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Changes in land use and in the ruderal plant component as observed over the past 80 years on the Island of Molara (NE Sardinia - Italy)

Abstract

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The authors report on the results of their floristic researches conducted on the Island of Molara (north-eastern Sardinia) as regards changes in the ruderal element linked to land use over the past 80 years. Our present-day research has identified 384 taxa, belonging to 83 families and 252 genera, whereas past floristic composition was 402. Comparison of present-day flora with that of the past showed that 86 taxa were new to the island, 285 were confirmed and 104 were no longer observed. Amongst the taxa no longer found, some 25% were ruderal. Their disappearance was due to changes in land use, in particular over the past 50 years, during which time farming activity ceased and stock rearing declined to minimal terms.

Introduction

In the framework of a research program – in the frame of INTERREG III – focusing on the changes in flora and vegetation landscape that have occurred on various Sardinian islands (Bocchieri 1990, 1992; Bocchieri & Iiriti 2000, 2002, 2003), our attention was drawn to the Island of Molara. We were able to identify the present floristic composition by numerous visits of investigated area between the end of 2001 and early in 2004.

The earliest botanical data on Molara were provided by Moris (1837-1859), who in his Flora Sardoa reported the presence of *Salix cinerea* L. Subsequent contributions were made by Béguinot (1929), Picci (1972), Lorenzoni (1970), Lorenzoni & Chiesura Lorenzoni (1973), Bocchieri (1995) and Bocchieri & Iiriti (2005). As regards endemic plants only, there are also mentions in some data sheets of the publication: Le piante endemiche della Sardegna (Arrigoni & al. 1977-1991).

Notes on the territory

The island of Molara is situated in north eastern Sardinia and belongs to the Municipality of Olbia and the Province of Sassari. The island's territory is shown on Sheet

No. 445, section III, of the topographical map of Italy and covers an area of approximately 3.5 km^2 with a coastal perimeter of 10 km (Fig. 1).

The island is made up of formations belonging to the granite pluton of Gallura which emerged during the Hercynic orogeny in the late Palaeozoic. Its coastline is rugged with very advanced erosion formations and small sandy inlets with stretches of beach attributed to the Tyrrhenian era.

The environment of the island has preserved a high degree of naturalness along the coast and in the surrounding marine ecosystems. Indeed it is one of the most interesting areas in the Marine Park of Tavolara and Capo Coda Cavallo, set up by Decree of the Ministry of the Environment of 22 September 1997. The Park extends over some 15000 hectares and includes many islets near Molara, such as Proratora, Ruja and Molarotto.

The analysis of the climate of the area under consideration is based on temperature and rainfall data for Olbia. The rainfall data are available for the period 1921-2001, while temperature data are limited to the period 1951-2001. The processing of these data shows that average annual rainfall is 600 mm, concentrated mainly in the autumn and winter. The alternation of years with high rainfall with others of drought is a phenomenon typical of Sardinia and indeed of all territories of the Western Mediterranean. Thus we find that in 1946 the Olbia station recorded no less than 1177 mm whereas in 1992 only 200 mm were recorded.

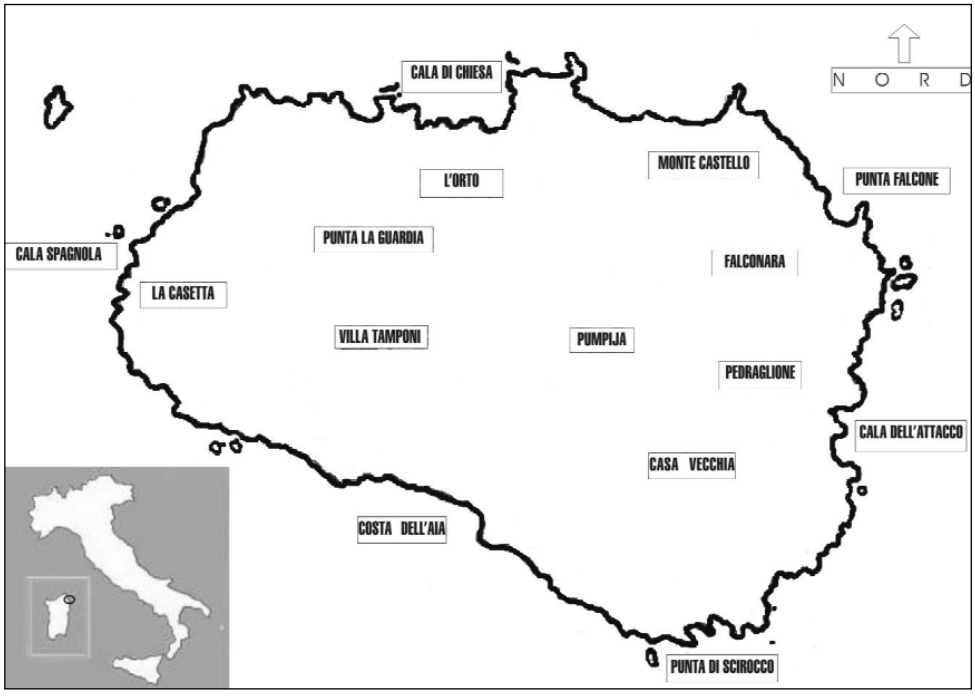

Fig. 1. The Island of Molara and its location with respect to Italy.

The mean annual temperature is 16.4°C with a mean minimum of 12.1°C and a mean maximum of 20.6°C. Dominant winds during autumn and winter blow from the north whereas during the summer we find a prevalence of southern winds, the most frequent being the Levanter (Pinna 1954).

As already was indicated in a study on the floristic component (Bocchieri & Iiriti 2005), the island of Molara has been inhabited since very ancient times as is shown by the ruins of a castle, a medieval village and an old Romanesque church. In all likelihood, one of the factors which favoured human presence on the island was the existence of a spring which made the island habitable in all seasons of the year. Moreover, there was abundance of grazing land and it was also possible to raise crops and livestock, both conditions necessary for permanent settlement in this type of place. For some fifty years now, farming activity has been abandoned, while stock rearing is limited to a few heads of cattle and goats handled by the family of Salvatore Piredda, caretaker of the island for some thirty years and who kindly gave us information – also drawn from old people from the area – dating back some 80 years.

Notes on flora and ruderal plant component

The result of our research is the identification of 384 taxa (371 spontaneous, 13 introduced) belonging to 83 families and 252 genera (Bocchieri & Iiriti 2005). The most numerous families were *Poaceae* with 42 taxa, followed by *Asteraceae* (39), *Fabaceae* (38), *Apiaceae* (15) and *Liliaceae* (15). The floristic composition identified in past years had numbered a total of 402 taxa, 360 of which were catalogued by Picci (1972) and the remainder by several botanists mentioned in the introduction to this paper. The comparison between the flora found by ourselves and that previously recorded shows that 86 taxa were new to the island, 285 were previously recorded and 104 were no longer found.

Using floristic investigations carried out by the authors mentioned above, it was discovered that of the 104 taxa not found, 24 are ruderal and weed and are the subject of this research paper. Their presence in the past was probably a result of farming and grazing activities, both widespread on the island.

The disappearance of these taxa was confirmed during recent visits aimed at ascertaining present flora and assessing its changes with respect to the situation described by Béguinot (1929) and Picci (1972), both authors of important contributions on the floristic composition of Molara. Amongst the 24 ruderal plants no longer found listed in Table 1, it should be noted that 19 are therophytes, 3 hemicryptophytes and 2 geophytes.

The differences in the floristic composition of the island can be observed by analysis of the biological spectrum and Grime's diagram (Bocchieri & Iiriti 2005). The present biological spectrum shows a clear dominance by therophytes (49.1%) followed by hemicryptophytes (19.9%), geophytes (14.8%), phanerophytes and nanophanerophytes (9.5%), camephytes (5.9%) and hydrophytes (0.8%). The comparison with the biological spectrum described by Picci (1972) shows that therophytes decreased by 2.6%, phanerophytes by 1.2% and hemicryptophytes by 0.1%, whereas camephytes increased by 0.9%, geophytes by 2.8% and hydrophytes by 0.4%. The high percentage of therophytes is a consequence of the typical climate of the Mediterranean basin, an area marked by a period of aridity dur-

Table 1. List of ruderal plants no longer found during recent visits.

Taxa	Family	Biological form	Chorological form
Spergula arvensis L.	*Caryophyllaceae*	T scap	Subcosmopol.
Fumaria agraria Lag.	*Papaveraceae*	T scap	Steno-medit.
Fumaria muralis Boiss. & Sonder	*Papaveraceae*	T scap	Subatl.
Sinapis alba L.	*Brassicaceae*	T scap	E-medit.
Sisymbrium officinale Scop.	*Brassicaceae*	T scap	Subcosmopol.
Lotus corniculatus L.	*Fabaceae*	H scap	Cosmopol.
Medicago arabica (L.) Hudson	*Fabaceae*	T scap	Euri-medit.
Medicago praecox DC.	*Fabaceae*	T scap	Steno-medit.
Trifolium incarnatum L.	*Fabaceae*	T scap	Euri-medit.
Trifolium ligusticum Balbis	*Fabaceae*	T scap	Steno-medit.
Trifolium squarrosum L.	*Fabaceae*	T scap	Euri-medit.
Vicia sativa L. subsp. *angustifolia* (Grufb.) Gaudin	*Fabaceae*	T scap	Subcosmopol.
Vicia hirsuta (L.) S. F. Gray	*Fabaceae*	T scap	Subcosmopol.
Erodium malachoides (L.) L'Hér.	*Geraniaceae*	T scap	Medit.-Macarones.
Erodium moschatum (L.) L'Hér.	*Geraniaceae*	T scap	Euri-medit.
Geranium pusillum L.	*Geraniaceae*	T scap	Europ.-Asiat.
Convolvulus arvensis L.	*Convolvulaceae*	G rhiz	Cosmopol.
Borago officinalis L.	*Boraginaceae*	T scap	Euri-medit.
Linaria triphylla (L.) Miller	*Scrophulariaceae*	T scap	W-medit.
Verbascum thapsus L.	*Scrophulariaceae*	H bienn	Europ.-Caucaso
Valerianella dentata (L.) Pollich	*Valerianaceae*	T scap	Submedit.-Subatl.
Conyza canadensis (L.) Cronq.	*Asteraceae*	T scap	Cosmopol.
Gladiolus segetum Ker.-Gawl.	*Iridaceae*	G bulb	Euri-medit.
Poa trivialis L.	*Poaceae*	H caesp	Eurasiat.

ing the summer months which extends from the end of May to the end of September. The high percentage of hemicryptophytes and the presence of hydrophytes are a consequence of the temperate-cool microclimate conditions and a relatively plentiful supply of water. The reduction in therophytes and increase in camephytes is evidence of the fact that over the past forty years the territory has been put to a different use, indeed during this period we find the abandonment of farming activity and reduction to minimal terms of stock breeding. The same differences are also to be found in Grime's diagram, where we find a variation of taxa marked by ruderal and competitive strategy, whereas taxa with stress-tolerant strategy display greater stability (Bocchieri & Iiriti 2005).

The land use over the past eighty years has been responsible for the variations in the island's floristic composition and vegetation landscape. In the past, this island was used

almost entirely for grazing purposes and those areas with moderate slope and low rockiness could be farmed. The formerly cultivated plots were located mainly in two areas: the Orto valley with terraces used mainly for growing the vegetable, and the area between Pumpija, Pedraglione and Falconara, which was mostly used for cereal crops. The choice of the Orto valley for cultivation of vegetable was mainly due to the presence of springs providing water year round, while the interior of the island had decidedly drier soil and climate. Small plots were cultivated with vine stock and fruit-bearing trees (olives, almonds, persimmons and chestnuts), in particular in the vicinity of Villa Tamponi. At the present time they have disappeared or are present only in isolated exemplars (Fig. 2). For instance, a single surviving chestnut (*Castanea sativa* Miller) is to be found near the spring of the Orto valley, while a few almond trees (*Prunus dulcis* (Miller) D. A. Webb) grow round Villa Tamponi.

The farming activity has been abandoned for some 50 years whereas the livestock grazing on the island has by now been reduced to minimal terms. Farming activity was in all likelihood more intense in the early twentieth century, since taxa such as *Spergula arvensis* L., *Fumaria agraria* Lag., *Sisymbrium officinale* Scop., *Medicago praecox* DC., *Vicia sativa* L. subsp. *angustifolia* (Grufb.) Gaudin, *Erodium malachoides* (L.) L'Hér., *Erodium moschatum* (L.) L'Hér. were reported as being present by Béguinot (1929) but had already disappeared during the early seventies when the studies of Picci (1972) took place.

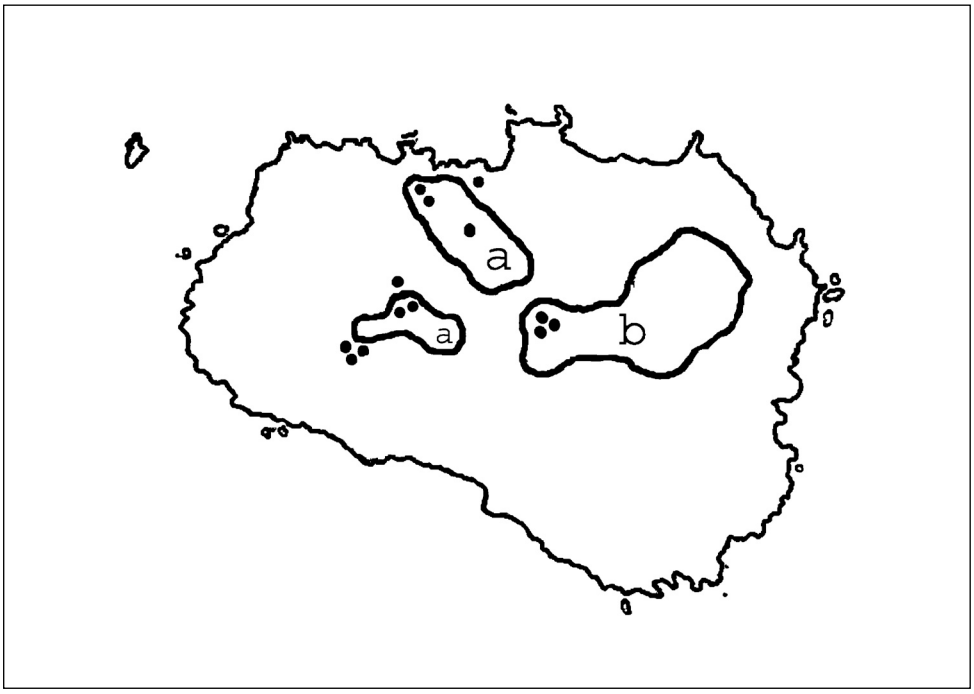

Fig. 2. Previously cultivated areas: a) vegetable crops; b) cereal crops; ●) vineyards and orchards.

Formerly cultivated areas can be recognised today by the terraces and/or heaps of stones from works to level plots of land and clear them from stones. In these areas, plant communities are mainly of the medium-low bush type, with a few scattered examples of trees which indicate vegetation evolution in the direction of more mature groupings. In these environments, the most widespread species are *Erica arborea* L., *Olea europaea* L. var. *sylvestris* Brot., *Phillyrea angustifolia* L., *Pistacia lentiscus* L., *Cistus monspeliensis* L., *Genista corsica* (Loisel.) DC., *Lavandula stoechas* L. and we also find clearings with *Helichrysum italicum* (Royh) G. Don subsp. *microphyllum* (Willd.) Nyman, *Asphodelus aestivus* Brot., *Carlina corymbosa* L. and *Brachypodium retusum* (Pers.) Beauv. Among the rocky outcrops there are the trees of *Olea europaea* L. var. *sylvestris* Brot. which were not cut down, as is to be seen in the locality of Pedraglione where some of them are larger than average.

The progressive evolution of bush growth is also shown by the ruderal plant taxa still present today on the island but only in rare exemplars. The examples are *Papaver rhoeas* L. and *Raphanus raphanistrum* L. that highlight the disappearance of ruderal and weed communities typical of environments strongly influenced by the presence of man in favour of others having a greater degree of naturalness.

Conclusions

During the past 80 years the flora of the island of Molara has undergone variations which confirm the fact that micro-insular systems are also subject to floristic turnover.

Comparison between today's flora and that of past years showed that 86 taxa were new to the island, 285 were confirmed and 104 were not found (Bocchieri & Iiriti 2005).

Among the 104 taxa not found, 24 were ruderal and weeds (approximately 25%).

The disappearance of ruderal and weed species, which are particularly subject to the changes in the floristic component of any territory, in this case was caused by changes in land use which altered the ecological conditions that had permitted their growth and diffusion.

The dynamic relationships between different vegetation types highlighted the difference in vegetation landscape and confirmed the fact that territories at one time dedicated to productive activities are today covered in medium-low bush growth and stunted trees.

The fact that at the present time the island is privately owned has contributed to the reduction in ruderal species and, at the same time, to an increase in the typical species of local plant populations.

Notwithstanding the fact that past human use of the island altered its vegetation cover, we still find here ecosystems of significant naturalistic value whose conservation has been favoured by the fact that Molara is privately owned. Limited access to the island has prevented the arrival of large tourist flows which, if left uncontrolled, all too often are responsible for ecosystem degradation phenomena; thus Molara has been spared despite the fact that the surrounding coastal area is subjected during the summer months to considerable tourist pressure.

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