

Appendix A

Vegetation type	Family	Pollen type (genus, species, type)
LOWER	Apocynaceae	<i>Masdevilla sp</i>
MOUNTAIN	Arecaceae	<i>Euterpe sp1</i>
	Begoniaceae	<i>Begonia</i>
	Bignoniaceae	<i>sp1</i>
	Cecropiaceae	<i>Cecropia</i>
	Elaeocarpaceae	<i>Sloanea</i>
	Euphorbiaceae	<i>Acalypha</i>
		<i>Alchornea</i>
		<i>Croton</i>
		<i>Hyeronima</i>
		<i>Sapium</i>
		<i>Tetrorchidium</i>
	Flacourtiaceae	<i>Casearia</i>
	Lauraceae	<i>sp1</i>
		<i>Ocotea type</i>
	Meliaceae	<i>Cedrela sp</i>
		<i>Ruagea sp</i>
	Meliosmaceae	<i>Meliosma</i>
	Menispermaceae	<i>sp1</i>
	Mimosaceae	<i>Mimosa pudica</i>
		<i>sp1</i>
		<i>sp2</i>
		<i>sp3</i>
		<i>sp4</i>
	Moraceae/Urticaceae	<i>sp1</i>
	Piperaceae	<i>Piper</i>
	Proteaceae	<i>sp1</i>
	Rubiaceae	<i>Borreria</i>
		<i>Psychotria sp1</i>
	Sapotaceae	<i>sp1</i>
	Solanaceae	<i>sp1</i>
		<i>Solanum sp1</i>
	Tiliaceae	<i>sp1</i>
		<i>Heliocarpus</i>
	Ulmaceae	<i>Celtis</i>
		<i>Trema sp1</i>
	Verbenaceae	<i>Verbena sp1</i>
UPPER	Aquifoliaceae	<i>Ilex</i>
MOUNTAIN	Betulaceae	<i>Alnus acuminata</i>
	Bromeliaceae	<i>sp1</i>
	Clethraceae	<i>Purdiaea nutans</i>
	Chloranthaceae	<i>Hedyosmum</i>
	Cunoniaceae	<i>Weinmannia</i>
	Elaeocarpaceae	<i>Vallea</i>
	Myricaceae	<i>Myrica</i>
		<i>Myrica ver</i>
	Myrsinaceae	<i>Myrsine</i>
	Myrtaceae	<i>sp1</i>
		<i>Myrteola sp1</i>
	Podocarpaceae	<i>sp1</i>
	Rosaceae	<i>Polylepis - Acaena type</i>
	Rutaceae	<i>Zanthoxylum</i>
	Sapindaceae	<i>sp1</i>
		<i>sp2</i>

<i>Vegetation type</i>	<i>Family</i>	<i>Pollen type (genus, species, type)</i>
		<i>sp3</i>
		<i>sp4</i>
	Styracaceae	<i>Styrax</i>
	Symplocaceae	<i>sp1</i>
		<i>sp2</i>
		<i>sp3</i>
		<i>sp4</i>
	Theaceae	<i>Gordonia (former Laplacea)</i>
SUBPARAMO	Araliaceae	<i>Oreopanax</i>
	Asteraceae	<i>Ambrosia sp1</i>
		<i>Ambrosia sp2</i>
		<i>Ambrosia sp3</i>
		<i>Senecio sp1</i>
		<i>Senecio sp2</i>
		<i>Vernonia</i>
	Asteraceae	Asteraceae subf. Asteroideae
		Asteraceae subf. Cichorioideae
		<i>Baccharis</i>
		<i>sp1</i>
		<i>sp2</i>
		<i>sp3</i>
		<i>sp4</i>
		<i>sp5</i>
		<i>sp6</i>
		<i>sp7</i>
		<i>sp8</i>
		<i>sp9</i>
	Clethraceae	<i>sp1</i>
		<i>Clethra</i>
	Ericaceae	<i>sp1</i>
		<i>sp2</i>
		<i>sp3</i>
		<i>sp4</i>
		<i>Vaccinium</i>
	Gunneraceae	<i>Gunnera</i>
	Hypericaceae	<i>Hypericum</i>
	Loranthaceae	<i>Gaiadendron</i>
		<i>sp1</i>
	Melastomataceae	<i>sp1</i>
		<i>sp2</i>
	Oxalidaceae	<i>Oxalis</i>
	Polygonaceae	<i>Muehlenbeckia/Rumex type</i>
	Rosaceae	<i>Hesperomeles</i>
	Thymelaeaceae	<i>Daphnopsis</i>
PARAMO	Amaranthaceae	Amaranthaceae small
	Amaranthaceae/Chenopodiaceae	Amaranthaceae/Chenopodiaceae
	Apiaceae	<i>sp1</i>
		<i>sp2</i>
		<i>Eryngium (type)</i>
		<i>Hydrocotyle type</i>
	Boraginaceae	<i>Moritzia</i>
	Brassicaceae	<i>sp1</i>
	Caryophyllaceae	<i>sp1</i>
	Cyperaceae	<i>sp1</i>
	Eriocaulaceae	<i>sp1</i>

Vegetation type	Family	Pollen type (genus, species, type)
	Gentianaceae	sp1 sp2 sp3
	Geraniaceae	<i>Geranium</i>
	Iridaceae	sp1 sp2
	Plantaginaceae	<i>Plantago australis</i> <i>Plantago lanceolata</i> typ <i>Plantago rigida</i> <i>Plantago rigida</i> 1 <i>Plantago rigida</i> 2 <i>Plantago</i> sp1
	Poaceae	sp1 sp2
	Polygalaceae	<i>Monnina</i>
	Ranunculaceae	<i>Ranunculus</i> <i>Thalictrum</i>
	Rubiaceae	<i>Arcytophyllum</i> cf <i>thymifolium</i>
	Valerianaceae	<i>Valeriana</i> sp1 <i>Valeriana</i> sp2 <i>Valeriana</i> sp3 <i>Valeriana</i> sp4 <i>Valeriana</i> sp5 <i>Valeriana</i> sp6
	Xyridaceae	<i>Xyris</i>
OTHER	Arecaceae	<i>Iriartea</i> type
	Euphorbiaceae	<i>Euphorbia</i> type sp1 <i>Sebastiania</i> type 1
	Fabaceae	sp1 sp2 sp3 sp4 sp5 sp6 sp7
	Flacourtiaceae	<i>Flacourtiaceae</i>
	Juglandaceae	<i>Juglans</i>
	Lamiaceae	sp1 sp2
	Mimosaceae	<i>Acacia</i> type
	Poaceae	<i>Zea mays</i>
	Rubiaceae	sp1 sp2 <i>Spermacoce</i>
UNKNOWN	Typhaceae	<i>Typha</i>
	Apocynaceae	cf Apocynaceae
	Arecaceae	cf <i>Euterpe</i>
	Caprifoliaceae	cf <i>Viburnum</i>
	Clethraceae	cf <i>Purdiaea</i>
	Euphorbiaceae	cf <i>Pera</i> cf <i>Sebastiania</i>
	Hypericaceae	cf <i>Hypericum</i>
	Juglandaceae	cf <i>Juglans</i>
	Meliaceae	cf <i>Cedrela</i>
	Rosaceae	cf <i>Prunus</i>

Vegetation type	Family	Pollen type (genus, species, type)
	Sapotaceae	cf Sapotaceae
	Scrophulariaceae	cf Scrophulariaceae
INDETERMINATE		<i>tetrad</i> <i>psi small circ fine</i> <i>type 3 or 2cp str 25 30</i> <i>type 3c fine ret 35</i> <i>type 3c fineret pores elongated</i> <i>type 3c finestriat</i> <i>type 3c sca 30 45 thick exine</i> <i>type 3c sca type Quercus</i> <i>type 3cp fine ret col</i> <i>type 3cp fine ret equatorial</i> <i>type 3cp microechi 35 40</i> <i>type 3cp p long</i> <i>type 3cp psi (narrow pores 15)</i> <i>type 3cp psi sca</i> <i>type 3cp round pores psi sca 30</i> <i>type 3cp sca</i> <i>type 3cp sca long col</i> <i>type 3cp sca pitted</i> <i>type 3cp short colpi</i> <i>type 3cp str circ 35-45</i> <i>type 3cp thick extruded pores</i> <i>type 3p an ex psi cf Celtis</i> <i>type 3p circ psi sca 35 40</i> <i>type camp small</i> <i>type Dodoneae striat</i> <i>type Quercus with pores</i> <i>type ret periporate</i> <i>types 3cp ret big</i> <i>types 3cp ret middle</i> <i>types 3cp ret small</i>

Appendix B

Explanations:

- Source for morphological descriptions of pollen and spore types: Hooghiemstra (1984)¹, Niemann (2008)², Brunschön (2010)³ and own descriptions.
- Picture sources: mainly own photographs, Niemann (2008)² and Brunschön (2010)³
- Abbreviations for the vegetation types: (LMF) Lower Mountain Forest, (UMF) Upper Mountain Forest, (SUB) Subpáramo, (PAR) Páramo.
- Database serial number: Refers to the “Ecuadorian Pollen Key” database, modified in this dissertation.

1 Hooghiemstra H., 1984. Vegetation and climatic history of the High Plain of Bogota, Colombia: a continuous record of the last 3,5 million years. *Dissertationes Botanicae* 79, Cramer, Vaduz, 368 pp.

2 Niemann, H., 2008. Late Quaternary vegetation, climate and fire dynamics in the Podocarpus National Park region, southeastern Ecuadorian Andes. Dissertation, University of Göttingen, Germany, 178 pp.

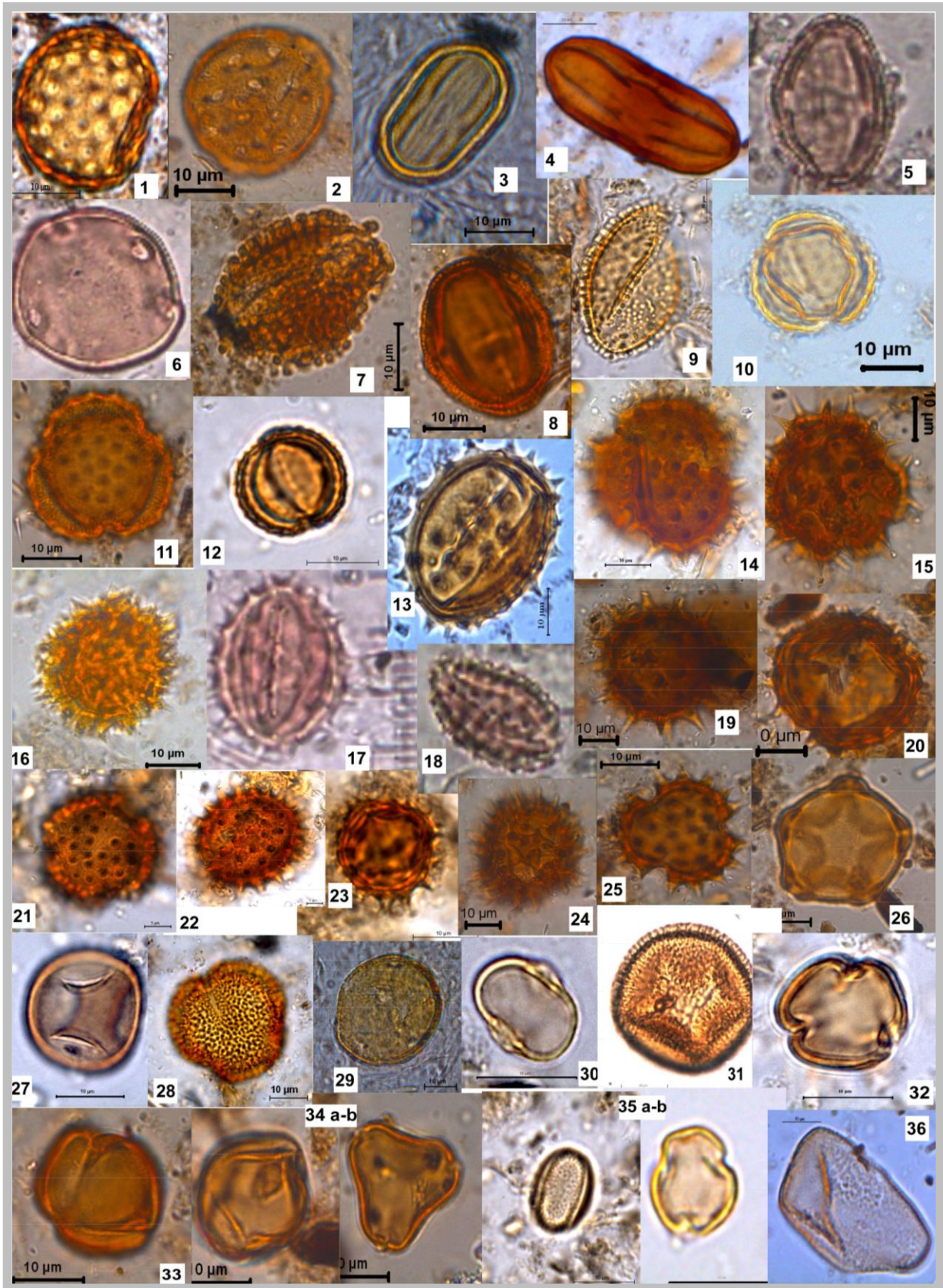
3 Brunschön, c., 2010. Late Quaternary Landscape Dynamics in the Podocarpus National Park Region in the Southeastern Andes of Ecuador. Dissertation, University of Göttingen, Germany, 209 pp.

Appendix B. List of identified pollen grains, description and photo plate

Family	Pollen type (genus, species, type)	Vegetation type	Morphology (short description)	Photo N°	Database serial N°
Amaranthaceae	Amaranthaceae small	PAR	periporate, reticulate, circular 15-20 µm	1	1357
Amaranthaceae/Chenopodiaceae	Amaranthaceae/Chenopodiaceae	PAR	periporate (ca. 25-40 pores), micro/per/supra-reticulate, subspheroidal 18-32 µm	2	1104
Apiaceae	<i>Apiaceae</i>	PAR	tricolporate, psilate, equat. subprolate-prolate ca. 25 µm	3	1352
Apiaceae	<i>Eryngium</i> (type)	PAR	tricolporate, psilate, equat. perprolate 25-35 µm	4	1248
Apiaceae	<i>Hydrocotyle</i> type	PAR	tricolporate, scabrate, equat. subprolate 20-30 µm, wall thickened on poles	5	1080
Apocynaceae	Apocynaceae (<i>Mandevilla</i>)	LMF	peri(col)porate, annulus, psilate/micro-reticulate, assymetric 29-40 µm	6 ³	1072
Aquifoliaceae	<i>Ilex</i>	UMF	tricolporate, clavate, equat. (sub)prolate, 21-31x30-40 µm	7	1081
Araliaceae	<i>Oreopanax</i>	SUB	tricolporate, (micro-) reticulate, equat. subprolate ca. 30-45 µm	8	1150
Arecaceae	<i>Iriartea</i> type	others	monosulcate, clavate/pilate, equat. rhombic (tall), polar 17-28 µm	9	1243
Asteraceae	<i>Ambrosia</i> type	SUB	tricolporate, (micro-)echinate, circular/suboblate, equatorial/polar 11-16x15-25 µm	10	1361
Asteraceae	<i>Ambrosia</i> type big	SUB	see <i>Ambrosia</i> , size > 25 µm	11 ³	1288
Asteraceae	<i>Ambrosia</i> type circ	SUB	see <i>Ambrosia</i> , smaller size and distinct circular shape	12	1179
Asteraceae	<i>Senecio</i>	SUB	tricolporate, echinate, few/short echinae with broad base, regular arranged, equat. subprolate 25-40 µm, polar circular 28-45 µm	13	1349
Asteraceae	<i>Senecio</i> type 40	SUB	see <i>Senecio</i> , size > 40 µm	14	1281
Asteraceae	<i>Vernonia</i>	SUB	tricolporate, echinate, echinae long with broad base, irregular arranged, some bended, circular 20 µm	15	1146
Asteraceae	Asteraceae subf. Cichorioideae	SUB	fenestrate, echinate, different types	16	1362
Asteraceae	Asteraceae type 1h	SUB	tricolporate, echinate, few long and thin echinae, circular ca. 30-40 µm	17	1326
Asteraceae	Asteraceae type 3h	SUB	tricolporate, echinate, many short echinae, exine indistinct, circular ca. 15-25 µm	18	1327
Asteraceae	Asteraceae type 6c	SUB	tricolporate, echinate, few and long echinae with rounded tops, circular ca. 25-35µm	19	1289
Asteraceae	Asteraceae type 7c	SUB	tricolporate, echinate, few thin and short echinae, circular ca. 25 µm	20	1290

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Family	Pollen type (genus, species, type)	Vegetation type	Morphology (short description)	Photo N°	Database serial N°
Asteraceae	Asteraceae type 1c	SUB	tricolporate, wide colpi, echinate, very short and broad echinae, regular arranged, circular 20-30 µm	21 ³	1163
Asteraceae	Asteraceae type 2c	SUB	tricolporate, wide colpi, echinate, few and very pointed spines (like <i>Senecio</i> type), equatorial 30-40 µm	22 ³	1155
Asteraceae	Asteraceae type 3c	SUB	tricolporate, echinate, long echinae (like <i>Baccharis</i> type), circular 12-20 µm	23	1177
Asteraceae	Asteraceae type 4c	SUB	tricolporate, echinate, many and long echinae, some bended, circular 20-40 µm	24	1178
Asteraceae	<i>Baccharis</i>	SUB	tricolporate, echinate, circular 28-40 µm	25	1328
Betulaceae	<i>Alnus acuminata</i>	UMF	stephanoporate (5(4) pores), psilate, polar 20x35 µm, acricolpate	26	1055
Boraginaceae	<i>Moritzia</i>	PAR	stephanocolporate (4 pores), colpi short and narrow, psilate-scabrate, circular 15-20 µm	27	1258
Brassicaceae	Brassicaceae	PAR	tricolporate, reticulate (sec. psilate), polar circular trilobate ca. 25-38 µm	28	1175
Caryophyllaceae	Caryophyllaceae	PAR	periporate, scabrate, circular ca. 25-40 µm	29	1365
Cecropiaceae	<i>Cecropia</i>	LMF	diporate, psilate to finely scabrate, 8x11 µm	30	1252
Chloranthaceae	<i>Hedyosmum</i>	UMF	inaperturate, clavate (regular), equat. (sub)spheroidal diam 25-41 µm	31	1082
Clethraceae	<i>Clethra</i>	SUB	tricolporate, psilate-scabrate, equat. spheroidal to prolate, 10-14x11-14 µm	32 ³	1084
Clethraceae	<i>Clethra</i> typ big	SUB	see <i>Clethra</i> , size 20-25 µm	33	1291
Clethraceae	<i>Purdiaea nutans</i>	UMF	tricolporate, pore area stick out laterally, psilate, equat. 10-17 µm, polar 9-16 µm	34a-b	1142/1212
Cunoniaceae	<i>Weinmannia</i>	UMF	tricolporate, (micro-/per-) reticulate, equat. prolate, 7-12x11-20 µm	35a-b	1145/1210/1211
Cyperaceae	Cyperaceae	PAR	periporate, pores indistinct, psilate to scabrate, pear-shaped or subspheroidal, variable in size, greatest diam 27-41 µm	36	1141



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Family	Pollen type (genus, species, type)	Vegetation type	Morphology (short description)	Photo N°	Database serial N°
Elaeocarpaceae	<i>Vallea</i>	UMF	tricolporate, psilate, equat. subprolate to prolate, 7-10x10-13 µm	37	1367
Ericaceae	Ericaceae psi 35 40	SUB	tricolporate, psilate to scabrate, tetrad, diam ca. 20-45 µm	38 ³	1140/1296
Ericaceae	<i>Vaccinium</i> type	SUB	tricolporate, psilate, tetrad, polar circular 28-35 µm	39	1073
Ericaceae	Ericaceae sca 40 50 (type 2)	SUB	tricolporate, scabrate, tetrad, ca. 40-50 µm	40	1085
Eriocaulaceae	Eriocaulaceae	PAR	syncolpate, echinate, few echinae, coarse grain, different shapes mostly circular, ca. 25-30 µm	41 ¹	1227
Euphorbiaceae	<i>Acalypha</i>	LMF	stephanocolporate (4-5), scabrate (verrucate), diam 23-21 µm	42	1113
Euphorbiaceae	<i>Alchornea</i>	LMF	tricolporate, fine scabrate to perforate, operculum, equat. oblate-spheroidal to prolate-spheroidal ca. 20-31 µm	43 a-b ²	1137
Euphorbiaceae	<i>Croton</i>	LMF	inapeturate, baculate/clavate, apolar, spheroidal, diam 52-63 µm	44	1297
Euphorbiaceae	<i>Euphorbia</i> type	others	tricolporate, reticulate, equat. prolate 20-30 µm, polar circular	45	1277
Euphorbiaceae	<i>Hyeronima</i>	LMF	tricolporate, reticulate, margo, equat.(per)prolate 22-34 µm, polar circular 8-13 µm	46	1255
Euphorbiaceae	<i>Sapium</i>	LMF	tricolporate, foveolate (scabrate-(micro-)verrucate in lower focus), equat. subprolate to perprolate, 27-48x44-73 µm	47	1182
Euphorbiaceae	<i>Sebastiania</i> type 1	others	tricolporate, reticulate, equat. subprolate 17-22 µm, polar circular 15-19 µm	48	1280
Euphorbiaceae	<i>Tetrorchidium</i>	LMF	tricolpate, clavate/pilate, equat. subprolate 28-38 µm, polar circular 33-50 µm	49	1267
Fabaceae	Fabaceae microret	others	tricolporate, micro-reticulate, mostly unique big pores, equat. subprolate ca. 25-30 µm	50	1298
Fabaceae	Fabaceae type1 ret	others	tricolporate, reticulate, mostly unique big pores, equat. subprolate up to 20 µm	51 ³	1181
Fabaceae	Fabaceae type2 ret	others	tricolporate, reticulate, mostly unique big pores, equat. subprolate up to 20-30 µm	52	1299
Fabaceae	Fabaceae type3 psi	others	tricolporate, psilate, mostly unique big pores, equat. subprolate > 30 µm	53	1368
Fabaceae	Fabaceae type3 ret	others	tricolporate, reticulate, mostly unique big pores, equat. subprolate > 30 µm	54	1151
Flacourtiaceae	Flacourtiaceae	others	stephanocolporate, psilate, 25-32x30-38 µm	55 ³	1369
Gentianacea	Gentianacea str ret	PAR	tricolporate, reticulate, secondary striate, unique reticulum, equat. subprolate 35-55 µm	56	1173

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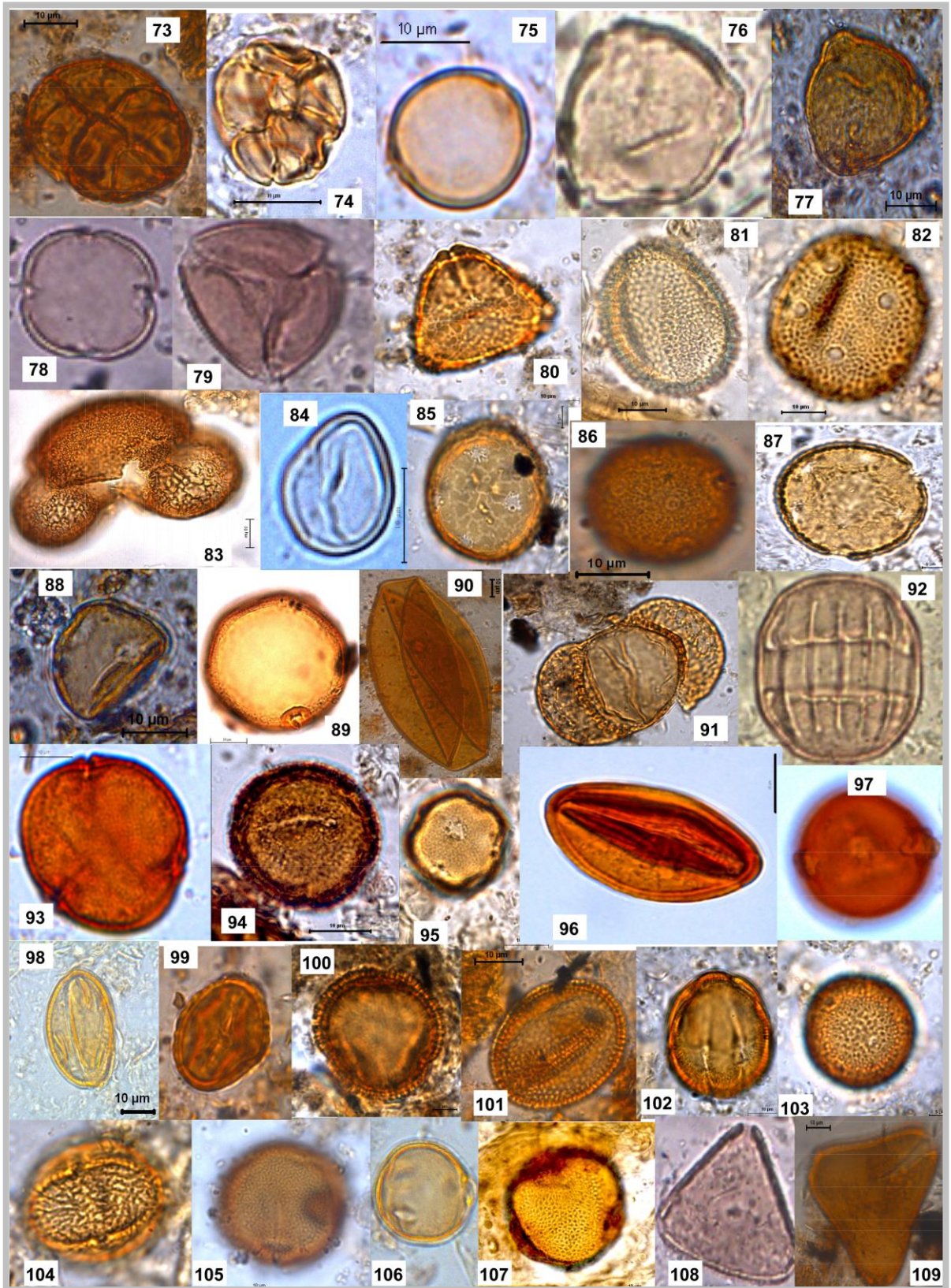
Family	Pollen type (genus, species, type)	Vegetation type	Morphology (short description)	Photo N°	Database serial N°
Gentianaceae	<i>Gentianella cf gilioides</i>	PAR	tricolporate, reticulate, equat. 30-40 µm, polar circular 25-35 µm	57	1174
Gunneraceae	<i>Gunnera</i>	SUB	tricolpate, micro-reticulate/per-reticulate, colpi recessed, lumina greatest in the centre, equat. spheroidal, polar trilobate, diam 23-38 µm	58 a-b	1050
Hypericaceae	<i>Hypericum</i>	SUB	tricolporate, (micro-)reticulate, unique even reticulum, slightly constricted at the equator, pores opened along colpi, 14-21x24-35 µm	59 a-b	1066/1224
Iridaceae	Iridaceae ret	PAR	monosulcate, reticulate, sulcus long and open, equat. subprolate, 25-30x30-40 µm	60	1244
Juglandaceae	<i>Juglans</i>	others	periporate (9-13 pores), pores situated in the equat. part of one hemisphere, heteropolar, scabrate, subspheroidal or flattened, diam 28-42 µm	61	1097
Lamiaceae	Lamiaceae	others	tri-stephanocolpate, reticulate, different shapes and sizes, ca. 35-45µm	62	1371
Lamiaceae	Lamiaceae sca 6c 40	others	stephanocolpate (6 colpi), reticulate/scabrate, colpi long and profound, polar circular ca. 40-50 µm	63 ^s	1161
Lauraceae	Lauraceae type Ocotea	LMF	inaperturate, echinate, grains very delicate, circular 20-30 µm	64	1259
Loranthaceae	<i>Gaiadendron</i>	SUB	syncolporate, psilate to scabrate, subtriangular concave, polar diam 18-23 µm	65	1221
Melastomataceae	Melastomataceae	SUB	heterocolporate, 3 colpi/3 pseudocolpi, equat. prolate to perprolate, 10-20x20-22 µm	66 a-b	1096
Melastomataceae	Melastomataceae >25 µm	SUB	see Melastomataceae, size > 25 µm, distinct pores	67	1305
Meliaceae	<i>Cedrela (montana)</i>	LMF	stephanocolporate (4 apertures) or tricolporate, psilate to scabrate, equat. spheroidal, 23-33x23-36 µm	68 ^s	1215
Meliosmaceae	<i>Meliosma</i>	LMF	tricolporate, reticulate, equat. suboblata 20-25µm	69	1156
Menispermaceae	Menispermaceae	LMF	inaperturate, reticulate, circular, different sizes	70	1176
Mimosaceae	<i>Acacia type</i>	others	polyade (4x4), psilate, circular ca. 20 µm	71	1374
Mimosaceae	<i>Mimosa pudica (4p small)</i>	LMF	tetrate, psilate, circular, ca. 10 µm	72 ^s	1256



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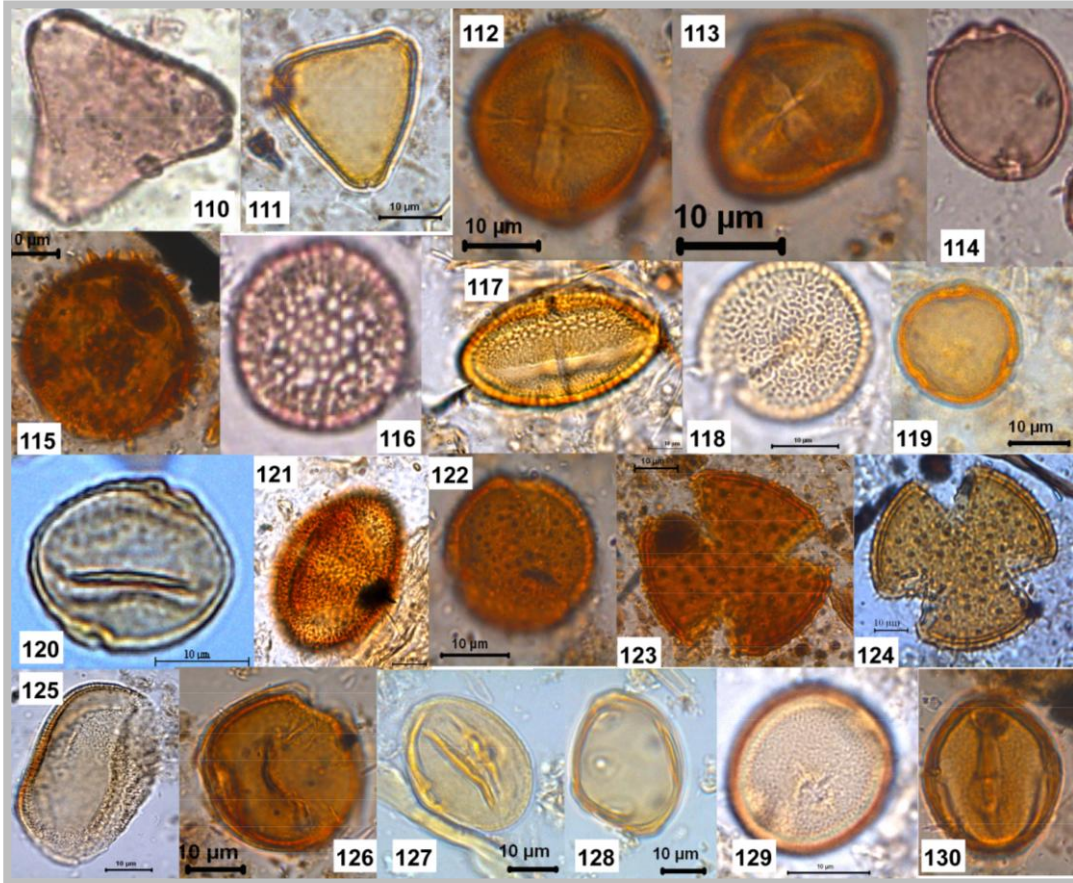
Family	Pollen type (genus, species, type)	Vegetation type	Morphology (short description)	Photo N°	Database serial N°
Mimosaceae	Mimosaceae 16p sca	LMF	polyade (4x4), scabrate, circular ca. 25-30 µm	73	1375
Mimosaceae	Mimosaceae 8p psi	LMF	polyade (2x4), psilate, circular ca. 15-20µm	74 ³	1257
Moraceae/Urticaceae	Moraceae/Urticaceae	LMF	diporate (triporate), psilate to fine scabrate, pores even and plain, circular ca. 20-25 µm	75	1247
Myricaceae	<i>Myrica</i>	UMF	triporate, scabrate (to rugulate), subtriangular convex, annulus, polar diam 25-38 µm	76	1093
Myricaceae	<i>Myrica</i> ver	UMF	see <i>Myrica</i> , verrucate	77	1376
Myrsinaceae	<i>Myrsine</i>	UMF	(3-)4(-5)colpate, psilate-scabrate, colpi recessed, margo, equat. circular 16-20 µm, polar quadrangular 18-25 µm	78	1058
Myrtaceae	Myrtaceae	UMF	syncolpate (3), psilate to sacabrate/micro-reticulate, subtriangular convex, diam 21-25 µm	79	1061/1083
Myrtaceae	Myrtaceae (<i>Myrteola</i> type)	UMF	syncolporate, verrucate (rugulate), subtriangular convex (to straight), diam 20-25 µm	80	1198
Oxalidaceae	<i>Oxalis</i>	SUB	tricolpate, reticulat, margo, equat. (sub)prolate 26-38, polar circular 22-28 µm	81	1260
Papaveraceae	<i>Bocconia cf integrifolia</i>	others/LMF	periporate (6-7 pores), per-reticulate, annulus, (sub)spheroidal, diam 25-34 µm	82	1088/1169
Pinaceae	<i>Pinus</i>	others (Plantation)	disaccate, corpus scabrate to rugulate, airsaccats with per-reticulum and wide lumina, corpus 50 - 64 µm long and 41 - 64 µm wide, air saccats 39 - 51 µm long and 55 - 68 µm wide, exine at area of the saccats stronger wavy and up to 4 µm thick, total size ca. 100 µm (> 80 µm)	83	1106
Piperaceae	<i>Piper</i>	LMF	monocolpate, psilate, intectate, 5-7x8-12 µm	84	1355
Plantaginaceae	<i>Plantago australis</i>	PAR	periporate (8-14 pores), verrucate irregular and swollen, apolar, circular with jagged margins, diam 2-5 µm, annuli indistinct, irregular shape and size, spheroidal, diam 18-42 µm	85 ³	1158
Plantaginaceae	<i>Plantago lanceolata</i> typ	PAR	periporate (6-8 pores), spores small and circular, scabrate to verrucate, annulus, circular, diam ca. 25-35 µm	86	1306
Plantaginaceae	<i>Plantago rigida</i>	PAR	periporate (8-12 pores), pores irregular with jagged margins, verrucate, apolar, annuli indistinct, verrucae irregular, spheroidal, diam 22-35 µm	87 ³	1054
Plantaginaceae	<i>Plantago</i> sp.	PAR	periporate, verrucate, size (equatorial/polar) 24-38 µm	88	1377
Poaceae	Poaceae	PAR	monoporate, psilate to fine-scabrate, pore with distinct annulus, circular ca. 22-60(80) µm	89	1099

Family	Pollen type (genus, species, type)	Vegetation type	Morphology (short description)	Photo N°	Database serial N°
Poaceae	<i>Zea mays</i>	others (Cultivation)	monoporate, psilate, pore 4-8 µm with annulus, circular 80-100 µm, often crumpled	90 ³	1103
Podocarpaceae	Podocarpaceae	UMF	disaccate, air saccats globose and reticulate, muri variable in continuity, variable size, grain length ca. 34-84 µm, corpus length ca. 30-55 µm, corpus width ca. 27-44 µm and saccus width ca. 23-47 µm, total size 50-80µm	91	1056
Polygalaceae	<i>Monnina</i>	PAR	stephanocolporate (11-14 apertures), foveolate, subprolate to prolate with broadly flattened polar areas, 25-36x30-46 µm	92	1069
Polygonaceae	<i>Muehlenbeckia/Ru mex</i> type	SUB	tricolporate, reticulate, lumina irregluar, colpi long and very narrow, pores laterally elongated, suboblate to prolate-spheroidal, 18-25x17-24 µm	93	1235/1246
Ranunculaceae	<i>Ranunculus</i>	PAR	tricolpate, echinate, circular ca. 21-27 µm, margo	94	1263
Ranunculaceae	<i>Thalictrum</i>	PAR	periporate (6-11 pores), pores irregular and recessed, scabrate, (sub)spheroidal, diam (14)17-23 µm	95	1089
Rosaceae	<i>Hesperomeles</i>	SUB	tricolporate, striate, equat. prolate ca. 15x25 µm	96	1222
Rosaceae	<i>Polylepis -Acaena</i>	UMF	tricolporate, verrucate, pores with an loose operculum, circular 20-41 µm	97	1185
Rosaceae	<i>Prunus</i> type	UMF/LMF	tricolporate, striate, size (equatorial/polar) 22-28x28-38 µm	98 ²	1379
Rosaceae	Rosaceae	UMF	tricolporate, striate, equat. prolate 12-20 µm	99 ²	1307
Rubiaceae	<i>Arcytophyllum</i> cf <i>thymifolium</i>	PAR	tricolporate, reticulate, pores indistinct, impressed and elongated, equat. 30-38 µm, polar circular 25-23 µm	100 ³	1149
Rubiaceae	Rubiaceae	others	tricolporate, reticulate different types	101	1110
Rubiaceae	Rubiaceae 6c	others	stephanocolporate (c6), (fine)reticulate, pores with operculum, equat. subprolate 30-35 µm	102	1209
Rubiaceae	<i>Spermacoce</i>	others	periporate, echinate, circular 25 µm	103 ²	1159
Rutaceae	<i>Zanthoxylum</i>	UMF	tricolporate, reticulate, reticulum elongated, equat. subprolate 20-26 µm, polar circular 18-23 µm	104	1148
Sapindaceae	<i>Dodonaea</i>	UMF/SDF	tricolporate, psilate (finely pitted), pores laterally elongated and protruding, prolate-spheroidal 25x30 µm	105	1276
Sapindaceae	<i>Dodonaea</i> small type	UMF/SDF	see <i>Dononaea</i> , size 25 µm	106 ³	1381
Sapindaceae	<i>Dodonaea</i> ret	UMF/SDF	see <i>Dodonaea</i> , reticulate, circular 30-35µm	107	1172
Sapindaceae	Sapindaceae fine ret (type 3)	UMF	triporate, fine reticulate, polar triangular, diam ca. 35-40 µm	108	1087
Sapindaceae	Sapindaceae psi	UMF	triporate, psilate, polar triangular, diam ca. 45-50 µm	109 ²	1310



Appendix B. List of identified pollen grains, description and photo plate

Family	Pollen type (genus, species, type)	Vegetation type	Morphology (short description)	Photo N°	Database serial N°
Sapindaceae	Sapindaceae type 1	UMF	triporate, micro-echinate, polar triangular concave, diam ca. 40-50 µm	110	1078
Sapindaceae	Sapindaceae	UMF	triporate, different types	111 ²	1380
Solanaceae	Solanaceae type 1	LMF	tricolporate, scabrate, long colpi and very broad pores (elongated), circular ca. 25µm	112	1311
Solanaceae	<i>Solanum</i> (type)	LMF	tricolporate, psilate, pores elongated and laterally extruded, equat. suboblate to rhombic 20-30 µm, polar circular 19-18 µm	113	1108
Symplocaceae	<i>Symplocos</i> 2p psi	UMF	diporate, psilate, pores circular with annulus, elliptic to circular ca. 20-35 µm	114 ³	1057
Theaceae	<i>Gordonia</i> (former <i>Laplacea</i>)	UMF	triporate, mixture of echinate, bacculate and clavate, circular to subprolate ca. 35-40µm	115	1180
Thymelaeaceae	<i>Daphnopsis</i>	SUB	periporate (9-12 pores), reticulate and scabrate on the muri, pores circular to elongated, lumina decreasing near the pores, spheroidal to ellipsoidal, diam 25-36 µm	116	1052
Tiliaceae	<i>Helioarpus</i>	LMF	tricolporate, per-reticulate, colpi long and narrow, pore indistinct, lumina elongated, muri relative thick forming striate pattern, prolate 26x44 µm	117 ²	1242
Typhaceae	<i>Typha</i>	others	monoporate, per-reticulate (to rugulate), heteropolar, aperture and lumina irregular, muri thin, spheroidal to elongated, diam 18-23 µm	118	1270
Ulmaceae	<i>Celtis</i>	LMF	triporate, fine scabrate, annulus, subspheroidal, diam 24-27 µm	119	1382
Ulmaceae	<i>Trema</i> type	LMF	diporate, psilate to scabrate, pores circular and thickened, equat./polar 13-17x15-20µm	120 ²	1356
Valerianaceae	<i>Valeriana</i> micro echinate	PAR	tricolpate, micro-echinate, circular ca. 35-40 µm	121	1160
Valerianaceae	<i>Valeriana</i> <i>stenophylla</i> typ	PAR	tricolpate, echinate, echinae short and irregular, colpi with smooth margo, circular ca. 25-30 µm	122 ³	1313
Valerianaceae	<i>Valeriana</i> typ 1	PAR	tricolpate, echinate, echinae irregular, equat. supoblate 30-35 µm, polar circular 32-50 µm	123 ²	1041
Valerianaceae	<i>Valeriana</i> type 3	PAR	tricolpate, echinate, size (equat./polar) 42x55 µm	124	1358
Xyridaceae	<i>Xyris</i>	PAR	dicolpate, reticulate, margo, equat. prolate 47-56 µm, polar 20-33 µm	125	1271
Apocynaceae	cf Apocynaceae	Unknown	stephanoporate (3), psilate, pores circular with annulus, circular ca. 25 µm	126	1335
Meliaceae	cf <i>Cedrela</i>	Unknown	4-colporate, psilate, colpi short and coarse, pores distinct and circular, equat. subprolate, polar circular ca. 20-35 µm	127	1384
Juglandaceae	cf <i>Juglans</i>	Unknown	see <i>Juglans</i>	128	1385
Euphorbiaceae	cf <i>Pera</i>	Unknown	tricolporate, scabrate to micro-reticulate, pores circular, colpi narrow, circular 15-20 µm	129 ³	1269
Sapotaceae	cf Sapotaceae	Unknown	see Sapotaceae typ	130 ²	1334

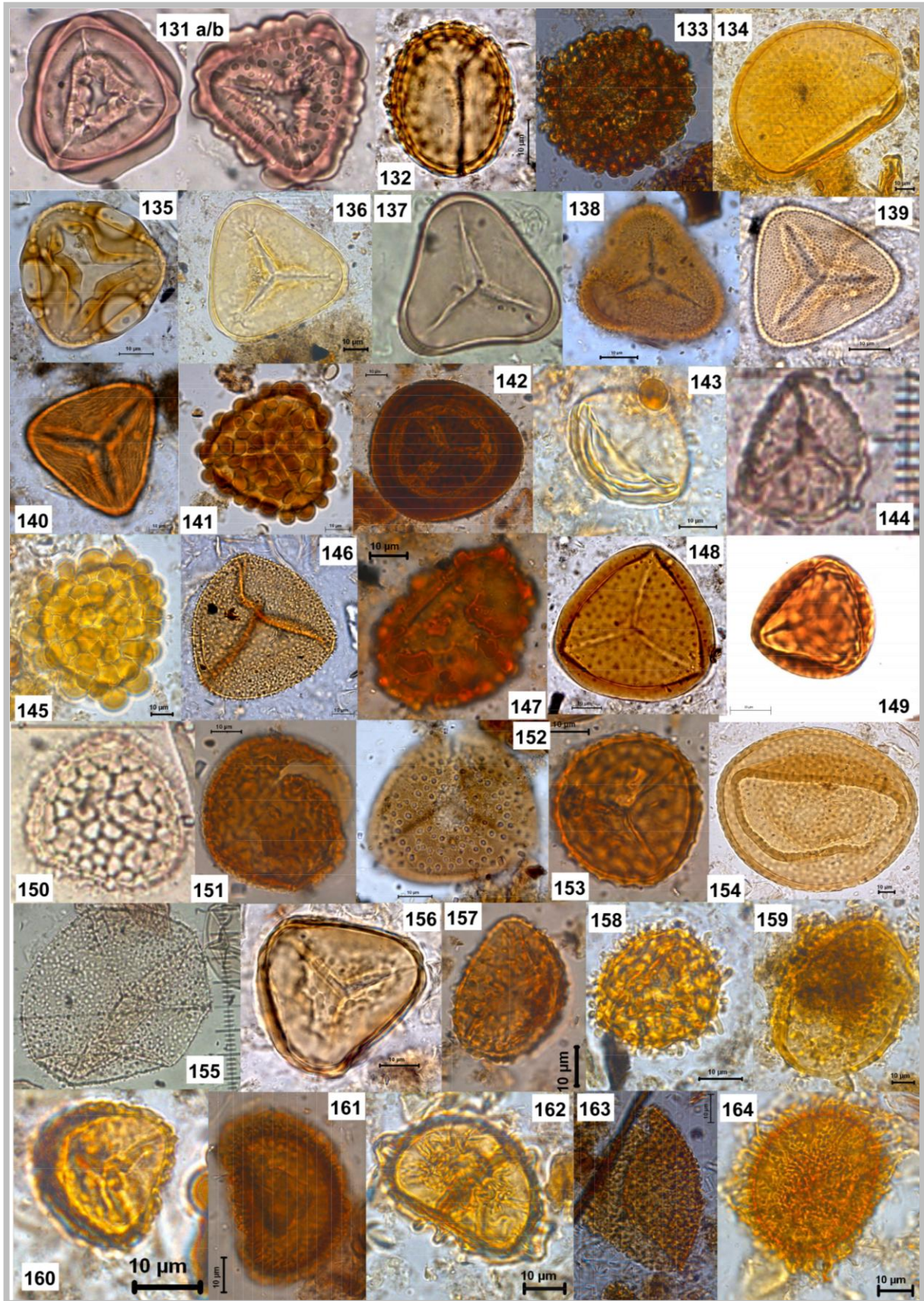


Appendix B. List of identified spore grains, description and photo plate

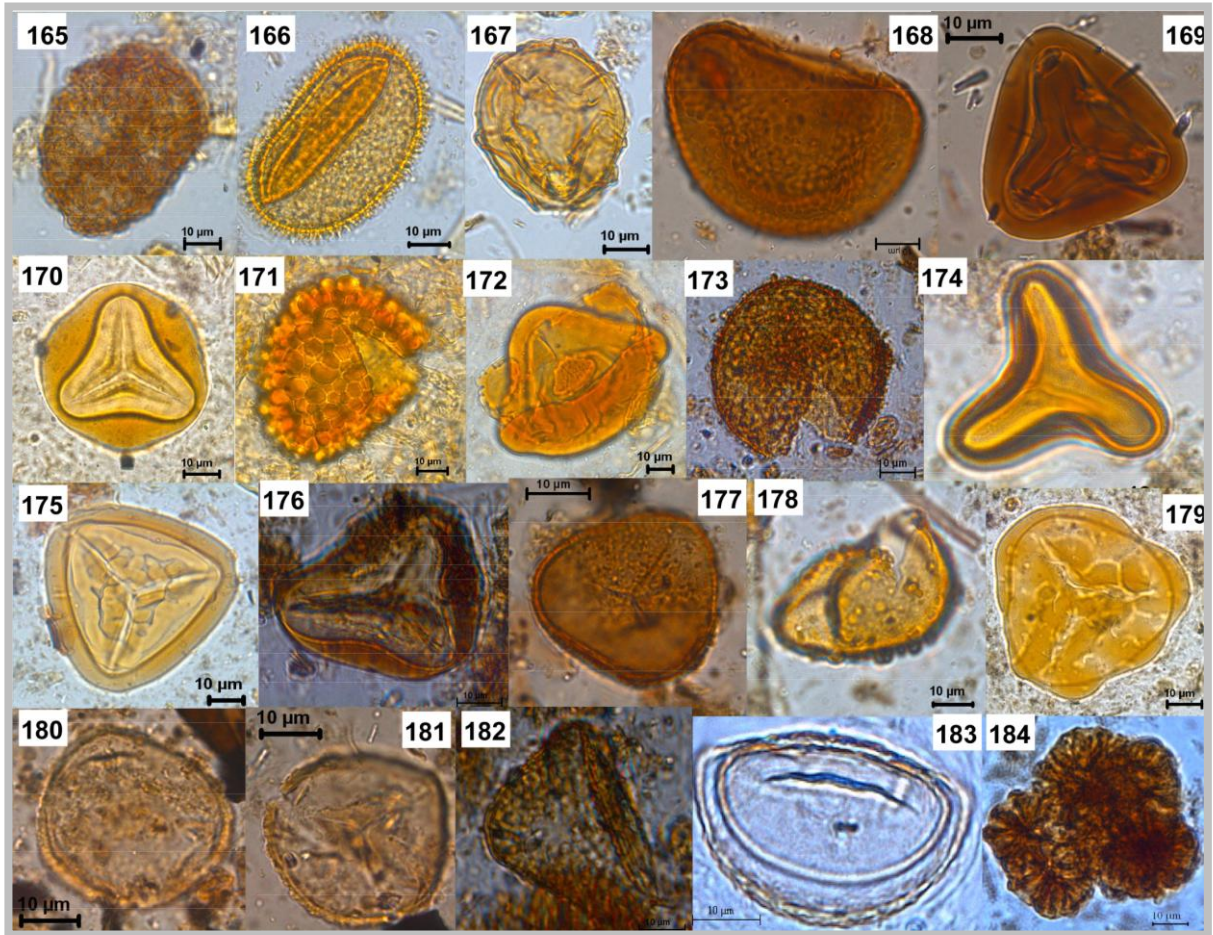
Family	Spore type (genus, species, type)	Spore Morphology (short description)	Photo N°	Database serial N°
Adiantaceae	<i>Jamesonia</i>	trilete, verrucate (highly variable), laesurae extending almost to the equator, mostly bordered by coarse verrucate to rugulate thickenings, sclerine thickened along the equator, triangular (convex), equat. diam ca. 45-80 µm, perispore	131 ³ a/b	1044/1186
Aspleniaceae	cf Aspleniaceae	monolete, psilate, perine adpressed with prominent short striate ridges, equat. ca. 30-40 µm	132	1253
Blechnaceae	<i>Blechnum cf olubilis</i>	monolete, rugulate, gemmae scattered, elliptical, equat. ca. 60-75 µm	133 ²	1398
Blechnaceae	<i>Blechnum finever</i>	monolete, fine verrucate, equat. ca. 50-90 µm	134	1399
Cyatheaceae	<i>Cyathea horrida</i>	trilete, psilate, triangular (convex), laesurae extending near the equator, interradially thickened, 3 large pores in the wall (diam 8-15 µm), equat. diam 30-50 µm	135	1077
Cyatheaceae	Cyatheaceae fine/ve	trilete, fine verrucate, triangluar, equat. diam > 50 µm	136	1400
Cyatheaceae	Cyatheaceae psi	trilete, psilate, triangular, equat. diam > 50 µm	137 ³	1053
Cyatheaceae	Cyatheaceae typ fine echinate	trilete, fine echinate, triangular, equat. diam > 50 µm	138 ²	1275
Cyatheaceae	Cyatheaceae type <i>Alsophila</i>	trilete, tenously reticulate, triangular (convex), equat. diam ca. 40-50 µm	139	1250
Cyatheaceae	Cyatheaceae type <i>Nephelea</i>	trilete, striat (perine), triangular (convex), equat. diam 40-60 µm	140	1245
Cyatheaceae	Cyatheaceae ver	trilete, peculiar verrucate (spherical tuberculae), triangular, equat. diam >50 µm	141	1045
Dicksoniaceae	<i>Lophosoria quadripinnata</i>	trilete, proximate scabrate or verrucate, distal psilate with scattered elongated foveolae, margo bordered by lobed and flattened sclerine, broad equat. cingulum, triangular convex to circular, equat. diam 40-95 µm	142	1321
Equisetaceae	cf <i>Equisetum</i>	alete, psilate, discontinous sclerine, diam ca. 60 µm	143 ²	1401
Grammitidaceae	<i>Grammitis</i>	trilete, (fine) verrucate irregular, laesuae extending almost to the equat. with raised margo, subcircular to triangular convex, equat. diam 25-40 µm	144	1079/1205/1206
Grammitidaceae	<i>Lellingeria</i>	trilete, verrucate irregular, laesuae extending almost to the equat. with raised margo, subcircular to triangular convex, equat. diam 30-35 µm	145	1402
Hymenophyllaceae	<i>Hymenophyllum</i>	trilete, verrucate to scabarate, laesurae extending to the equat. with margo, triangular convex, equat. diam 35-75 µm	146 ³	1091
Hypolepidaceae	<i>Histiopteris incisia</i> typ small	monolete, smooth flattened rugulae and platae (partly fused), laesurae to 3/4 of the spore lenght, ca. 25-30 µm	147 ²	1329

Appendix B. List of identified spore grains, description and photo plate

Family	Spore type (genus, species, type)	Spore Morphology (short description)	Photo N°	Database serial N°
Lycopodiaceae	<i>Huperzia</i>	trilete, verrucate to foveolate, sclerine thickened, distinct long laesuae, triangular convex, equat. diam 35-50 µm	148	1039/1223
Lycopodiaceae	<i>Lycopodium cernuum</i>	trilete, fossulate (rugulate), triangular convex, laesurae almost extending to the equat., margo, equat. diam 30-50 µm	149 ³	1065
Lycopodiaceae	<i>Lycopodium clavatum</i>	trilete, reticulate, triangular convex, lumina 2,5 - 8,5 µm wide and muri 1 µm wide, equat. diam 45-50 µm	150	1092
Lycopodiaceae	<i>Lycopodium curvatum</i>	trilete, fossulate to slightly foveolate, triangular convex, laesurae almost extending to the equat., sclerine forms interr radial thickenings, equat. diam 30-50 µm	151	1319
Lycopodiaceae	<i>Lycopodium</i> formtype foveolate	trilete, foveolate (proximally psilate), laesurae extending almost to the equat., triangular convex, equat. diam 35-50 µm	152 ³	1278
Lycopodiaceae	<i>Lycopodium jussiaei</i> type	trilete, proximal psilate, distal with a spacious reticulum, laesurae extending almost to the equator, triangular convex, equat. diam 40-50 µm	153 ²	1320
Ophioglossaceae	<i>Ophioglossum</i>	trilete, reticulate with transition to foveolate and fossulate, laesuae 2/3 of the radius, circular, equat. diam 50-75 µm	154	1282
Osmundaceae	<i>Osmunda</i>	trilete, verrucate (variable), circular, equat. diam 65-90 µm, spores often deformed and fragmented	155	1064
Pteridaceae	<i>Pteris</i>	trilete, fossulate (rugulate) to verrucate, laesurae extending almost to the equat., margo sometimes present as a part of the ornamentation, triangular, psilate cingulum, triangular convex to circular, equat. diam 50-70 µm (with cingulum)	156 ³	1261
Selaginellaceae	<i>Selaginella</i>	trilete, echinate, triangular convex, diam 25-35 µm, different types	157	1323
Selaginellaceae	<i>Selaginella anceps</i> type	trilete, clavate, clavae 3-5 µm long, laesurae extending almost to the equat., triangular convex, equat. diam 30-35 µm	158	1404
Selaginellaceae	<i>Selaginella excurrens</i> type	trilete, clavate to psilate, laesurae fine, circular, equat. diam 25-65 µm	159 ²	1405
Selaginellaceae	<i>Selaginella</i> ver	trilete, verrucate, triangular convex, equat. diam ca. 30 µm	160 ³	1408
UNKNOWN	fern clavate	monolet, clavate, elliptical < 50 µm long	161	1333
	fern ml corrugated ps <50	monolet, corrugated psilate, elliptical < 50 µm long	162	1409
	fern ml droplet ver > 50	monolet, distinct verrucate, elliptical > 50 µm long	163	1410
	fern ml ech ps <50	monolet, echinate, with perispore, elliptical < 50 µm long	164 ³	1411



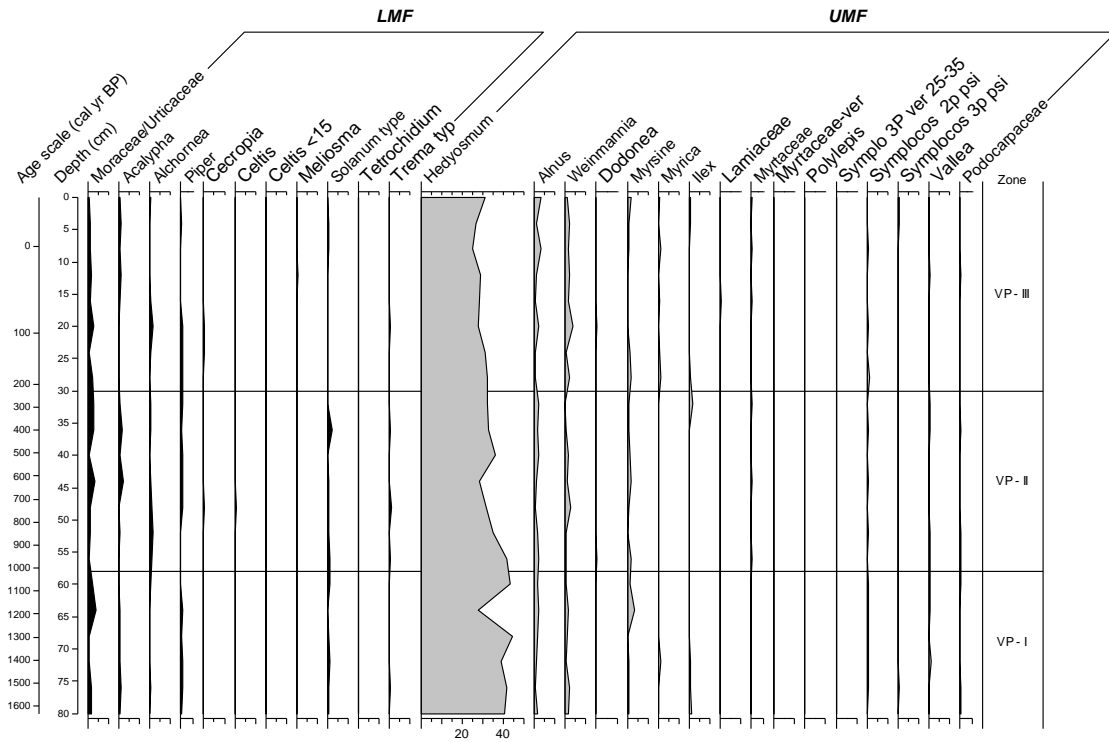
Family	Spore type (genus, species, type)	Spore Morphology (short description)	Photo N°	Database serial N°
	fern ml linty >50	monolete, linty ornamentation mixture of scabrate, verrucate and clavate, elliptical > 50 µm long	165	1412
	fern ml microechinate	monolete, micro-echinate, elliptical	166	1413
	fern ml psi ps <50	monolete, psilate, perispore, elliptical < 50 µm long, different types	167	1414
	fern ml ver >50	monolete, verrucate, elliptical > 50 µm long, different types	168 ³	1332
	fern tl cf Eriosorus	trilete, psilate to verrucate, laesuae extending almost to equat., margo with a strongly undulating outer rim, thickened sclerine along equat. forming a cingulum, triangular convex, equat. diam 45-60 µm	169	1315
	fern tl circexo psi	trilete, psilate, distinct circular perispore	170 ²	1415
	fern tl clavate	trilete, clavate, triangular, equat. diam < 50 µm, different types	171	1416
	fern tl crusted thick ex 30	trilete, irregular and mixed ornamentation, thickened exospore, equat. diam ca. 30 µm	172	1417
	fern tl mixed structure	trilete, mixed ornamentation, equat. diam < 50 µm	173 ³	1418
	fern tl psi <50	trilete, psilate, triangular, equat. diam < 50 µm, different types	174	1419
	fern tl psi exospore	trilete, psilate, perispore, equat. diam < 50 µm	175	1420
	fern tl sca exo	trilete, scabrate, perispore, equat. diam < 50 µm	176	1421
	fern tl scabrat	trilete, scabrate, equat. diam < 50 µm	177 ³	1331
	fern tl ver cla	trilete, verrucate to clavate, equat. diam < 50 µm	178	1422
	fern tl ver exo >50	trilete, verrucate, perispore, triangular, equat. diam > 50 µm	179	1423
Anthocerotaceae	<i>Phaeoceros</i>	trilete, echinate and verrucate, echini and verrucae 1 - 2 µm long and irregular, laesurae long and with fine margo, circular, equat. diam 60-70 µm	180 ²	1322
Sphagnaceae	<i>Sphagnum</i>	trilete, laesuae extending almost to equat., psilate to scabrate to fine verrucate, greenish lustre, sclerine thickened, triangular convex, equat. diam 30-40 µm	181	1324
	cf <i>Anthocerus</i>	trilete, fine echinate (sometimes branched), triangular convex to circular, laesurae extending almost to the equat., equat. diam 35-70 µm	182	1424
Isoëtaceae	<i>Isoëtes</i>	monolete, scabrate to rugulate, long laesuae, extended perine with crumpled outer borders, elliptical ca. 25-35 µm long (with perine)	183 ³	1098
Dictyosphaeriaceae	<i>Botryococcus braunii</i>	colonial algae, brown, irregular size, diam usually 20-80 µm (depending on fragmentation rate)	184	1354



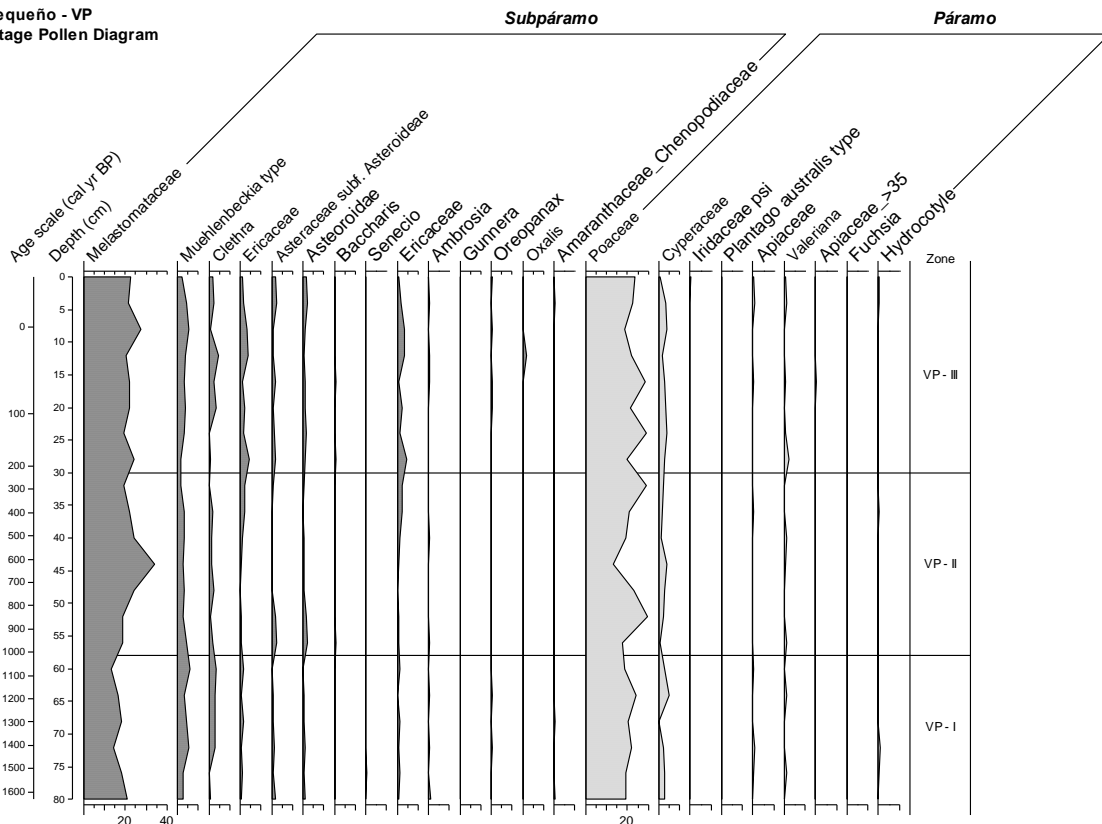
Appendix C

Appendix C: Complete pollen and spores diagram for Valle Pequeño bog (VP)

Valle Pequeño - VP
Percentage Pollen Diagram

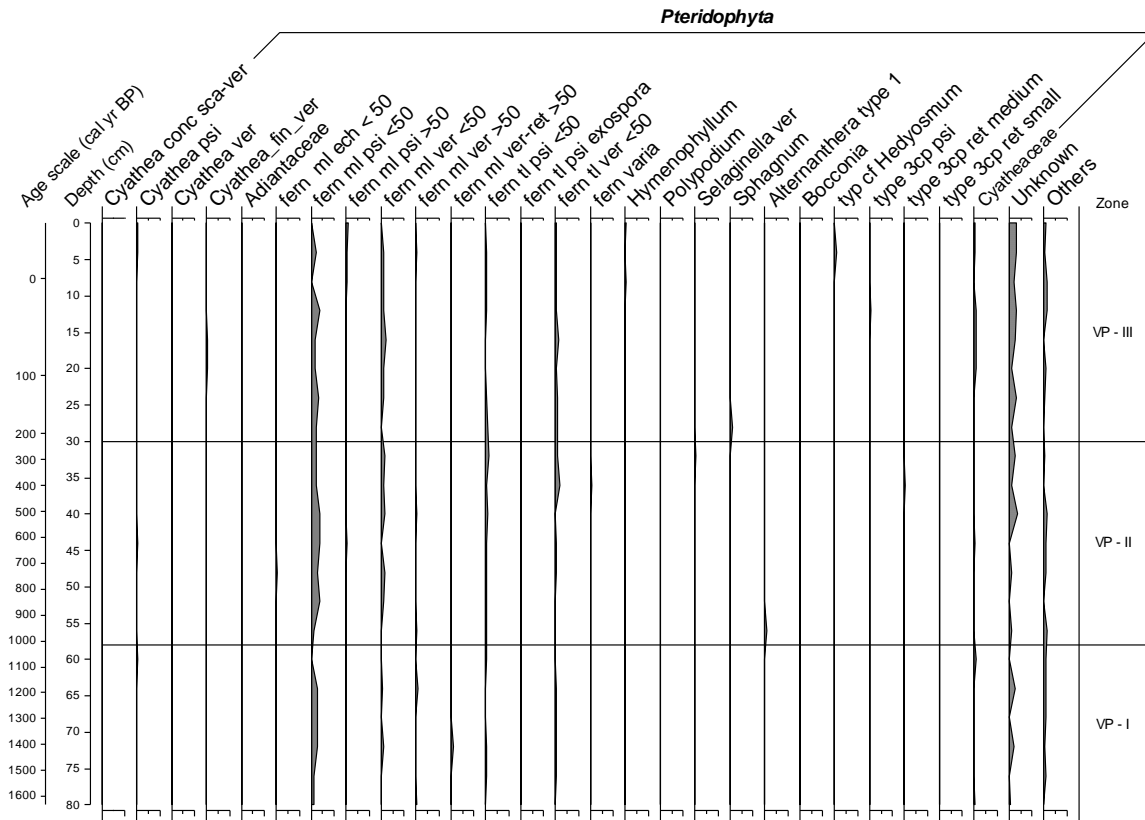


Valle Pequeño - VP
Percentage Pollen Diagram



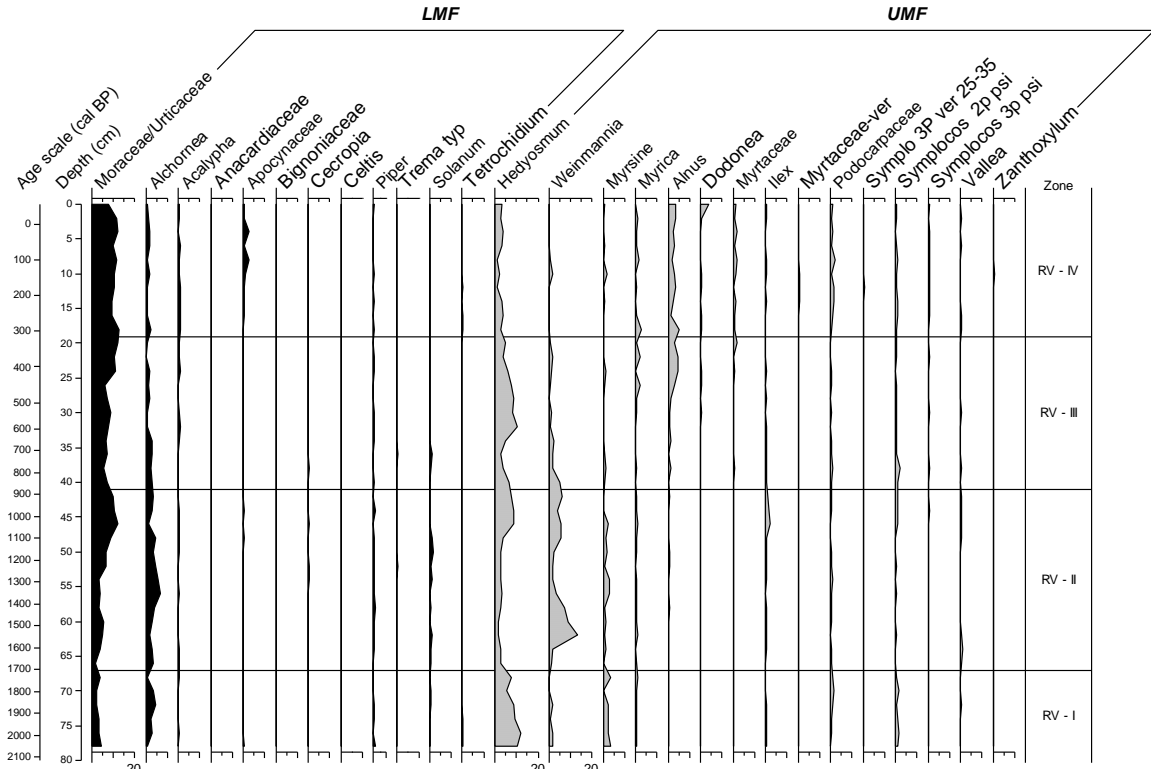
Appendix C: Complete pollen and spores diagram for Valle Pequeño bog (VP)

Valle Pequeño - VP
Percentage Pollen Diagram

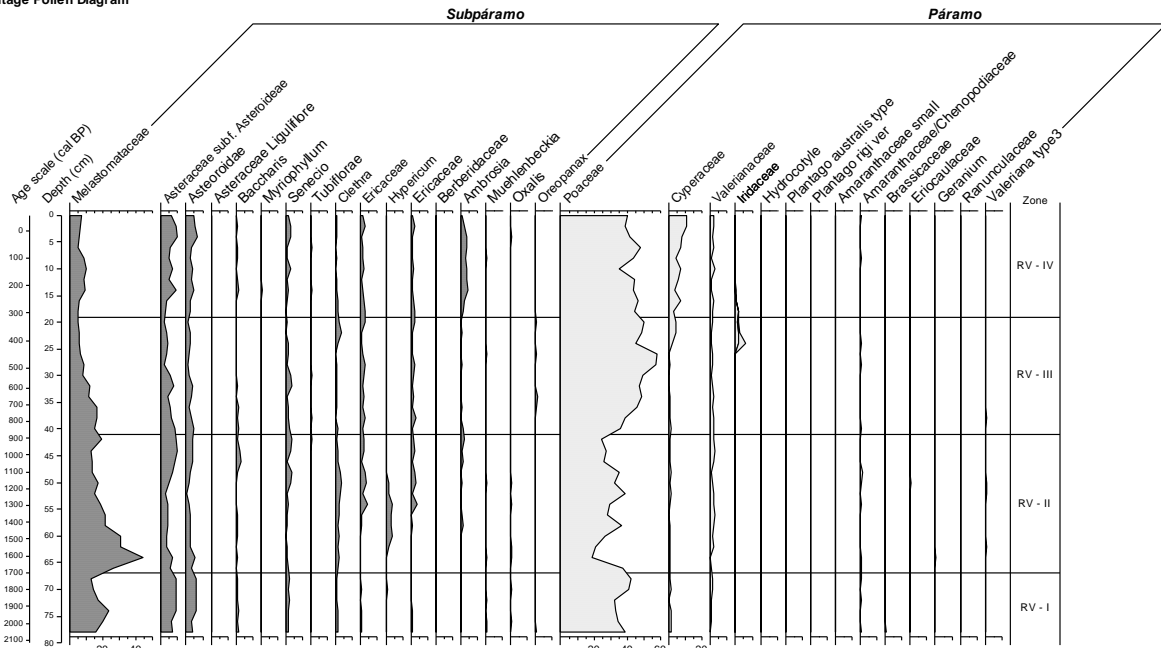


Appendix C: Complete pollen and spores diagram for Rabadilla de Vaca mire (RVM)

Rabadilla de Vaca - RV
Percentage Pollen Diagram

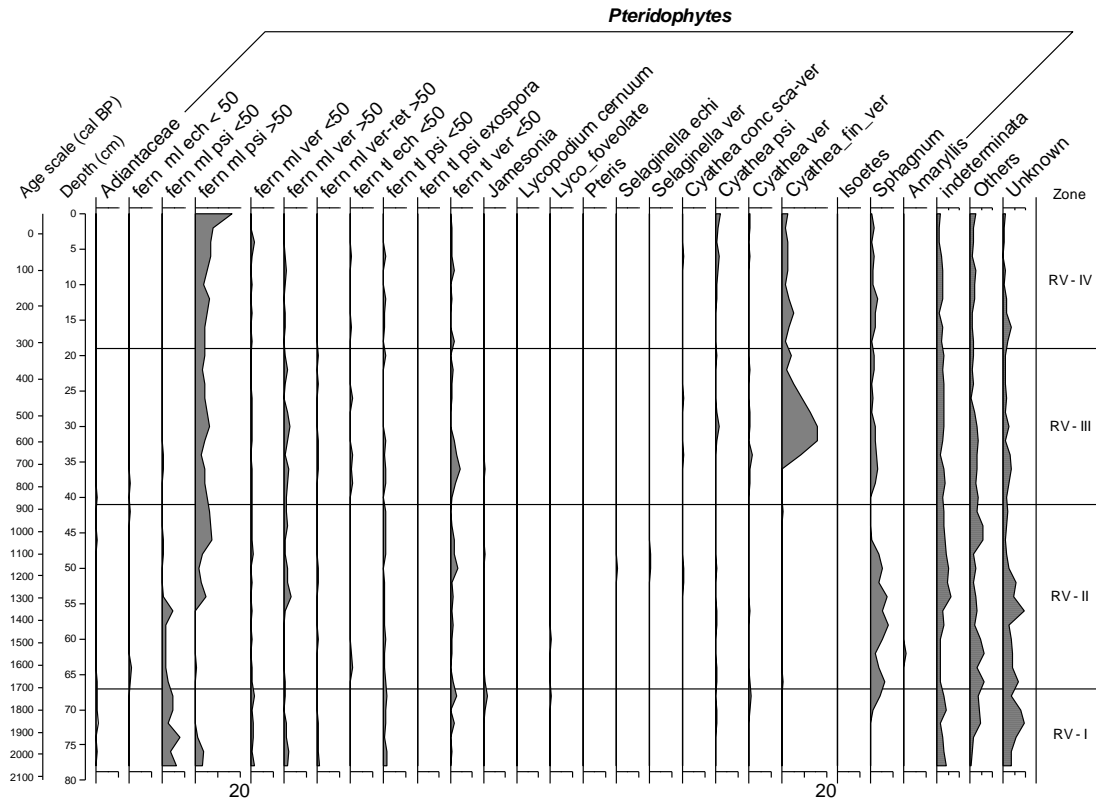


Rabadilla de Vaca - RV
Percentage Pollen Diagram



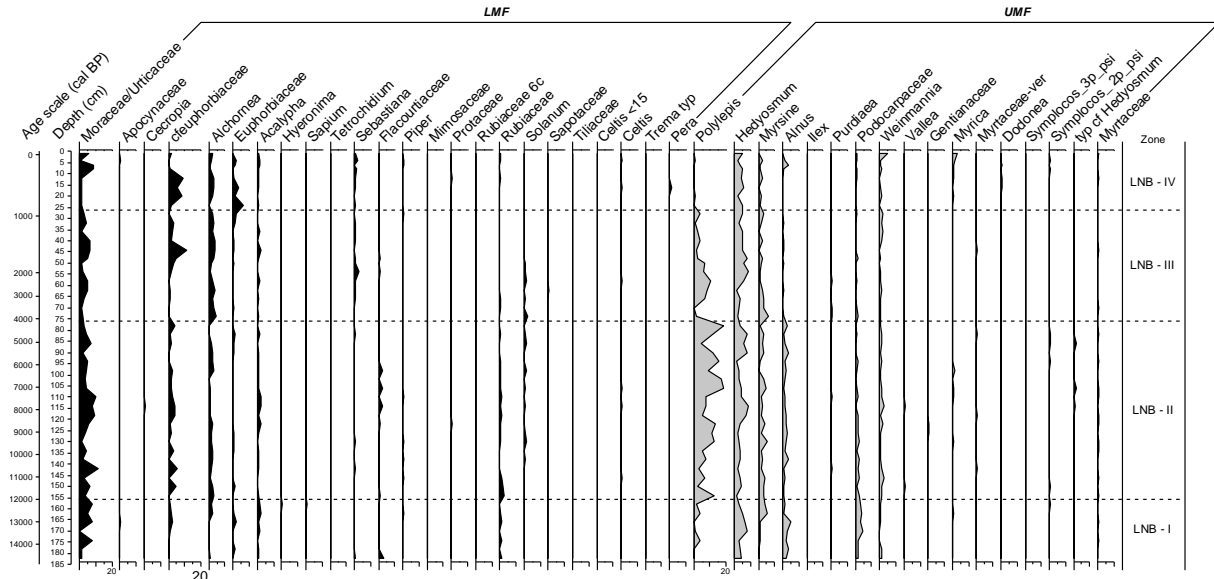
Appendix C: Complete pollen and spores diagram for Rabadilla de Vaca mire (RVM)

Rabadilla de Vaca - RV
 Percentage Pollen Diagram

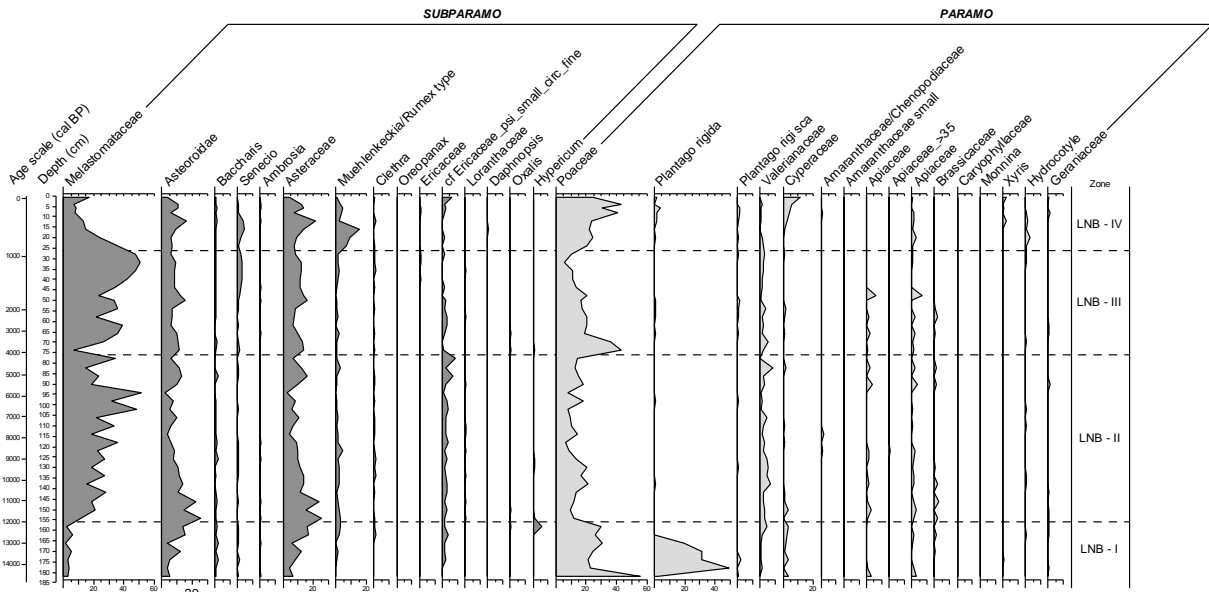


Appendix C: Complete pollen and spores diagram for Lagunas Natasas Forest (LNB)

Lagunas Natasas Forest
Percentage Pollen Diagram

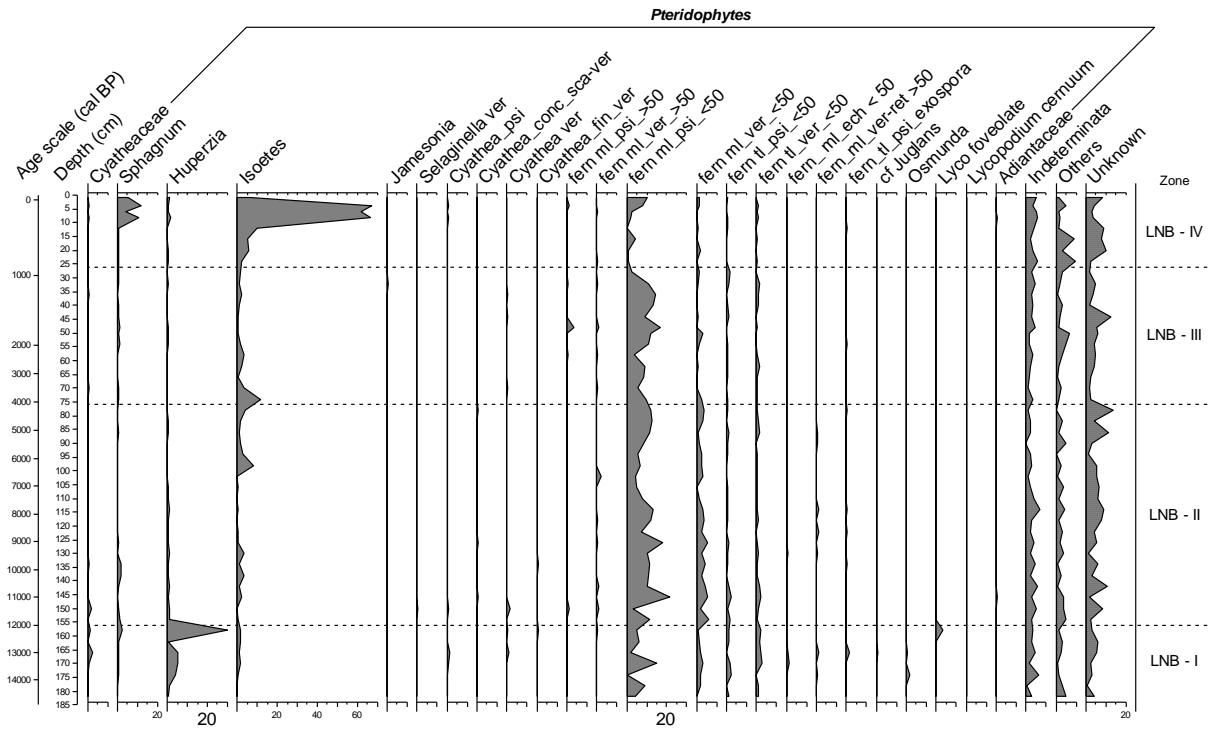


Lagunas Natasas Forest
Percentage Pollen Diagram



Appendix C: Complete pollen and spores diagram for Lagunas Natasas Forest (LNB)

Lagunas Natasas Forest
Percentage Pollen Diagram



CURRICULUM VITAE

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EDUCATION

PhD. Candidate. Department of Palynology and Climate Dynamics, Albrecht-von-Haller-Institute for Plant Sciences, University of Göttingen. May-2012.

Master in Science. International Institute for Aerospace Survey and Earth Sciences (ITC). Rural and Land Ecology. Enschede – The Netherlands. February–1997.

Bachelor degree. Catholic University of Ecuador (PUCE). Biology Department. Quito. June–1991.

COURSES AND SEMINARIES

International Workshop. Ecorregional Vision of Chocó area. Conservation International/WWF. Cali-Colombia. June, August–2001.

Habitat modeling for flora and fauna using Geographical Information System (GIS). US Geological Survey, The Nature Conservancy y EcoCiencia. Quito, July-2002.

Seminar “ Building Biodiversity models to regional level”. Ministry of Public Health and Environment /RIVM – Holland. June–2004.

Colloquium “Tropical Mountain Rainforest in Ecuador”. Göttingen University. May-July/2007.

Palaeoecology and its impact in environment. Göttingen University. July-2007.

37th Annual Conference of the Ecological Society of Germany, Switzerland and Austria (GfÖ) Universidad de Marburg, Germany. September-2007.

Congress “Biodiversity and Sustainable Management of a Megadiverse Mountain Ecosystem in South Ecuador”- DFG-Forschergruppe 816, Loja, Ecuador. 09/2007, 09-11/2008, 10/2009, 11/ 2010.

WORKING EXPERIENCE

2007 – Present days. PhD. Thesis research. Palaeoecological environmental factors reconstruction for the Ecosystems since the Pleistocene in the Podocarpus National Park and the surrounding areas.

2001 – Present days. EcoCiencia. Coordinator and Researcher for of Management Plans for territories of several Indian Communities and Afroecuatorians (Awa, Huaorani, Shuar, Achuar, Shiwiar, Chachi, Afroecuatorians, among others) and for Protected Areas System of Ecuador (Protected Forest Mindo -Nambillo, Ecological Reserve Cayapas Mataje Mangrove, Ecological Reserve Cotacachi Cayapas, Wildlife Refuge of Muisne, among others).

1990-2002. EcoCiencia. Project Coordinator and Researcher for conservation of biological diversity of the different natural protected areas (Yasuní National Park, Cayambe Coca and Cotacachi Cayapas Ecological Reserves). Studies of the biology and ecology of fauna and flora. In the Cotacachi Cayapas Ecological Reserve (RECC) biological monitoring system was implemented to follow up deforestation activities (timber, logging) in the Esmeraldas-Ecuador.

1993-2001. EcoCiencia. Project Investigator. Responsible for generating, handling and evaluating spatial information related with monitoring natural resources and biodiversity using GIS and remote sensing. Modeling of predictive scenarios for flora and fauna species. Planning strategies to contribute to the conservation and handling of nature based on the Land Planning and the sustainable use of the natural resources. Development of social, economic and environmental indicators to implement an integral monitoring system of the environmental partner at national level.

TRAINING

2008-2012. Part time Instructor. Introduction to Palynology and Palaeoecology of Ecuador. Biology Department, Catholic University. Quito, Ecuador

1995-2005. Part time Instructor. Training processes for multidisciplinary group on the use and applications of GIS that allows optimizing their capabilities. Integration of analogical and digital information in a GIS environment for its analysis and implementation. CEPEIGE, San Francisco University, Catholic University. Quito, Ecuador.

2005 – 2009. Part time Teacher for postgraduate modules “Environmental Management”. Polytechnic Army Institute. Quito, Ecuador.

DISTINCTIONS

2010-2012 President of EcoCiencia (Ecuadorian Foundation for Ecological Studies)

2012-2012 Executive Director of EcoCiencia (Ecuadorian Foundation for Ecological Studies)

PUBLICATIONS

- Onofa, M., **Rodríguez, F.**, y Ponce, J. 2012. Avance de los Objetivos de Desarrollo del Milenio en la Amazonía Ecuatoriana. Abya-Yala, EcoCiencia. Quito.

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