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NOTES

CAN PALYNOLOGY CONTRIBUTE TO PLANT DIVERSITY CONSERVATION ACTIVITIES? THE WETLAND PLANTS IN SOUTHERN PO PLAIN AS A CASE STUDY

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Abstract – The vegetation of the Po Plain has long been modified by natural and human factors. The present plant landscape is almost entirely anthropogenic. Many hydro-hygrophilous species, quite common until a few decades ago, are now very rare and in danger of extinction, so conservation programmes are necessary for their protection and maintenance. It is known that the former vegetation can be reconstructed thanks to palynological data, but assessing the real presence of a given species is not always possible. This work aims to understand whether palynology can give information about the presence and identification of hydro-hygrophilous species, supporting the classical flora analyses commonly conducted on herbarium data. In some cases, these species are well characterized from a morphopalynological and phytogeographical viewpoint: the plant occurrence may be suggested even by pollen findings in surface-samples. Discovering the presence of some of these species by pollen morphotypes offers a real opportunity to gear the reintroduction/reinforcing programmes, but ecological analysis will obviously be essential to ascertain the real suitability of the chosen sites, according to the ecological requirements of the species. Our analysis refers to wetlands of the southern Po plain within the Modena Province, where detailed palynological data about present and historical local flora were available.

Keywords: Palynology, wetlands, Po plain, Emilia-Romagna, plant conservation

Introduction

The Emilia-Romagna plain is an alluvial lowland and its current plant landscape is almost completely anthropogenic. In a patchwork of urban areas, farmland and industrialized zones are progressively encroaching on the remnants of spontaneous vegetation (Accorsi et al., 2004). The agricultural and industrial development of the Po Plain has led to the disappearance of many marsh and forest areas, leaving a landscape with a few relatively natural surviving parts in a matrix highly transformed by man (Pignatti & Trezza, 2000; Santini et al., 2009; Dallai et al., 2011).
Archaeobotanical studies on seeds and fruits have notably contributed to the understanding of flora composition and environmental dynamics of wet habitats in Emilia-Romagna (Bosi, 2000; Bandini Mazzanti et al., 2001; Bosi et al., 2004; Bandini Mazzanti et al., 2005; Bandini Mazzanti et al., 2009; Bosi et al., 2010; Rinaldi, 2010; Rinaldi et al., infra).
According to palynological data, it could be inferred that, since the Boreal, the vegetation of the Emilia-Romagna plain has belonged mainly to the Middle European vegetation belt *sensu* Pignatti (1979), but also to communities currently growing in higher-altitude vegetation belts (e.g. the Subatlantic) and belonging to associations of the *Fagion* alliance, present in the plain (Accorsi et al., 2004).
Given the improvement of the climate, the hydro-hygrophilous species most dependant on the calcareous and alluvial soils of the Po Plain could not find refuge in the hills or mountains, so they were confined to swampy or periodically flooded zones. Hydrophytes like *Nymphaea alba* L., *Nuphar lutea* L., *Hydrocharis morsus-ranae* L., *Marsilea quadrifolia* L. and river corridor plants such as *Nymphoides peltata* (Gmélin) Kuntze, *Viola pumila* Chaix, *Viola elatior* Fries, *Jacobaea paludosa* (L.) Gaertn., Mey *et* Scherb. ssp.

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angustifolia (Holub) Nord. *et* Greuter, *Euphorbia palustris* L., with a Eurasian or Eurosibiric distribution, typical of climates colder than the present one in the Po Plain, must have occupied quite extended habitats, particularly in the low plain areas where rivers could easily form swamps and the climate tended to be more clearly continental, due to scarce atmospheric circulation.

Some of the current vegetation series, such as *Quercetalia pubescenti-petreae* and *Salicion eleagni*, *Salicion albae* and *Alnion incanae* (Puppi et al., 2010), could include the main coenoses of the pollen assemblages recorded from the Boreal onwards, such as *Quercetum carpinetum boreoitalicum* Pignatti 1952-53, which was indicated as the "palaeoclimax of the Po Plain from the Boreal-Atlantic" (Bertolani Marchetti, 1969-70). Its origin was probably in the Boreal, when *Carpinus* had its peak and *Quercus*, though not at its peak, was abundant and widespread (Accorsi et al., 2004). Subsequent modifications of the landscape are due to human impact, especially in the late Holocene: the reduction of natural woodland vegetation is evident from the mid- and mainly late Holocene. Human activities determined the substitution of former arboreal vegetation with crops, pastures or protected plants and managed woods such as chestnut or pine woods, orchards or olive groves. Therefore, the evolution of the landscape in the Po Plain through the thinning and management of oak woods became unquestionably evident at around 3600 cal. yrs B.P. (Mercuri et al., 2012), as also demonstrated by the *Olea-Juglans-Castanea* curve in pollen spectra, that rises fairly suddenly from the Bronze Age onwards, in the Italian peninsula (Mercuri et al., 2013).

Palaeoecological data provide a picture of potential regional biodiversity and constitute a sound baseline for preserving or restoring wetland plant communities (Muller et al., 2011). Recent methodological developments and conceptual advances in Quaternary paleo-ecology can address specific ecological and environmental questions over the past 100-200 years, the time span of primary interest for nature conservationists (Birks, 1996). In fact, the aim of restoration measures, in most cases, is not to recreate static landscapes or woodlands that existed under natural conditions, but restoring the elements of the cultural landscape that are of most benefit to a range of flora and fauna (Brown, 2010). Palaeoecology is becoming an important and necessary discipline needed to properly understand subjacent ecological processes useful for management purposes. However, the lack of synergy between palaeoecologists, neoecologists, anthropologists and conservation scientists is still a handicap (Vegas-Villarúbia et al., 2011).

In this paper, a list of the threatened species, which are present now or in past times in the low plain of the province of Modena, is presented. These species, quite common until a few decades ago, are now rare and conservation programmes are necessary for their protection and maintenance.

Conservation problems of hydro-hygrophilous species

Man's activities have caused a progressive decrease and fragmentation of areas suitable for the above-mentioned hydro-hygrophilous species, confining them to marginal zones and greatly reducing their populations, with an obvious, irreversible loss of the phytogenetic features developed *in loco* (Ferrari, 2010). In the few sites still existing, where the ecological conditions are quite similar to those in the past, some of these Central European species may have found their refuge areas.

In general, hydro-hygrophilous species are now threatened by pollution, widespread water eutrophication, invasive herbivorous species (e.g. *Procambarus clarkii* Girard, *Myocastor coypus* Molina) whose containment is often ineffective. In addition, artificial reshaping of the banks of rivers and canals causes severe reduction of transitional habitats between permanently wet zones and temporarily submerged zones (Alessandrini, 2003), so the biological richness typical of these ecoclines has been lost (Ferrari, 2010). Over the past few years, intense ongoing urban development in the low plain has led to a further decline of water quality and to problems of hydraulic safety, given soil impermeability and documented alterations of annual precipitation. All these factors have induced a drastic, serious decrease of many hydrophytes, which were quite widespread until the late 1990s.

Even if the restoration of disappeared habitats or the reintroduction of locally extinct species raises a number of ethical questions, these measures would obviously allow increasing biodiversity and balance the worldwide homogenisation of biological communities resulting from human interventions (Muller et al., 2011).

Materials and methods

The analysis of the protected flora has been conducted basing on the Flora of Modena (Alessandrini et al., 2010), only focusing on the hydro-hygrophilous species; then a critical analysis on the identification level (species/type) by palynological investigations has been conducted on account of the available literature and geographic distribution. A table of the threatened plants, protected at European, national or regional level and present in the flora of the province of

Modena (Alessandrini et al., 2010), has been prepared, showing the possible identification of the pollen grains at species or type level.

The pollen of some species, now interested by conservation programmes at the Botanical Garden of Modena, has been studied by acetolysis (Erdtmann, 1960), observing the pollen grains at a Diaplan Leitz light microscope (1000 magnifications) and measuring polar axe, equatorial diameter and esine thickness. The photographs of the pollen grains have been taken at a Diaplan Leitz light microscope at 1000 magnifications, using a Nikon Coolpix 4500 digital camera.

Results and discussion

The threatened species which are linked to wet habitats in our study area are listed in Table 1.

Morphological pollen features of some species, whose ecology is peculiar and can give important information on the protection of wetland habitats, are considered in detail (Fig. 1-2-3).

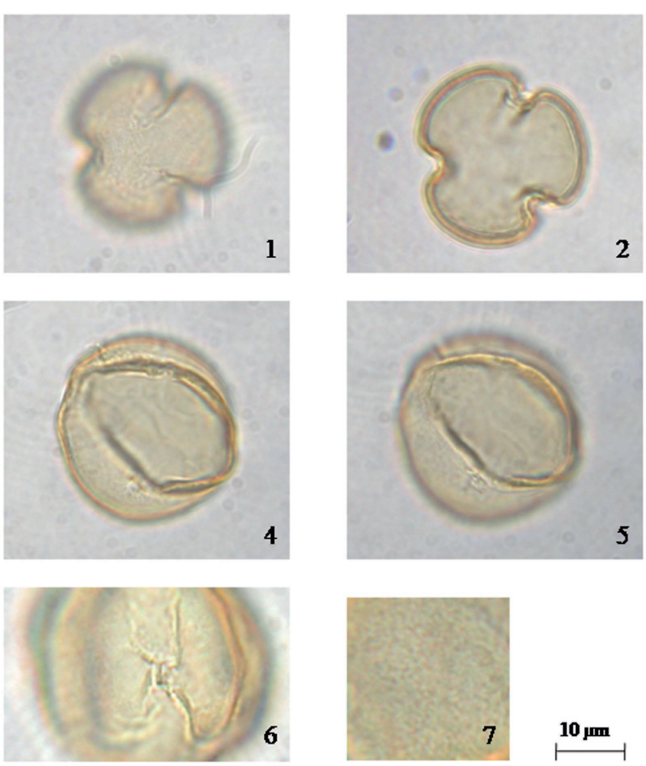

Fig. 1. Pollen grains of *Viola pumila*. 1-2: polar vision at different focuses; 3-4: equatorial vision at different focuses; 5: detail of the colporus; 6: exine.

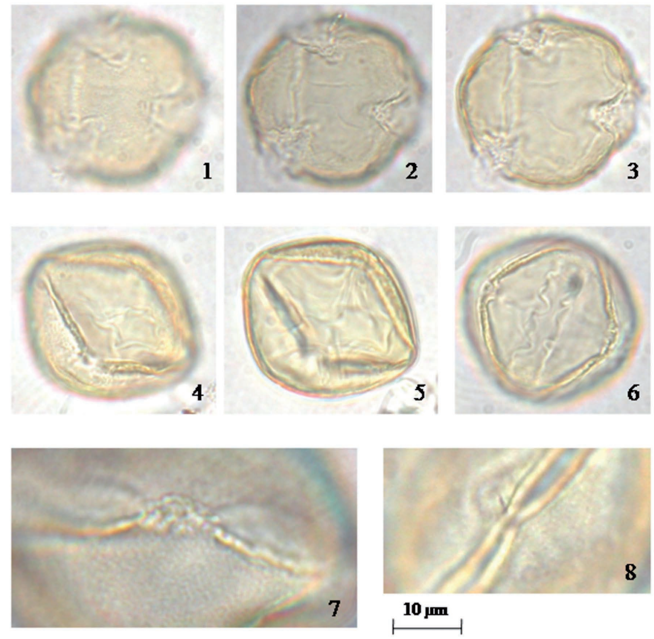

Fig. 2. Pollen grains of *Viola elatior*. 1-3: polar vision at different focuses; 4-6: equatorial vision at different focuses; 7-8: details of the colporus.

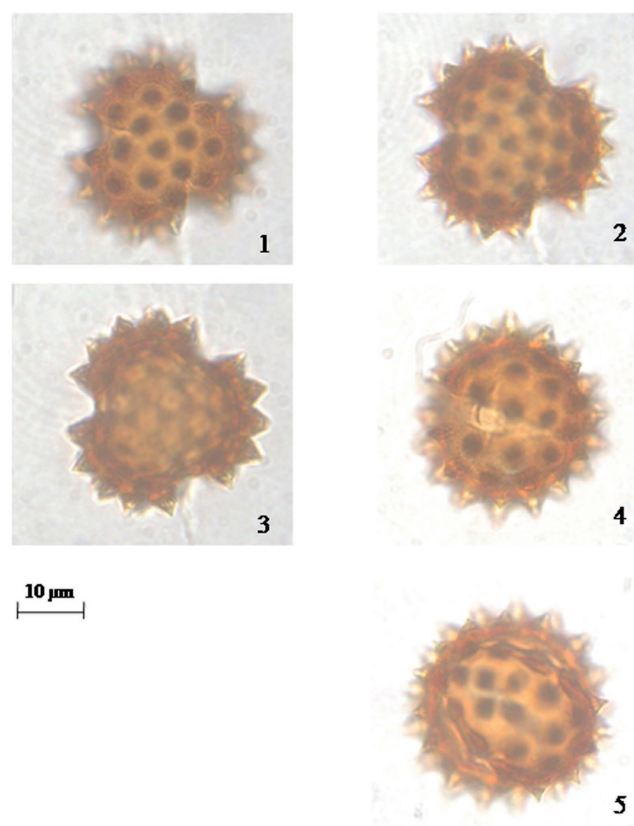

Fig. 3. Pollen grains of *Jacobaea paludosa* ssp. *angustifolia*. 1-3: polar vision at different focuses; 4-5: equatorial vision at different focuses.

Table 1. The protected plant species of the Modena province. The European, national or regional level is detailed (Alessandrini et al., 2010). The identification based on palynological features is at species level (■).

Scientific name	Biological Form	Chorology	Identification at species level	Convention CITES	Convention of Berna
Part A					
Allium angulosum L.	G BULB	EUROSIB.	.	.	.
Alopecurus geniculatus L.	H CAESP	SUBCOSMOP.	.	.	.
Alopecurus rendlei Eig	T SCAP	EURIMEDIT.	.	.	.
Baldellia ranunculoides (L.) Parl.	I RAD	STENOMEDIT.-ATL.	.	.	.
Butomus umbellatus L.	I RAD	EURASIAN	■	.	.
Callitriche palustris L.	I RAD	CIRCUMBOR.	.	.	.
Callitriche stagnalis Scop.	I RAD	EURASIAN	.	.	.
Cardamine matthioli Moretti	H SCAP	OROPH. S-EUROP.	.	.	.
Carex pseudocyperus L.	H CAESP	SUBCOSMOP.	.	.	.
Ceratophyllum demersum L.	I RAD	SUBCOSMOP.	.	.	.
Ceratophyllum submersum L.	I RAD	PALAEOTEMP.	.	.	.
Cirsium canum (L.) All.	G RHIZ	SE-EUROP.	.	.	.
Eleocharis uniglumis (Link) Schultes	G RHIZ	SUBCOSMOP.	.	.	.
Gaudinia fragilis (L.) Beauv.	T SCAP	EURIMEDIT.	.	.	.
Gymnadenia conopsea (L.) R. Br.	G BULB	EURASIAN	.	App. II	.
Hippuris vulgaris L.	I RAD	COSMOPOL.	■	.	.
Hottonia palustris L.	I RAD	EUROSIB.	■	.	.
Hydrocharis morsus-ranae L.	I RAD	EURASIAN	■	.	.
Jacobaea paludosa (L.) Gaertn, Mey *et* Scherb. ssp. a*ngustifolia* (Holub) Nord. *et* Greuter	HE	EUROSIB.	.	.	.
Juncus subnodulosus Schrank	G RHIZ	EUROP.-CAUCAS.	.	.	.
Lemna trisulca L.	I NAT	COSMOPOL.	.	.	.
Leonurus marrubiastrum L.	H BIENNE	S-EUROP.-S-SIB.	.	.	.
Leucojum aestivum L.	G BULB	EUROP.-CAUCAS.	.	.	.
Listera ovata (L.) R. Br.	G RHIZ	EURASIAN	.	App. II	.
Lotus tenuis W. *et* K.	H SCAP	PALAEOTEMP.	.	.	.
Ludwigia palustris (L.) Elliott	T REPT	SUBCOSMOP.	■	.	.
Lythrum hyssopifolia L.	T SCAP	SUBCOSMOP.	.	.	.
Marsilea quadrifolia L.	I RAD	CIRCUMBOR.	.	.	All. I
Myriophyllum verticillatum L.	I RAD	CIRCUMBOR.	■	.	.
Najas marina L.	I RAD	COSMOPOL.	.	.	.
Najas minor All.	I RAD	PALAEOTEMP.-SUBTROP.	.	.	.
Nuphar lutea (L.) S. *et* S.	I RAD	EURASIAN	.	.	.
Nymphaea alba L.	I RAD	EURASIAN	.	.	.
Nymphoides peltata (Gmélin) O. Kuntze	I RAD	EURASIAN	■	.	.
Oenanthe aquatica (L.) Poiret	H SCAP	EURASIAN	.	.	.
Oenanthe silaifolia Bieb.	H SCAP	EURIMEDIT.-SUBATL.	.	.	.
Peucedanum palustre (L.) Moench	H SCAP	EUROSIB.	.	.	.
Ranunculus peltatus Schrank	I RAD	EUROP.	.	.	.
Sagittaria sagittaefolia L.	I RAD	EURASIAN	.	.	.
Salvinia natans (L.) All.	I NAT	EURAS.-TEMPER.	.	.	All. I
Samolus valerandi L.	H CAESP	COSMOPOL.	.	.	.
Schoenoplectus mucronatus (L.) Palla	HE	PANTROP.	.	.	.
Schoenoplectus pungens (Vahl) Palla	G RHIZ	SUBCOSMOP.	.	.	.
Spiranthes aestivalis (Lam.) L.C. Rich.	G RHIZ	EURIMEDIT.-SUBATL.	.	App. II	All. I
Spirodela polyrrhiza (L.) Schleid.	I NAT	SUBCOSMOP.	.	.	.
Trapa natans L.	I NAT	PALAEOTEMP.	■	.	All. I
Typha laxmannii Lepechin	G RHIZ	E-EURIMEDIT.	.	.	.
Typha minima Hoppe	G RHIZ	EURASIAN	.	.	All. I
Utricularia australis R.Br.	I NAT	EUROP.	.	.	.
Utricularia minor L.	I NAT	CENTRAL EUROP.	.	.	.
Veronica anagalloides Guss.	T SCAP	EURIMEDIT.	.	.	.
Viola elatior Fries	H SCAP	EURASIAN	.	.	.
Viola pumila Chaix	H SCAP	EURASIAN	.	.	.

Scientific name	Habitats Directive 92/43/CEE	Reg. (CE) 338/97	L.R. 2/77	National Red List	Regional Red List	Watching List in Flora of the Modena province
Part B						
Allium angulosum L.	.	.	.	VU	.	X
Alopecurus geniculatus L.	.	.	.	.	.	X
Alopecurus rendlei Eig	.	.	.	.	.	X
Baldellia ranunculoides (L.) Parl.	.	.	.	CR	.	.
Butomus umbellatus L.	.	.	.	.	VU	.
Callitriche palustris L.	.	.	.	.	.	X
Callitriche stagnalis Scop.	.	.	.	.	.	X
Cardamine matthioli Moretti	.	.	.	.	.	X
Carex pseudocyperus L.	.	.	.	.	.	X
Ceratophyllum demersum L.	.	.	.	.	.	X
Ceratophyllum submersum L.	.	.	.	.	.	X
Cirsium canum (L.) All.	.	.	.	VU	EW	.
Eleocharis uniglumis (Link) Schultes	.	.	.	.	.	X
Gaudinia fragilis (L.) Beauv.	.	.	.	.	.	.
Gymnadenia conopsea (L.) R. Br.	.	All. B	X	.	.	.
Hippuris vulgaris L.	.	.	.	VU	EN	.
Hottonia palustris L.	.	.	.	VU	CR	X
Hydrocharis morsus-ranae L.	.	.	.	.	.	X
Jacobaea paludosa (L.) Gaertn, Mey *et* Scherb. ssp. *angustifolia* (Holub) Nord. *et* Greuter	.	.	.	EN	CR	X
Juncus subnodulosus Schrank	.	.	.	.	.	X
Lemna trisulca L.	.	.	.	.	.	X
Leonurus marrubiastrum L.	.	.	.	.	.	X
Leucojum aestivum L.	.	.	X	.	EN	X
Listera ovata (L.) R. Br.	.	All. B	X	.	.	.
Lotus tenuis W. *et* K..	.	.	.	CR	.	.
Ludwigia palustris (L.) Elliott	.	.	.	EN	EW	.
Lythrum hyssopifolia L.	.	.	.	.	.	X
Marsilea quadrifolia L.	All. II - All. IV	.	.	VU	CR	X
Myriophyllum verticillatum L.	.	.	.	.	.	X
Najas marina L.	.	.	.	.	.	X
Najas minor All.	.	.	.	.	.	X
Nuphar lutea (L.) S. *et* S.	.	.	.	.	.	X
Nymphaea alba L.	.	.	X	VU	LR	X
Nymphoides peltata (Gmélin) O. Kuntze	.	.	.	EN	.	X
Oenanthe aquatica (L.) Poiret	.	.	.	.	.	X
Oenanthe silaifolia Bieb.	.	.	.	.	.	X
Peucedanum palustre (L.) Moench	.	.	.	.	.	.
Ranunculus peltatus Schrank	.	.	.	.	.	X
Sagittaria sagittaefolia L.	.	.	.	EN	EN	.
Salvinia natans (L.) All.	.	.	.	VU	.	X
Samolus valerandi L.	.	.	.	.	.	X
Schoenoplectus mucronatus (L.) Palla	.	.	.	.	.	X
Schoenoplectus pungens (Vahl) Palla	.	.	.	.	.	X
Spiranthes aestivalis (Lam.) L.C. Rich.	All. IV	All. A	X	EN	EW	.
Spirodela polyrrhiza (L.) Schleid.	.	.	.	.	.	X
Trapa natans L.	.	.	.	EN	.	X
Typha laxmannii Lepechin	.	.	.	VU	EN	X
Typha minima Hoppe	.	.	.	.	.	X
Utricularia australis R.Br.	.	.	.	EN	.	X
Utricularia minor L.	.	.	.	EN	.	.
Veronica anagalloides Guss.	.	.	.	.	.	X
Viola elatior Fries	.	.	.	.	.	X
Viola pumila Chaix	.	.	.	.	.	X

Among the 53 species reported in Table 1, by palynological analysis, 8 (15,1%) can be identified at species level (Punt, 1976; Punt & Clarke, 1980-1991; Moore et al., 1991; Punt et al., 1995; Punt et al., 2003-2009). These are: *Butomus umbellatus*, *Hippuris vulgaris*, *Hottonia palustris*, *Hydrocharis morsus-ranae, Ludwigia palustris, Myriophyllum verticillatum, Nymphoides peltata*, *Trapa natans.* In some cases, even if the determination at species level is not possible, the species presence can be supposed basing on the phytogeographical exclusion criterion: e.g. *Nymphaea alba* type include *N. alba* and *N. candida* (Moore et al., 1991), but this last is not present in Italy (Pignatti, 1982). When identifying at type level, in the same type two or more species or genera can be included: for example (Moore et al., 1991) *Alisma plantago-aquatica* type includes *A. gramineum*, *A. lanceolatum*, *A. plantago-aquatica*, *Baldellia ranunculoides*, *B. repens* and *Luronium natans*, while in the Flora of Modena only the first four species are present. However, this phytogeographical criterion must be used with care because of the recent introduction of some exotic species due to human activities (e.g. *Lemna minuta* Kunth., belonging to the Lemnaceae).

The rarest and endangered species of our wet habitats are widely distributed in Europe and sometimes in Eurasia. In our study area, some of them are at the southwestern margin of their range and can give important information concerning the ecological features of their sites. Recent investigations (Buldrini, 2012) carried out on the sites of populations of *Viola pumila* Chaix, *V. elatior* Fries and *Jacobaea paludosa* (L.) Gaertn., Mey *et* Scherb. ssp. *angustifolia* (Holub) Nord. *et* Greuter, present in the provinces of Modena and Reggio Emilia, reveal a presence of northern species up to 20% (while the average is 10% in the Po Plain): it can be supposed that there is an ecological peculiarity in those sites, due to an average temperature lower than in surrounding areas. Thus, in the southern Po Plain, these species, now at the geographic boundary of their range (Fig. 4) and separated from the nearest Central European populations, are a relict of a flora typical of colder, more continental climates; being rare and relict their conservation should be a priority. In Central Europe, these three species are known as river corridor plants, typical of alluvial continental grasslands subject to periodic flooding in winter and spring and regularly mown. In Italy these species are at the south-western margin of their range, in conditions of severe geographical and reproductive isolation, separated from the nearest Central European populations, located beyond the Alps. They have analogous ecology, distribution and conservation problems in common.

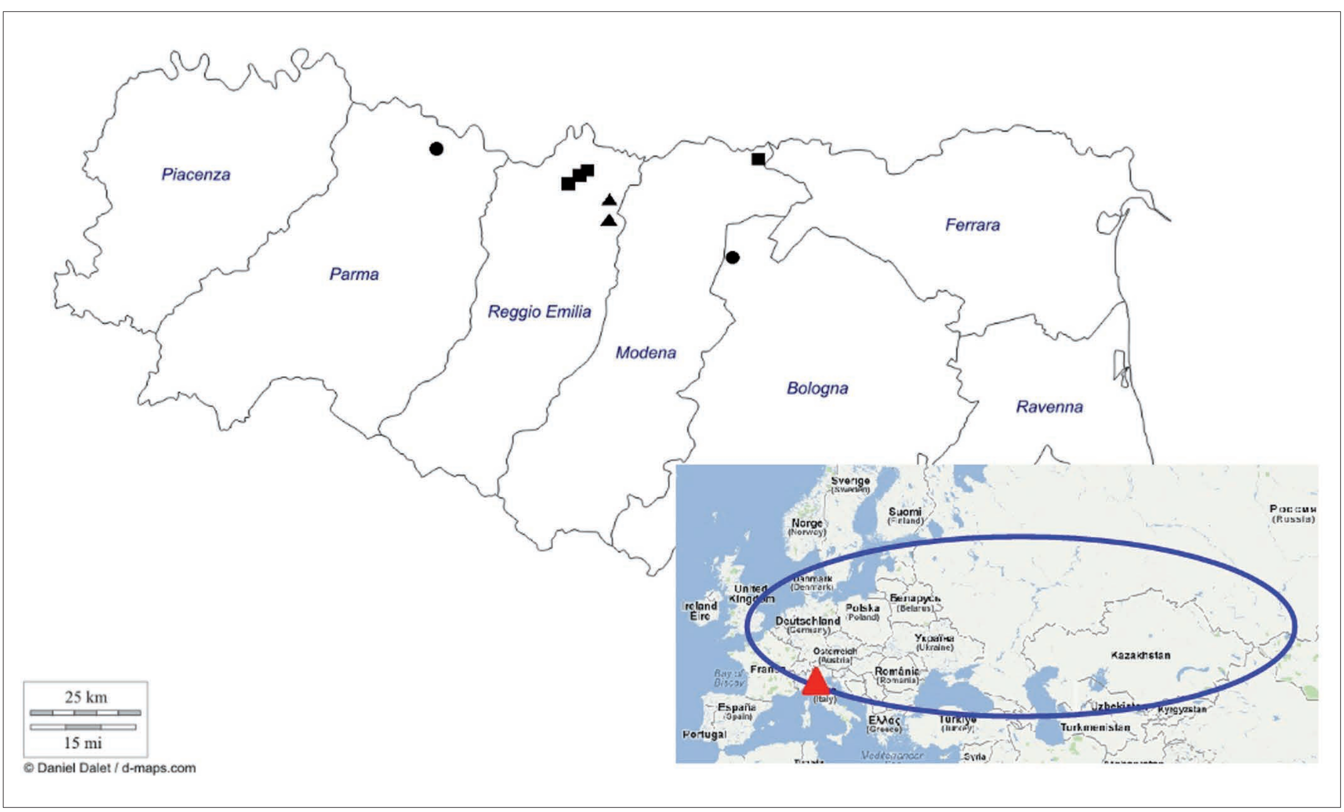

Fig. 4. Geographical distribution in Emilia-Romagna of the studied sites of *V. pumila* (■), *V. elatior* (●) and *J. paludosa* ssp. *angustifolia* (▲). As it can be observed, the species are at the south-western margin (triangle) of their range (elliptic line).

Various ongoing conservation projects for these species have been carried out for a number of years at the Botanical Gardens of Modena (Morselli, 2003; Dallai & Sgarbi, 2004; Sgarbi et al., 2004; Del Prete et al., 2006; Grimaudo, 2007; Dallai et al., 2008; Buldrini & Dallai, 2009; Buldrini, 2010; Buldrini et al., 2010; Dallai et al., 2010; Buldrini & Dallai, 2011; Buldrini, 2012; Buldrini et al., 2012; Dallai et al., 2012; Buldrini et al., 2013a; Buldrini et al., 2013b; Dallai et al., in press).

For these reasons, although we know that these three species belong to widely distributed families, not characterized at species level from a palynological viewpoint according to the generalist keys, we tried to observe their morphological pollen features, never deeply investigated for their scarce allergological and palaeopalynological interest.

Pollen grains of Violaceae (Fig. 1-2) are usually radially symmetrical, isopolar, tricolporate, sub-prolate to prolate-spheroidal; the sexine is scabrate, slightly thicker or thinner than nexine; the tectum is mostly densely punctate, rarely subpsilate (Perveen & Qaiser, 2009).

Our preliminary observations on *V. pumila* and *V. elatior* pollen confirm a substantial similarity between the two species, with grains tricolporate (extremely rare the tetracolporate in *V. pumila*), oblate-sphaeroidal to prolato-sphaeroidal (only in *V. elatior* we observed a 20% of suboblate grains), dimension slightly greater in *V. elatior* (average dimensions: *V. pumila*: P = 29,7 µm, E = 30,0 µm; *V. elatior*: P = 32,5 µm, E = 34,6 µm). Given the morphological and dimensional similarity, by light microscope and using the generalist keys the distinction between the two species is very difficult.

The pollen of *J. paludosa* ssp. *angustifolia* (Fig. 3) is ascribable to the *Senecio vulgaris* type, characterized by a complex of adhering features like presence of a mesoaperture, more or less distinct endoaperture usually tapering, conical echinae, usually about as high as they are broad; in polar view, usually 21 (15-23) echinae are visible in the equatorial plane (Punt & Hoen, 2009).

In our preliminary observations, pollen grains have an oblate-sphaeroidal or sphaeric shape, with average P = 30,2 µm and E = 31,0 µm. The exine is 1,9-2,2 µm thick (with echinae: 3,8-4,3 µm).

The identification at species level is very difficult by light microscope, using the generalist keys, because of the great similarity between the *S. vulgaris* type and the *Aster tripolium* type: this last lacks a mesoaperture, has an indistinct endocolpus, narrow and not tapering, and echinae without a cavity in the top of the point; in polar view 15-18 (14-22) echinae are visible in the equatorial plane (Punt & Hoen, 2009).

Final Remarks

It is known that wetlands contain a mosaic of contiguous microhabitats, where plant communities correspond to slight ecological variations. On the other hand, by palynological analyses the past vegetation can be inferred in broad terms, with high details on anemophilous species, but without details on the whole species composition.

In certain cases, the rare and threatened species of Emilia-Romagna are well-characterized from a morphopalynological and phytogeographical standpoint, so the presence of their pollen in surface samples provides useful information for species reintroduction. Some of them, in Italy, are at the southwestern boundary of their geographic range: for this reason, their presence can help to understand the habitat features of the sites. Nevertheless, the possibility to discover the presence of some of these species by pollen morphotypes offers a real opportunity to gear reintroduction and/or reinforcing programmes: finding the pollen of these species, when it is well identifiable, can help to detect sites for their reintroduction, even in the absence of more direct documentation (herbarium samples, floristic lists, seeds, fruits). Obviously, when the sites have been discovered, an ecological analysis will be essential to ascertain the real suitability of the place, according to the ecological requirements of the species. In addition, improvements of studies in pollen morphology could contribute to deepen the knowledge in other taxa. Thus palynology offers the mean to respond to important questions given by ecologists and nature conservationists. The ecological features of a site chosen for the reintroduction on account of field observations can be confirmed by the presence of certain pollen morphotypes. For example, being *V. pumila*, *V. elatior* and *J. paludosa* ssp. *angustifolia* microthermic species, the "guide pollen" may be *Hottonia palustris* and *Myriophyllum verticillatum*, microthermic species, whose chorotypes respectively are eurosibiric and circumboreal, both recognizable at species level. The presence of *Trapa natans*, on the contrary, would document aquatic but not microthermic environments, being instead a palaeotemperate chorotype. Thus, palynology, by analyzing certain pollen assemblages and the presence of well characterized "guide pollen", can provide useful information for conservation programmes.

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