Chapter 9

Palynology of some archaeological deposits from Tas-Silġ

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[Final proofs seen by MA, NV and AB]

9.1 Introduction

The Maltese Islands lie in an area of strong Mediterranean climate, so that deposits suitable for the preservation of pollen, such as peat bogs, have never formed. The soils of the islands are alkaline and the seasonal wetting and drying is not conducive to the preservation of pollen. Mollusc shells do survive well in Maltese soils and have provided an important environmental sequence at the Brochtorff Circle at Xagħra on Gozo[1], and another at Tas-Silġ[2], but resolution of these studies is limited by the extreme environmental elasticity of the Maltese land-snail fauna. Until recently, therefore, apart from occasional archaeological pollen analyses[3], there was very limited understanding of Maltese vegetation history. The coastal marine deposits have recently yielded pollen, but the deposits are discontinuous and often poorly dated[4]. In essence, the marine sequences show rapid clearance of what appears to have been pine-cupressaceae woodland some time before 7000 years ago and then a relatively unchanging open landscape with steppic vegetation and cereal cultivation through to the present day. The dating of the marine deposits is, however, rarely exact enough to be able to reliably relate events in the pollen diagrams to Maltese cultural phases. There is, therefore, a need for more chronologically-controlled palynological work, in close proximity to sites of human activity, so that a well-resolved history of human-landscape interaction may be established. This chapter describes and interprets the palynology of selected contexts at Tas-Silġ, as a step towards this aim.

9.2 Materials and methods

The results of two preliminary samples from Tas-Silġ were briefly discussed by Hunt[5], and these results are incorporated in this report. In total, twenty-five samples of sediment from selected stratigraphic units were submitted for analysis. The criteria for selection were that the deposits had to have been rapidly buried, and at excavation showed no signs of bioturbation. It was also important that the material

1 Schembri *et al*. 2009.
2 Fenech and Schembri, this volume.
3 Hunt 2000; Evans 1971. pp. ?
4 Carrol *et al*. submitted; Fenech 2009.
5 Hunt 2000.

was relatively fine-grained. Rapid burial is important since it removes organic matter in the sediment from circulating water and oxygen and thus limits oxidation and biological attack. Stratigraphic units were also selected to provide the maximum stratigraphical coverage corresponding to the periodization scheme for the site[6].

Subsamples of 10 g were weighed out, boiled in 5% potassium hydroxide solution to remove humic substances, sieved on 6 μm nylon mesh to remove fines and solutes, further disaggregated in 5% sodium tetrapyrophosphate solution to remove clays, decalcified in 5% hydrochloric acid to remove calcite, then swirled on a clock-glass to remove silt and sand. The remaining organic concentrate was stained with safranin and mounted for microscopic examination in glycerine jelly. Palynofacies counts of 200-400 fragments of particulate organic matter were made using the conventions of Hunt and Coles[7] and all pollen present in each sample was counted. There was sufficient particulate organic matter in all samples for a palynofacies diagram to be produced, but only fifteen samples contained sufficient pollen to justify inclusion in a pollen diagram. The complete results of the pollen analysis are shown in **Table 9.1**.

9.3 Palynofacies analysis

The palynofacies analysis is shown in **Fig. 9.1**. All of the samples but one are dominated by thermally mature material (10.3-92.9%), which has been darkened by charring, rather in the same way as bread darkens when it is toasted. The term 'microcharcoal' is not used here because geological processes of burial and slight metamorphism can cause thermal maturity, and material of this type is abundant in the Blue Clay Formation on Malta. Most thermally mature material showed structures produced by fires, but some fragments were structureless and a few showed an amorphous texture. Thermally mature amorphous matter seems to be formed by the charring of amorphous organic matter in soil profiles underneath fires. Dark spherules, which can be formed during high-temperature burning of resinous or oily material, for instance during the kilning of pottery, are present in one stratigraphic unit of the Tarxien phase and two of the Borġ in-Nadur phase.

Plant cell walls and cuticle are relatively common in most samples (1.8-56.0%). This material shows cellular structure and/or stomata, sieve-plates, and tracheids, is likely to be mostly cellulosic and derived from partially-decayed plant stems, leaves and roots. Much shows the characteristic morphology of monocotyledonous plants and is likely to be derived from grasses or cereals.

Material of fungal origin is widely distributed. This includes fungal hyphae and spores and a variety of specialised organs distinctive of soils, such as fungal

[6] Vella *et al*. this volume (§3.3).
[7] Hunt and Coles 1988.

zoospores and vesicular arbuscular miccorhyzae (VAMs), which are fungal symbionts on plant roots. The *incertae sedis Concentricystes* is also possibly of fungal origin, on consideration of its staining characteristics and pattern of occurrence.

There are also rare occurrences of a number of freshwater microfossils such as Peridinioid dinoflagellate cysts, the algae *Botryococcus*, *Zygnema* and *Spirogyra*, poorly-preserved siliceous pennate diatom frustules and scleres of the freshwater sponge *Spongilla*. These probably reflect seasonal pools or puddles. Occasional marine plankton such as cysts of the dinoflagellate *Brigantedinium* sp., the chlorophycean *Tasmanites* and test-linings of foraminifera may be expected given the coastal location of the site.

There is very little systematic change through the phases represented at Tas-Silġ, but some trends can be identified. The Early Tarxien phase in Area A is characterised by the presence of relatively diverse algal microfloras including the planktonic *Botryococcus, Sigmopollis*, Type 114, and the benthonic *Spirogyra, Zygnema*, *Penium,* and pennate diatoms. *Spongilla* is also benthonic. The variety of algae is suggestive of relatively long-lived pools of fairly oligotropic (low in nutrients) water, probably persisting for several months at the least and this is consistent with the generally waterlain aspect of these layers. *Trichurus* eggs are present in one sample. These are gut parasites and the eggs are passed in faeces. The presence of marine indicators only in these layers is perhaps indicative of the coast at this stage being relatively close. Marine plankton will occasionally be thrown into the air by breaking storm waves and can be blown several kilometres inland with suitable onshore winds. Soil-derived microfossils such as the VAMs are most probably consistent with soil erosion or the redeposition of soils since the stratification in these layers is distinct and not disturbed by plant roots. The strong representation of thermally mature material in this phase points to nearby persistent burning. Whether this is domestic or from the temple is uncertain.

Algae cease to be present in the main Tarxien phase, but several samples are characterised by high percentages (up to 40%) of plant cell walls and cuticle. Pollen in these samples is relatively well-preserved and common and it is therefore suggested that these layers were deposited and covered very rapidly, possibly incorporating plants as well as relocated soil. This is consistent with the archaeological interpretation of these being preparation layers and being sealed with a plaster floor[8].

The Borġ in-Nadur phase layers in Area C look rather similar in the palynofacies diagram to the Tarxien phase, but there are some considerable differences. The thermally mature material is often subrounded, suggesting that it has been derived

[8] See Vella *et al*. this volume (§3.4.1.2.1).

from earlier deposits rather than being freshly generated at this time, so this may be a period of relatively low human activity on this part of the site. Fungal material and insect fragments are fairly common, and pollen and plant cell walls and cuticle in these layers are rather poorly preserved, all suggesting that soil-formation processes were operating. Peridinioid cysts are present, consistent with occasional rather ephemeral and probably very eutrophic pools of water.

There is one sample of Punic age from Area C. This is rather similar in all respects to the Borġ in-Nadur phase contexts, with rounded thermally mature material, poorly-preserved pollen and abundant fungal material. This again suggests derivation of the soil from elsewhere and relatively low levels of human activity.

The Hellenistic/Roman contexts from Area B contain fresh-looking thermally mature material, plant cell walls and cuticle, and pollen is sometimes very well preserved. Fungal spores are relatively common, suggesting the presence of decaying organic matter. This is most consistent with these being midden deposits[9].

Finally, the single sample of Late Roman age is extremely rich (43.6%) in plant cell walls and cuticle, and in fungal remains, particularly fungal hyphae (27.5) and VAMs (14.9). Pollen is poorly preserved. The excavation report suggests that this is midden material and the very high percentage for fungal hyphae is consistent with the presence of abundant decaying organic matter. Later soil formation processes are suggested by the VAMs and poor pollen preservation.

9.4 Pollen analysis

Results of pollen analysis are shown in **Fig. 9.2**. Histogram bars are shown as hollow where a species was noted to be in tetrads or aggregates in a sample. There are several possible explanations for pollen being in tetrads or aggregates. First, with cereals, which are self-fertile, the pollen occurs in tetrads where it was retained in the husk. Second, if flowers are incorporated into a deposit, then immature pollen often occurs in tetrads. Third, ground-nesting bees will sometimes make aggregates of pollen and place them in their nest. The indeterminate pollen is largely immature and, therefore, difficult to characterise taxonomically.

9.4.1 Early Tarxien phase

The Early Tarxien phase is characterised by abundant Lactucae (8.6-40%), fairly abundant *Pinus* (4.5-19%), *Bellis* type (1.6-15%), Cereal (1.6-11.3%), Poaceae (3.1-8.4%) and some *Juniperus/Tetraclinis* (1.7-4.8%) and *Pistacia* (1.6-3.4%). *Cistus,* Myrtaceae and a fairly wide variety of herbaceous taxa are present, including *Asphodelus*, *Aster* type, *Bidens* type, *Carduus* type, *Centaurea nigra* type, Chenopodiaceae, *Malva*, Bryophyta, *Hupzeria*, *Polypodium* and Pteropsida. Lower plants are diverse and

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[9] See Vella *et al*. this volume (§3.4.4).

relatively common at this time, with *Botrychium*, Bryophyta, *Hupzeria*, Musci, *Osmunda*, *Polypodium*, *Pteris* and Pteropsida all represented.

The Early Tarxien phase assemblages are similar to assemblages of this approximate date at Salina Bay[10]. It is likely that there was some residual pine-juniper woodland with a diverse fern-rich understorey, pistachio-cistus scrub, and areas of grassy steppe, rather degraded in places with asphodels, mallows and thistles. Cereals were cultivated and the high percentages may be consistent with local threshing, since cereals retain their pollen within the husk. Taxa such as Bryophyta (liverworts), *Hupzeria* (clubmoss) and Musci (mosses) point to the local availability of perennially-damp shaded environments nearby and *Typha* is typical of freshwater marsh.

9.4.2 Tarxien phase

The Tarxien phase is characterised by abundant Lactucae (19.5-42%), *Bellis* type (9.9-29%) and *Pinus* (1.9-28%), some *Aster* type (0.6-4%), Cereal (0.9-9.5%), *Malva* (0.6-4.1%) and Poaceae (1.5-4%). *Berberis*, Chenopodiaceae, *Sedum*, *Artemisia* and *Onionis* type are sometimes common but are not present in every sample.

There are distinct changes between the Early Tarxien and the later Tarxien phase layers. Part of this is undoubtedly taphonomic, with *Berberis, Artemisia, Bellis, Sedum* Cereal, Lactucae and Indeterminate pollen present in tetrads or larger aggregates in some samples. It was suggested above on grounds of palynofacies that these make-up layers may have incorporated plants and the presence of large numbers of pollen in tetrads or larger aggregates is consistent with this, particularly because the indeterminate pollen is immature and therefore unlikely to have been transported by ground-nesting bees. Considering these taxa, the environment that this material was derived from and/or dumped in was almost certainly covered with rather weedy vegetation, perhaps with episodic cereal cultivation. There are also some wider inferences that can be drawn about the regional vegetation. The decline in *Pinus, Pistacia, Juniperus/Tetraclinis,* and Poaceae, appearance of *Berberis, Hippophae, Tamarix, Mentha* type (includes thyme) and *Potentilla,* the rise of Asteraceae and the continued occurrence of *Cistus, Asphodelus, Sedum, Valeriana,* is consistent with the continued opening up and drying of the landscape and the spread of degraded steppe and garrigue habitats.

9.4.3 Borġ in-Nadur phase

The Borġ in-Nadur phase layers are characterised by high Lactucae (12.3-33.3%), *Bellis* type (0-33.3%), *Bidens* type (0-19.2%), with some *Pinus* (0-10.7%), *Aster* type (0-5.8%), *Carduus* type (0-10.5%), *Carlina* type (0-5.3%), *Centaurea nigra* type (0-14.3%), Cereal (0-15.8%), *Malva* (0-10%), Poaceae (0-3.8%), Bryophyta (0-10%) and *Hupzeria* (0-7.1%).

[10] Carroll *et al*. submitted.

These samples again are likely to be derived from dumped deposits or from material arriving by wash or shallow mudflow. The presence of tetrads or larger aggregates of pollen of *Bidens* type, *Centaurea nigra* type, Cereal, Lactucae and indeterminate juvenile pollen suggests that plants were again incorporated within the accumulating material. The taxa concerned are consistent with weedy vegetation and cereal cultivation, so the soil was probably either derived from an arable field or dumped in an area where cereals were cultivated. The very low percentages for trees and shrubs and continued rise in Asteraceae (*Artemisia*, *Aster*, *Bellis*, *Bidens*, *Carduus*, *Carlina, Centaurea* types) and Lactucae and continued presence of *Malva*, point to a rather degraded and weedy landscape. It is difficult to be sure whether this is a reliable environmental signal since nearly all the taxa present all produce highly corrosion-resistant pollen. If it is a reliable signal, it may point to a weedy and degraded local environment. Although there is little resolution in the Marsa core at this point, the Salina Bay core shows a stable agricultural landscape through the Neolithic and Bronze Age with little evidence of landscape degradation (Carroll et al. submitted)[11]. One very interesting signal in the Borg in-Nadur layers is given by the lower plant spores. The presence of *Hupzeria, Polypodium, Sphagnum,* Pteropsida and Bryophyta is consistent with the development of a shaded, rather moist habitat, suggesting perhaps a seep of ground-water amongst ruins.

9.4.4 Punic period

The pollen of the Punic layer is essentially very similar to that in the Borġ in-Nadur layers with high Lactucae, a wide variety of Asteraceae, some *Malva*, Poaceae, Cereal and a variety of lower plant spores. This suggests a continuation of the conditions suggested above for the Borġ in-Nadur layers.

9.4.5 Hellenistic/Roman period

Only one of the samples from the Hellenistic/Roman layer produced sufficient pollen for inclusion in the pollen diagram. This is characterised by high *Pinus* (18.5%), *Bellis* type (13.1%), Lactucae (13.1%), some *Arabis* type (8.4%), *Bidens* type (5.7%) and *Sinapis* type (8.4%), with a little Chenopodiaceae (2.7%), Cereal (1.3%), Poaceae (1.7%) and other herbaceous taxa. One surprise in this layer was the finding of *Nuphar* (1.3%). A pollen grain of *Nuphar* from the layer is illustrated in **Fig. 9.3**.

Tetrads or larger aggregates of *Arabis*, *Bellis* type, Chenopodiaceae, Lactucae and indeterminate immature pollen were found in this layer, suggesting the incorporation of plants within the accumulating midden material, probably because they were growing on the dumped material and then covered by the arrival of new waste material. The abundant *Pinus* in this layer might reflect local pine trees, but it is possible that it is instead long-distance transported and a reflection of very low

[11] Carroll *et al*. submitted.

pollen productivity locally. *Pinus* is low in the Marsa core at this time so the latter possibility is likely[12]. This layer shows cereal pollen and a diverse weed flora and it can be suggested that cereal cultivation was occurring in the landscape around the site. The decline of the lower plants in this layer suggests that the shady, water-rich habitat present locally during the Bronze Age and the Punic period had vanished. *Nuphar* is a water-lily not to be expected on a dry hilltop in Malta and is not a native plant, but its pollen is very distinctive.

9.4.6 Late Roman period

The Late Roman layer is highly dominated by Lactucae (62%), with *Pinus* (12.1%), Juniperus/Tetraclinis (1.1%), Poaceae (7.5%), *Bellis* type (5.7%), Cereal (1.1%) and a variety of other herbaceous pollen types. There are no lower plants. *Olea* and *Juglans* are present.

The very abundant Lactucae and abundant *Pinus* are most probably taphonomic, and while the former might reflect bee nesting, it is most likely that both have been differentially preserved because they are highly resistant to corrosion and microbial attack[13]. The assemblage otherwise reflects a predominantly open landscape with grassy steppe, some areas of cereal cultivation and perhaps a little juniper scrub. It is probable that olives were cultivated – the pollen appears relatively early in the Marsa core[14]. *Juglans* first occurs close to a date of ca. 500 BC in the Marsa core, but had vanished by the Late Roman period.

9.5 Discussion

The sequence at Tas-Silġ is of considerable importance for Maltese archaeology because it is stratigraphically highly resolved and provides evidence, albeit highly discontinuous, for the evolution of a Maltese landscape over a period of nearly 4000 years. The changing nature of the depositional environment had a major influence on the scale of the botanical and cultural landscape that can be perceived at any point – it is particularly restricted in the Tarxien, Borġ in-Nadur, Punic and Hellenistic/Roman phases, where the taphonomic signals suggest that much of the pollen is derived from plants buried by the arrival at the site of soil, whether arriving by anthropogenic means as in the Tarxien and Hellenistic/Roman phases or by natural processes as in the Borġ in-Nadur and Punic phases.

In spite of the taphonomic imprints, the evolution of the Maltese landscape can still be seen. Thus, the Early Tarxien phase saw the survival of remanié pine-juniper-pistachio woodland and scrub, which was gone locally by early in the Tarxien phase. The Early Tarxien phase steppe vegetation was relatively biodiverse and rich in grasses and sedges, although degraded areas, with asphodels and various

[12] Carroll *et al*. submitted.
[13] Havinga 1984.
[14] Carroll *et al*. submitted.

Asteraceae, were present. Cereal cultivation and processing occurred locally. During the later part of the Tarxien phase, this steppe landscape became more degraded and perhaps drier in aspect. The Borġ in-Nadur phase saw a change in the Asteraceae, with a relative decline in *Bellis*-type and a rise in *Aster*, *Carduus*, *Carlina* and *Centaurea nigra* types. *Malva* also rises at this point and it may be suggested that these changes reflect an even more open and xerophytic aspect to the landscape and perhaps, given that several of these herbs are rather spiky, fairly intensive grazing. The high percentages of cereal pollen make it unlikely that the area was abandoned. The Hellenistic/Roman period is marked by a rise in *Pinus* and the reappearance of *Juniperus*/*Tetraclinis* and it is possible that woodland regenerated at this time. There is, however, little trace of this in the Marsa core[15]. In the Late Roman period, *Pinus* remains high, *Juniperus*/*Teraclinis* is still present and grasses expand while cereal pollen declines. Al-Himyari wrote about the quality of Maltese juniper in the Arab period[16] and it is conceivable that in the Late Roman period the relaxation in trade and population decline caused a decline in arable activity and grazing pressure which was already leading to the spread of trees and shrubs and the recovery of vegetation.

In addition to the vegetational history, the site has, somewhat surprisingly, provided indications of a local history of water. This is manifest in the algae and the aquatics and lower plants. The Early Tarxien phase sediments were waterlain and the diverse algal flora and *Spongilla* scleres points to a semi-permanent pool, presumably fed by a seep of groundwater. Spores of a variety of lower plants are present in the Early Tarxien phase, consistent with the occurrence of shaded, relatively damp habitats. The later Tarxien phase assemblages contain few lower plants, perhaps consistent with the relative drying of the environs of the site, but there is a strong rise in *Hupzeria*, Bryophyta and Pteropsida in the Borġ in-Nadur phase suggesting the return of humid conditions. These appear to persist through the Punic period.
The occurrence of the waterlily *Nuphar* in Hellenistic/Roman times suggests a permanent pool might have been built and that the seep water had been diverted into it. The waterlilies must have been imported. It is possible that this pool was an important component of the ritual aspect of the site at this time. All trace of damp habitats had vanished by Late Roman times in spite of a general rise in precipitation in the Central Mediterranean countries after 430 AD[17]. It may be hypothesised that with the spread of Christianity during the Roman period, any groundwater was diverted into irrigated agriculture.

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[15] Carroll *et al*. submitted.
[16] Brincat 1995.
[17] Marquer *et al*. 2008.

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Captions to figures

Fig. 9.1. Palynofacies diagram from Tas-Silġ.

Fig. 9.2. Pollen diagram from Tas-Silg. Where tetrads or larger aggregates of pollen of a species were encountered in a sample, the histogram boxes for those taxa are unfilled.

Fig. 9.3. A pollen grain of *Nuphar* from the Hellenistic levels at Tas-Silġ.

Table 9.1. The raw pollen counts from Tas Silg.

Rosaceae	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Tamarix	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Corylus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Juglans	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Ephedra	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Sphagnum	0	0	0	0	0	0	0	0	0	0	0	0	0	4	1	0	0	0	0	0	0	0	0	0
Cyperaceae	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0
Ostrya	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1
Sinapis type	0	0	0	0	0	0	0	0	0	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cannabis type	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nuphar	0	0	0	0	0	0	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mentha type	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Alnus	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Geranium	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Musci	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Betula	1	2	0	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Linum	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Carlina type	0	0	0	0	1	0	0	0	0	0	0	0	0	2	0	1	1	2	0	0	0	3	0	0
Spergula type	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Arabis	0	2	0	0	1	0	0	0	0	25	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Poterium	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ericales	1	0	0	0	1	0	0	0	0	1	0	0	0	2	1	0	0	1	0	0	0	0	0	0
Quercus	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Hippophae	0	0	0	0	3	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Botrychium	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Onionis	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Potentilla	1	0	0	0	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Umbelliferae	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Olea	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Sedum	0	1	0	0	4	27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Berberis	0	0	0	0	0	14	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tamarix	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Caryophyllaceae	0	0	0	0	1	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Mentha type	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bryophyte	1	3	0	0	1	0	1	1	0	0	0	0	0	0	3	0	1	2	0	0	0	0	0	0
Ranunculus	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Serratula	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Fraxinus	1	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pteris	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Typha	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polypodium	0	1	0	0	0	0	1	0	0	1	0	0	0	2	1	0	0	0	0	0	0	0	0	0
Chenopodiaceae	3	1	0	0	38	15	1	0	0	8	0	0	0	1	0	0	0	0	0	0	0	0	0	2
Pteridium	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Liliaceae retic	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Malva	1	3	1	0	9	5	5	0	0	1	0	0	0	1	3	1	0	2	0	0	0	5	0	0
Myrtaceae	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Osmunda	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Papaver	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Artemisia	12	0	0	0	0	16	2	0	0	4	0	0	0	0	0	1	0	0	0	0	0	0	0	2
Pistacia	0	0	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Plantago	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Carduus	0	0	0	0	7	3	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	6	0	5
Valerianella	1	0	0	0	3	2	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Indet	11	0	0	0	0	8	5	0	0	54	0	0	0	0	0	0	18	0	0	0	0	0	0	0
Bellis type	49	9	7	0	45	26	21	1	0	39	8	0	0	6	0	4	2	1	1	0	0	19	0	16
Pteropsida	0	1	0	0	0	0	0	1	0	1	0	0	0	2	0	1	1	2	0	0	0	0	0	0
Cistus	0	0	0	0	1	0	0	1	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polypodium	0	0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Asphodelus	1	1	0	0	2	1	10	1	1	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Carduus	0	0	0	0	0	0	0	3	0	0	0	0	0	1	0	0	0	3	0	1	0	0	1	0
Hupzeria	4	1	0	0	4	4	8	1	0	0	0	0	0	4	2	2	3	3	0	0	0	0	0	0
Pistacia	1	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cyperaceae	0	1	0	0	2	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Bidens	6	6	0	0	7	3	4	1	0	17	0	0	0	0	2	0	10	1	0	0	0	1	0	5
Aster	1	0	1	0	3	5	7	1	0	3	0	0	0	2	1	1	3	1	0	1	0	0	0	3
Centaurea	0	1	0	0	4	1	3	3	0	0	0	0	0	0	0	0	0	6	0	0	0	7	0	0
Armeria	2	0	0	0	4	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cereal	16	1	1	0	2	1	17	7	0	4	1	0	0	3	1	3	0	5	0	0	0	9	0	3
Pinus	12	11	7	0	10	5	9	4	0	55	1	0	0	1	1	3	0	2	0	0	0	0	0	34
Juniperus	1	1	0	0	0	0	1	3	0	1	0	0	0	0	0	1	0	0	0	1	0	0	0	3
Poaceae	5	2	1	0	5	4	11	5	0	5	1	0	0	3	0	1	2	1	0	0	0	0	0	21
Lactucae	33	5	5	0	52	110	72	25	0	39	0	0	0	13	13	8	9	10	0	1	0	7	5	174
Layer	371	372	412	426	460	463	464	473	481	1056	1057	1060	1061	2156	2159	2165	2166	2167	2169	2175	2177	2178	2179	034