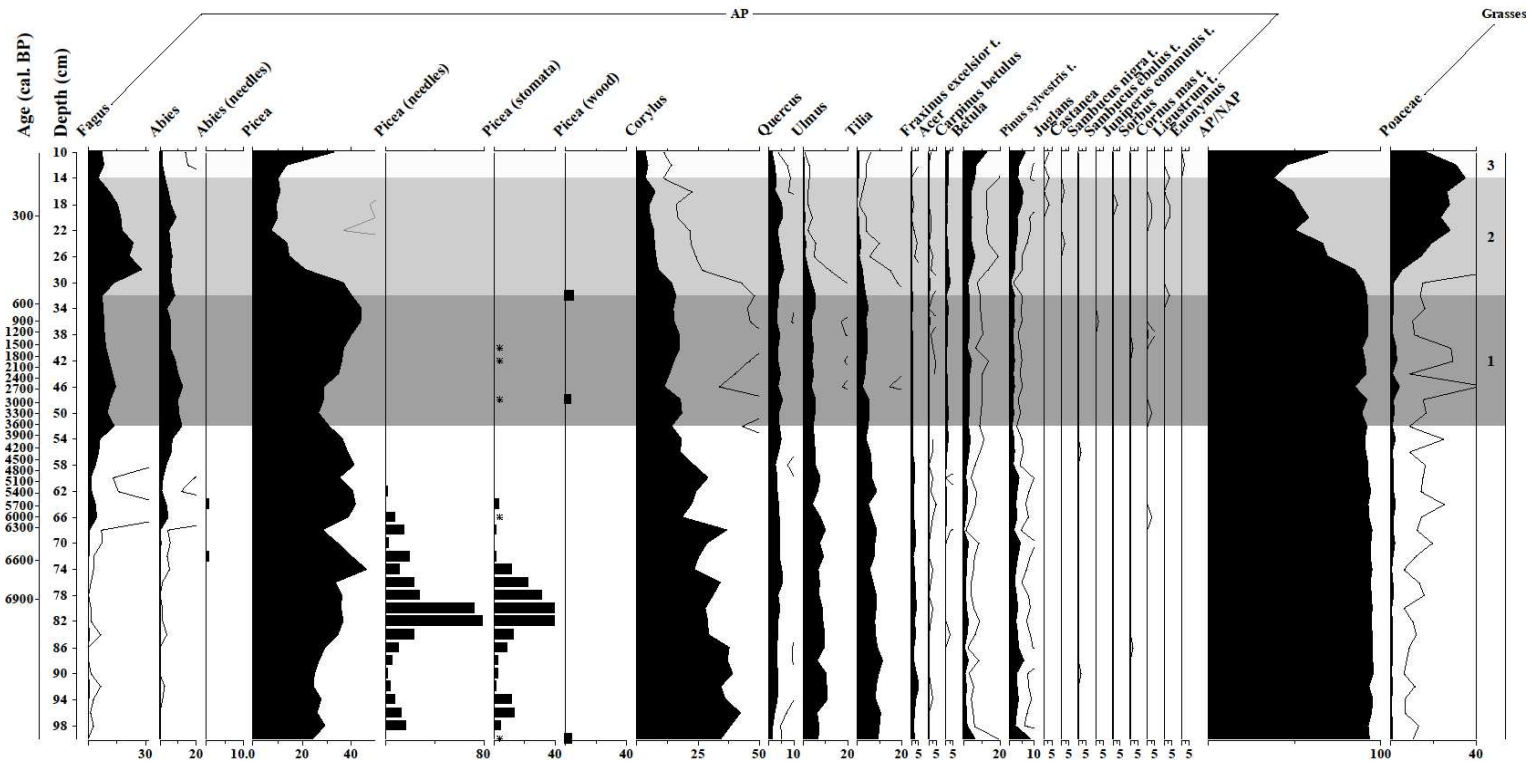
Pálenica


AP
Grasses
Age (cal. BP)
Depth (cm)
Fagus
Abies
Abies (needles)
Picea
Picea (stomata)
Picea (needles)
Corylus
Quercus
Ulmus
Tilia
Fraxinus excelsior t.
Acer
Carpinus betulus
Betula
Pinus sylvestris t.
Juglans
Sambucus nigra t.
Larix
Juniperus communis t.
AP/NAP
Poaceae
3
2
1

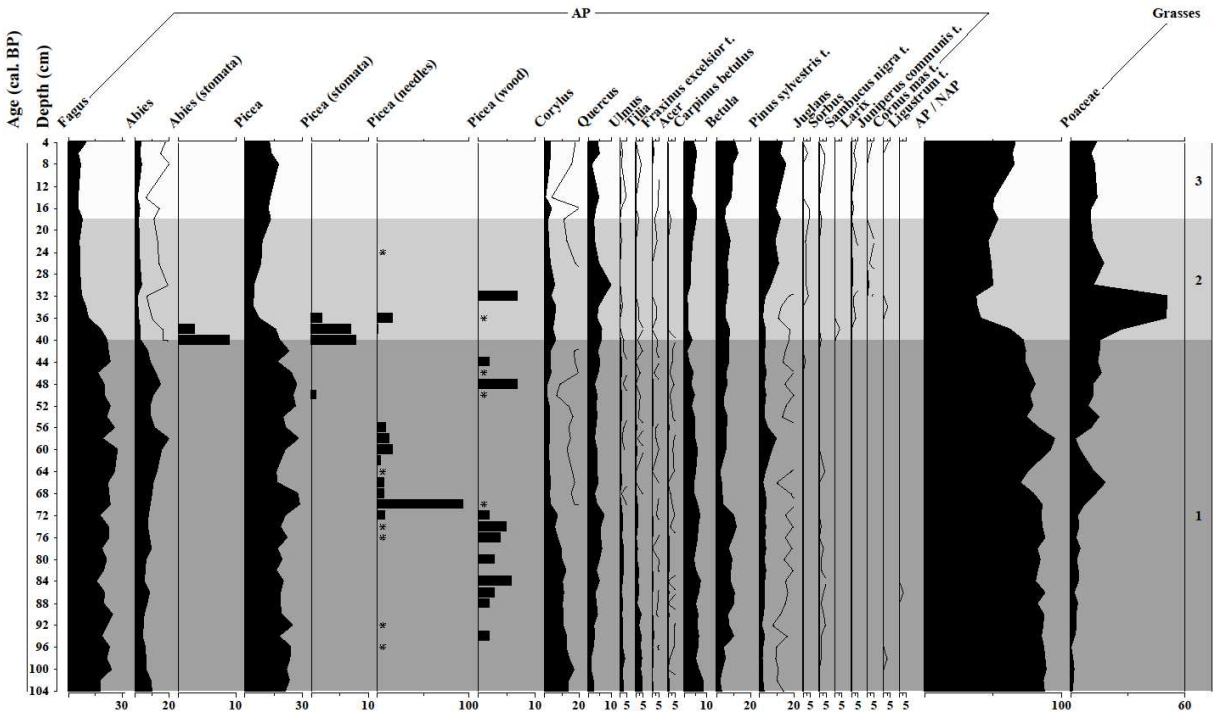
Kláťa


AP
Grasses
Age (cal. BP)
Depth (cm)
Fagus
Abies
Abies (needles)
Picea
Quercus
Ulmus
Tilia
Fraxinus excelsior t.
Acer
Carpinus betulus
Corylus
Betula
Pinus sylvestris t.
Juglans
Sambucus nigra t.
Larix
Juniperus communis t.
AP / NAP
Poaceae
3
2
1
*

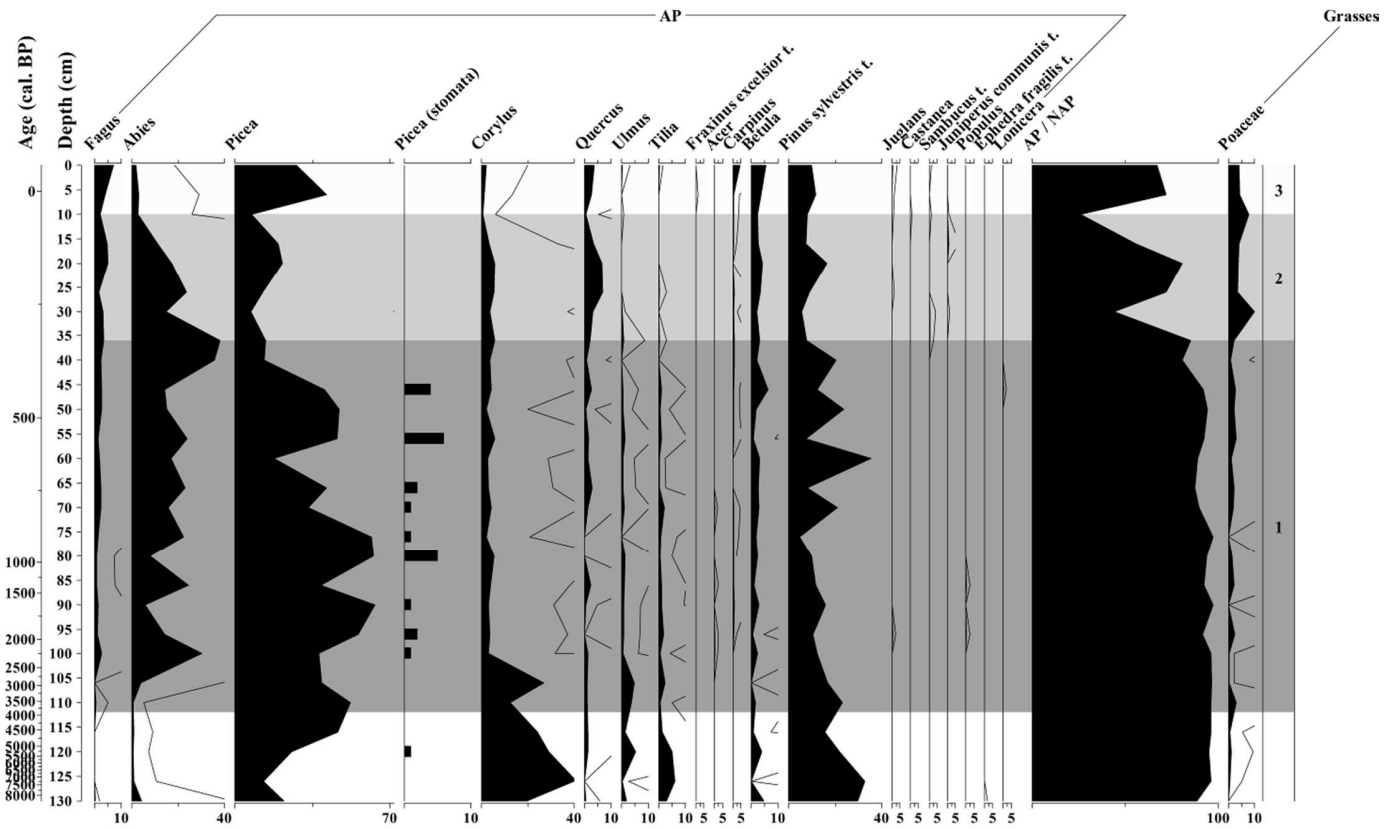
Bykovo


AP
Grasses
Age (cal. BP)
Depth (cm)
Fagus
Abies
Abies (needles)
Picea
Picea (needles)
Picea (stomata)
Picea (wood)
Corylus
Quercus
Ulmus
Tilia
Fraxinus excelsior t.
Acer
Carpinus betulus
Betula
Pinus sylvestris t.
Juglans
Castanea
Sambucus nigra t.
Sambucus ebulus t.
Juniperus
Sorbus
Cornus mas t.
Ligustrum t.
Euonymus
AP/NAP
Poaceae
1
2
3

Biele skaly

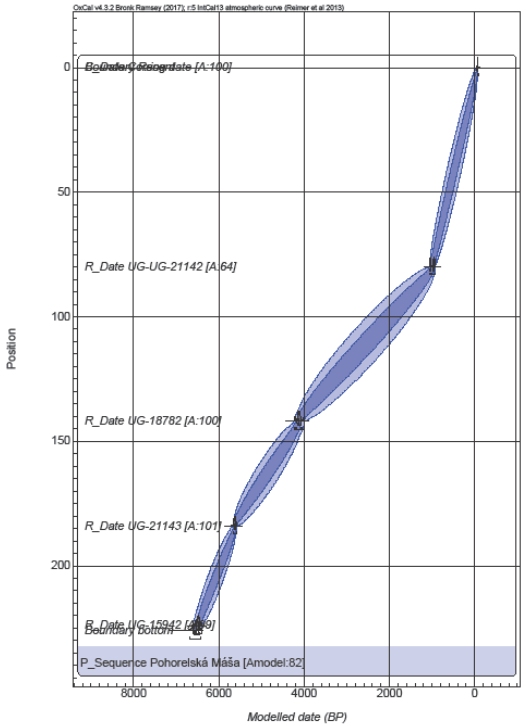

AP
Grasses
Age (cal. BP)
Depth (cm)
Fagus
Abies
Abies (stomata)
Picea
Picea (stomata)
Picea (needles)
Picea (wood)
Corylus
Quercus
Ulmus
Tilia
Fraxinus excelsior t.
Acer
Carpinus betulus
Betula
Pinus sylvestris t.
Juglans
Sorbus
Sambucus nigra t.
Larix
Juniperus communis t.
Cornus mas t.
Ligustrum t.
AP / NAP
Poaceae
3
2
1

Žliebky

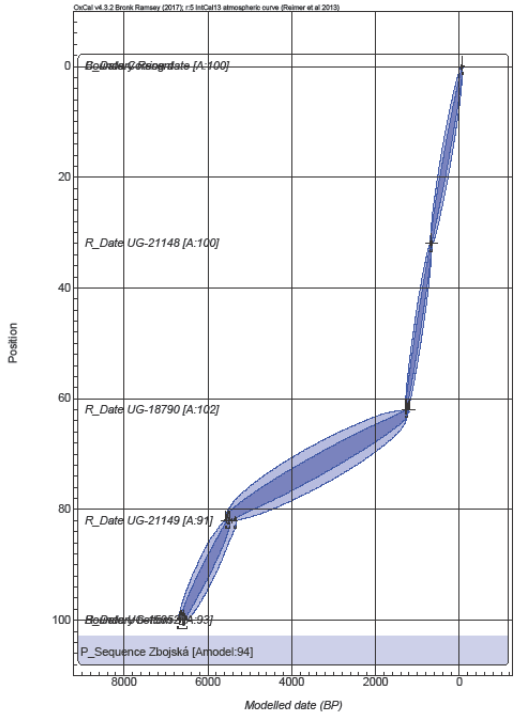

AP
Grasses
Age (cal. BP)
Depth (cm)
Fagus
Abies
Picea
Picea (stomata)
Corylus
Quercus
Ulmus
Tilia
Fraxinus excelsior t.
Acer
Carpinus
Betula
Pinus sylvestris t.
Juglans
Castanea
Sambucus t.
Juniperus
Populus
Corylus avellana t.
Ephedra fragilis t.
Lonicera
AP / NAP
Poaceae
3
2
1

Electronic Appendix 3. The age-depth models of the sites used in this study. The age-deph models for the Turček and Biele skaly sites were not constructed, because only two layers were dated.

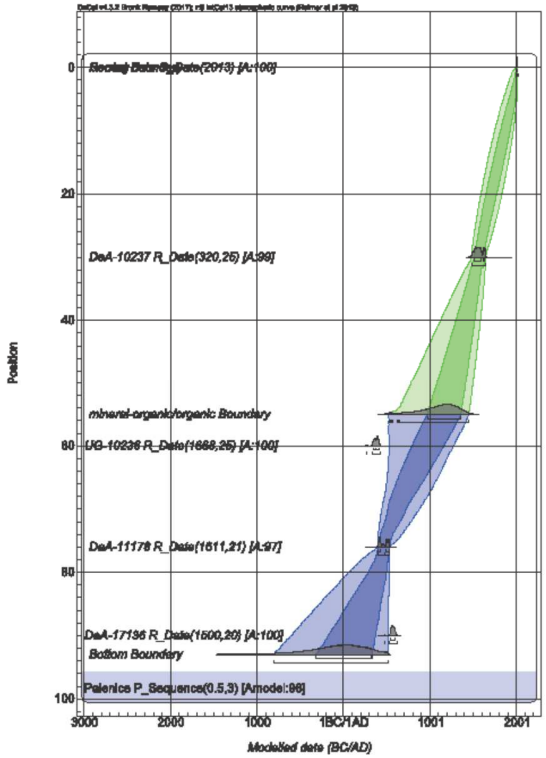
Pohorelská Maša



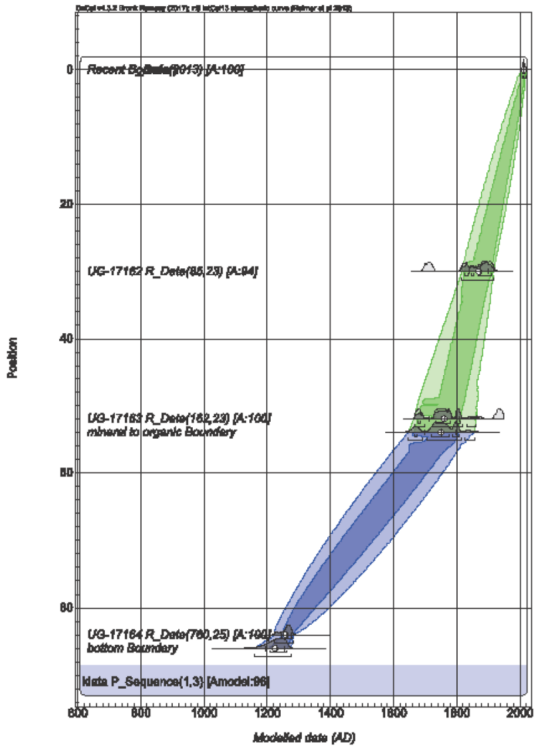
Zbojská


OxCal v4.3.2 Bronk Ramsey (2017); r:5 IntCal13 atmospheric curve (Reimer et al 2013)
R_Date UG-21148 [A:100]
R_Date UG-18790 [A:102]
R_Date UG-21149 [A:91]
P_Sequence Zbojská [Amodel:94]
Position
0
20
40
60
80
100
8000
6000
4000
2000
0
Modelled date (BP)

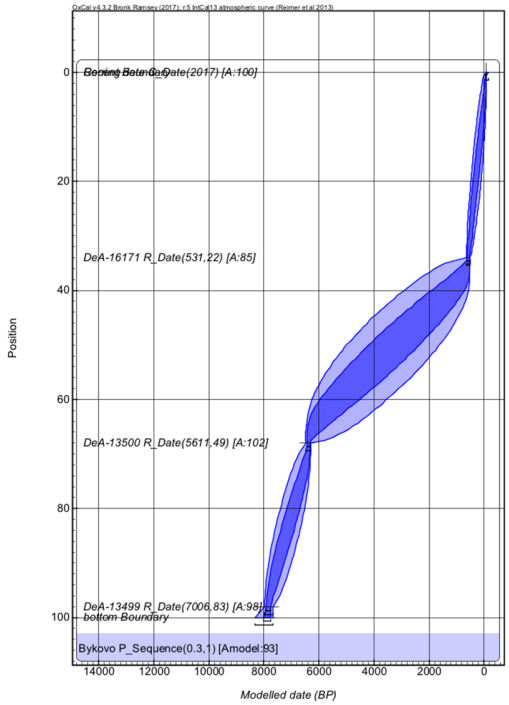
Pálenica


Position
0
20
40
60
80
100
DeA-10237 R_Date(320,25) [A:96]
mineral-organic/organic: Boundary
UG-10236 R_Date(1668,25) [A:100]
DeA-11178 R_Date(1611,21) [A:97]
DeA-17136 R_Date(1500,20) [A:100]
Bottom Boundary
Palenica P_Sequence(0.5,3) [Amodel:96]
3000
2000
1000
1BC/1AD
1001
2001
Modelled date (BC/AD)

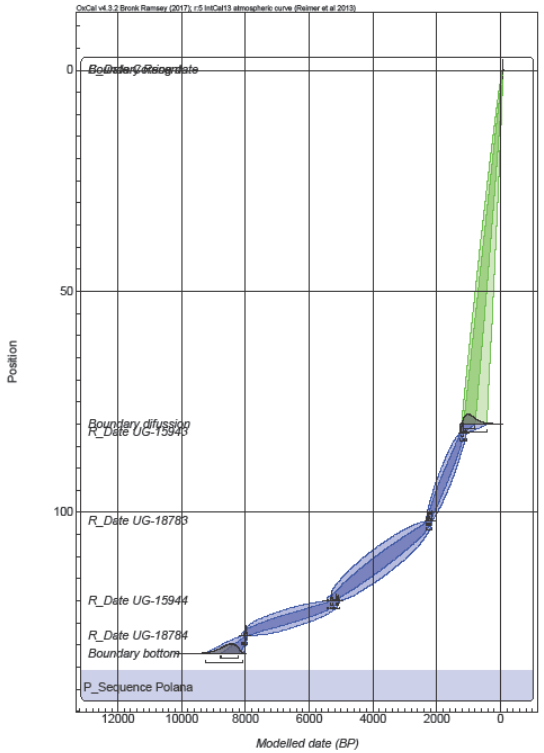
Kláťa


Recent
UG-17162 R_Date(85,23) [A:94]
UG-17163 R_Date(163,23) [A:100]
mineral to organic Boundary
UG-17164 R_Date(760,25) [A:100]
bottom Boundary
Klata P_Sequence(1,3) [Amodel:96]
Position
0
20
40
60
80
600
800
1000
1200
1400
1600
1800
2000
Modelled date (AD)

Bykovo


OxCal v4.3.2 Bronk Ramsey (2017); r:5 IntCal13 atmospheric curve (Reimer et al 2013)
Boundary Date(2017) [A:100]
DeA-16171 R_Date(531,22) [A:85]
DeA-13500 R_Date(5611,49) [A:102]
DeA-13499 R_Date(7006,83) [A:98]
bottom Boundary
Bykovo P_Sequence(0.3,1) [Amodel:93]
Position
0
20
40
60
80
100
14000
12000
10000
8000
6000
4000
2000
0
Modelled date (BP)

Žliebky


OxCal v4.3.2 Bronk Ramsey (2017); r:5 IntCal13 atmospheric curve (Reimer et al 2013)
0
50
100
Position
Boundary diffusion
R_Date UG-15943
R_Date UG-18783
R_Date UG-15944
R_Date UG-18784
Boundary bottom
P_Sequence Polana
12000
10000
8000
6000
4000
2000
0
Modelled date (BP)

Electronic Appendix 4. Pollen counts from surface moss samples

POL 4				POL 5				POL 6		
May		**October**		**May**		**October**		**May**		**October**
AP				**AP**				**AP**		
Picea	405	526		Picea	289	219		Picea	326	391
Abies	3	26		Abies	13	27		Abies	10	11
Fagus	80	114		Fagus	92	51		Fagus	136	77
Betula	60	66		Betula	61	37		Betula	62	39
Corylus	27	49		Corylus	25	65		Corylus	33	46
Alnus	38	41		Alnus	31	89		Alnus	44	64
Pinus	70	92		Pinus	80	64		Pinus	77	73
Quercus	22	13		Quercus	47	15		Quercus	26	15
Carpinus	16	21		Carpinus	32	30		Carpinus	41	30
Acer	7	3		Aver	2	2		Aver	1	1
Sambucus	1	2		Ulmus	1	0		Fraxinus	11	4
Fraxinus	9	0		Fraxinus	6	4		Salix	6	1
Salix	5	1		Sorbus	2	3		Juglans	1	3
Juglans	2	2		Salix	1	1		Tilia	1	2
Tilia	5	2		Juglans	7	1		**Sum**	**775**	**757**
Sum	**750**	**958**		Tilia	6	5		**NAP**		
NAP				**Sum**	**695**	**613**		Apiaceae	2	0
R.acetosa t.	1	0		**NAP**				R.acetosa t.	1	5
Brasicaceae	2	3		Apiaceae	9	8		Brasicaceae	10	6
Artemsia	1	6		R.acetosa t.	5	0		Mercur.anua t	1	0
Lotus	1	1		Brasicaceae	8	3		Rubus	10	9
Senecio t.	2	3		Artemsia	3	7		Ambrosia	16	30
Galium	1	1		Rubus	18	18		Senecio t.	6	1
P.lanceolata t.	5	3		Ambrosia	13	21		Gentiana	1	0
Apiaceae	3	5		Senecio t.	2	7		A. ligulifloreae	1	1
Xanthium strumarium	1	0		P. major t.	2	0		Urtica	3	12
Scrophulariaceae	16	6		R. acris t.	4	8		R. acris t.	1	2
Ambrosia	19	28		Galium	1	0		Galium	1	0

Urtica	16	2		P.lanceolata t.	5	2		P.lanceolata t.	4	0
Chenopodiaceae	4	13		Cyperaceae	1	0		Cyperaceae	1	0
Poaceae	46	28		Ranunculaceae	2	0		Scrophulariaceae	5	3
Polypodiaceae	4	18		Scrophulariaceae	6	11		Chenopodiaceae	1	0
Mercurialis annua t.	0	3		Caltha t.	1	0		Poaceae	18	9
Cirsium	0	1		Rosaceae	4	2		Cerastium t.	0	1
A. tubifloreae	0	1		Chenopodiaceae	4	3		Lotus	0	1
A.liguliflоreae	0	1		Poaceae	46	8		Mentha t.	0	1
P. aviculare t.	0	2		A. liguliflоreae	0	1		Artemisia	0	1
Triticum t.	0	2		R. acetosa t.	0	1		Triticum t.	0	1
Silene	0	2		**Sum**	**134**	**100**		**Sum**	**82**	**83**
R. acris t.	0	1		Lyc.tablets	17	17		Lyc.tablets	3	8
Cerealia	0	1		Polypod	42	152		Polypodiaceae	32	36
Sum	**122**	**131**								
Lyc.tablets	11	2								