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Flora of Capo Malfatano (S-Sardinia, Italy)*

Abstract

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The authors report on the results obtained from the research project carried out on the promontory of Capo Malfatano (Southern Sardinia). The flora, completely new, consists at the present time of 255 entities and is grouped in 57 families and 186 genera. We find in this area a floristic component poor in endemic species, dominated by Mediterranean elements, annual cycle species and of R & S strategy. The floristic listing shows also the species present on the walls of the tower which might well contribute to the deterioration of this monument. Vegetation cover is dominated by phytocoenoses typical of the thermo-Mediterranean coastal strip in which evident factors of human and animal disturbance may be noted. The low woodland, with *Juniperus turbinata* and *Olea europaea* var. *sylvestris* with *Pistacia lentiscus* represents the most mature aspect of vegetation. In the interior there are dense formations of *Calicotome villosa* while in those areas marked by steep slopes we find a predominance of growths of *Euphorbia dendroides*.

Introduction

Of the 36 headlands or capes present along the coasts of Sardinia, shown on the maps of the I.G.M., only 10 have been the subject of floristic study. These are Capo Caccia (Valsecchi 1966), Capo Mannu (Bocchieri & al. 1988), Capo S. Marco (Bocchieri & Mulas 1996), Capo Frasca (Bocchieri & Mulas 1992), Capo Teulada (Ballero & Bocchieri 1987), Capo Pula (Bocchieri 1984), Capo S. Elia (Martinoli 1950), Capo Carbonara (Camarda & Ballero 1981), Capo Ferrato (Ballero 1988) and Capo Bellavista (Bocchieri 1998a). For this reason, in the framework of a research programme covering the study of the "Capes" of Sardinia and since these sites include in their flora elements of particular significance, the authors felt it worthwhile to carry out research at Capo Malfatano, a promontory of Southern Sardinia (Fig. 1) which is little known from a botanical point of view.

The area subject of this research programme belongs to the municipality of Domus de Maria and is mapped in Sheet n. 573, Section III, of the Topographical Map of Italy. Its geographical coordinates are 38° 53' 07'' and 38° 54' latitude, and 08° 48' 14'' and 08° 48' longitude; it has a surface area of approximately 100 hectares.

*Research carried out in the framework of the "INTERREG 3" project

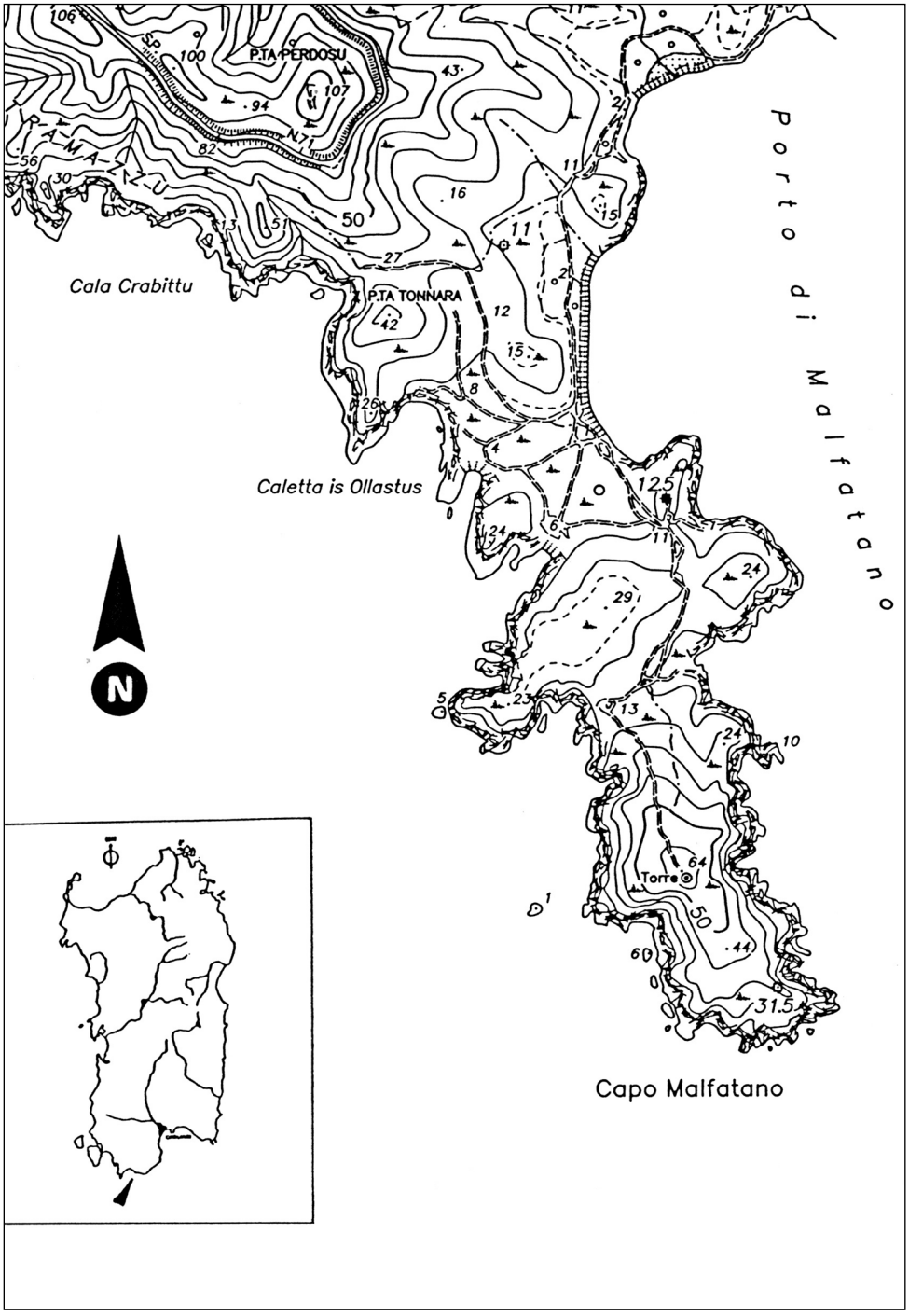

Fig. 1. Capo Malfatano and its position in Sardinia (scale 1:10.000).

Geomorphological notes

Between Capo Teulada and Capo Malfatano there stretches a gulf marked by a typical Rias coast, originating from the invasion by the sea of an ancient river valley, due to the lowering of the coastline. Within this gulf, the coastline is mainly steep and rocky, interspersed with sandy and pebbly beaches, all small in size, which have evolved only in very sheltered inlets. The promontory stretches in a N-S direction, and together with the headland known as Schiena del Siciliano, encloses the Port of Malfatano.

According to reports in the bibliography (Debrenne & al. 1975; Tucci 1983), Capo Malfatano represents the schistose continuation towards the south of the Cambrian structures of the Iglesiente and Sulcis areas.

The stratigraphic series includes the Nebida Formation (Sandstone Group) consisting of alternating layers of argillaceous and arenaceous schists, greyish green in colour arranged in fine strata and rare structures of the ripple-mark type.

In the higher part of the series we find a variable number of biothermal strata of limestone, often Oolitic, containing Archaeociathyd deposits, of thickness ranging from a few dm to 2-3 m and alternating with the sandstones.

From a tectonic point of view, these formations represent a "Sardinian phase" of the Caledonian orogenic cycle, which manifested itself in a slight anticlinal folding of the structure and a series of fractures arranged in a southerly direction, intersected in turn by other fractures of the Hercynian era. We date in the Hercynian Cycle the fractures arranged from N-S to NW-SE, which were conditioned by the settling of the granites which in this sector are located close to the surface, often as outcrops where some phenomena of thermo-metamorphism are to be seen.

All these formations are covered patchily by thin metric strata of alluvial sediments consisting of incoherent gravel, sand and silt of the Quaternary.

Climate

Data covering temperature and rainfall available to picture the climatic characteristics of the Cape come from the station at Teulada, the nearest to the area of our study. Average rainfall and temperature data are shown in Table 1 and on their basis we have drawn up a Mitrakos histogram (1982) and an ombrothermic diagram. The Mitrakos histogram (Fig. 2) highlights the fact that there is limited stress from cold which involves primarily the winter months and, albeit in limited form, also the months of March and April. Observing the values for monthly stress from drought, we see that this occurs, to a limited extent, dur-

Table 1. Monthly values of maximum, minimum and mean temperatures (1989-2001) expressed in °C and of rainfall (1921-2001) indicated in mm, recorded at the Teulada station.

	J	*F*	*M*	*A*	*M*	*J*	*J*	*A*	*S*	*O*	*N*	*D*	*Yr*
max	15.2	16.2	18.6	20.1	25.0	29.9	33.3	34.2	29.2	24.7	19.4	16.2	23.5
min	6.2	5.8	7.7	9.3	13.3.	16.8	19.2	20.4	18.1	14.7	10.3	7.4	12.4
mean	10.7	11.0	13.2	14.7	19.1	23.4	26.2	27.3	23.6	19.7	14.8	11.8	17.9
mm	77.4	72.1	65.4	43.1	33.8	9.7	2.1	8.2	35.0	71.7	86.2	90.3	595

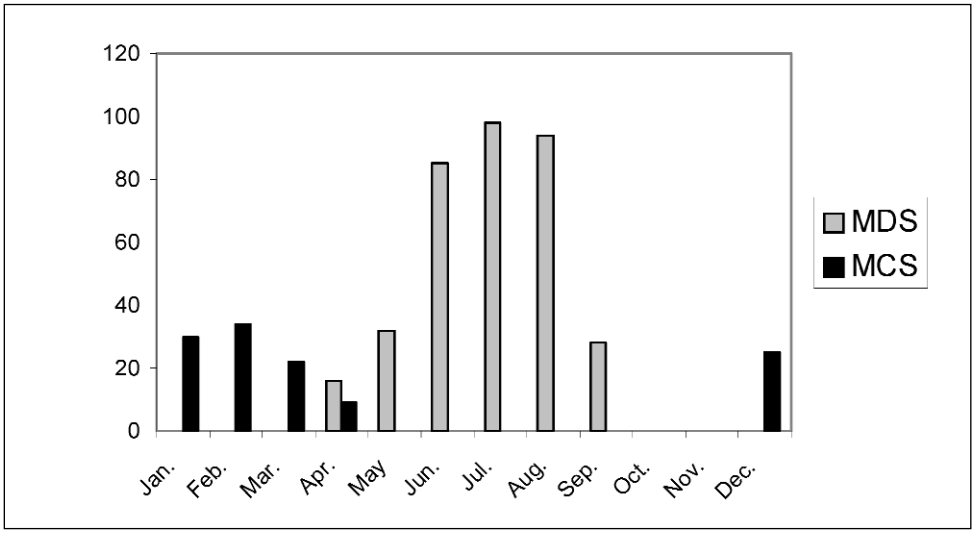

Fig. 2. Mitrakos Diagram (1921-2001).

ing April, May and September and with significant accentuation during the summer months.

Analysis of the ombrothermic diagram (Fig. 3) confirms that the period of drought starts at the end of April and covers all the summer months up to the middle of September. Rainfall over the whole area of the headland is irregular as is shown by analysis of the data in Figure 4 which gives average values over the last 80 years, grouped in decades. In this last decade (1992-2001), average annual rainfall was 426 mm, a value considerably lower

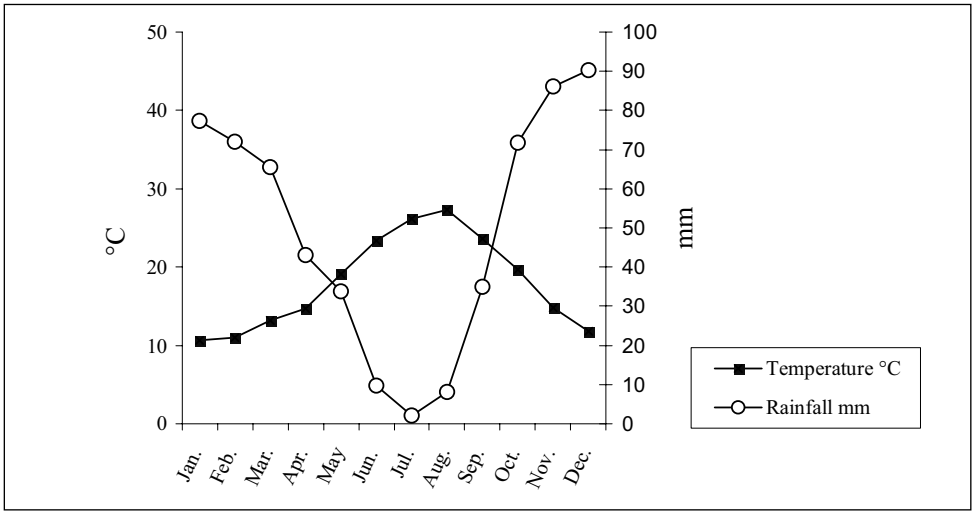

Fig. 3. Ombrothermic diagram of Teulada.

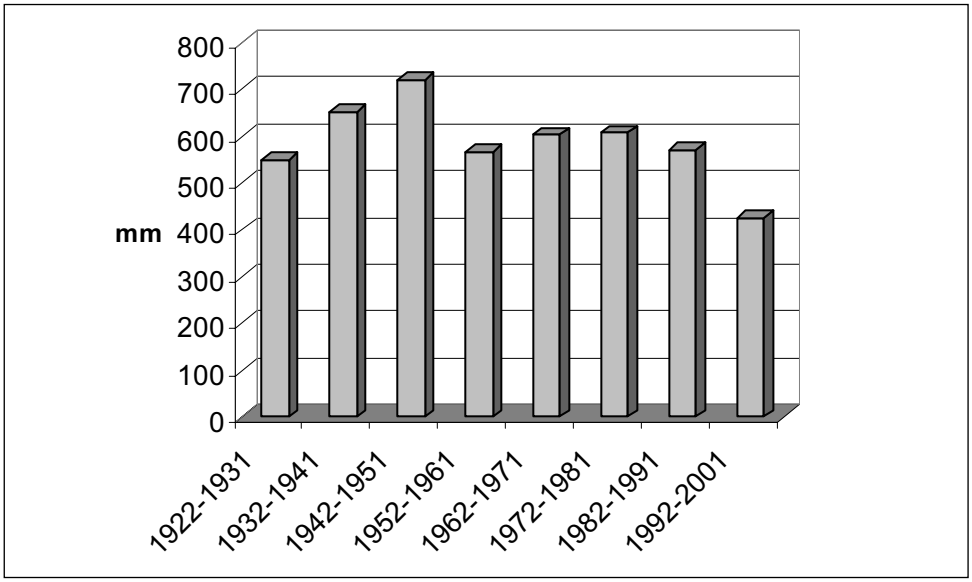

Fig. 4. Average rainfall for the decades between 1922 and 2001.

than those of previous decades during which average rainfall was between 500 and 600 mm. The decade with most copious rainfall was that between 1942 and 1951, with 721 mm.

The winds which blow on the headland, at times very strongly, come from the II and IV quadrants. They affect the growth of vegetation as may be observed throughout the western sector of the headland and round the tower, where we find low bush formations close to the ground which cannot exceed growth of one metre and are forced into a "flattened" form of development.

The thermicity index (It) of Rivas-Martinez (1994) shows that the Cape may be included in the thermoMediterranean bioclimate (It = 444) with dry ombro-type since mean annual rainfall is 595 mm.

Historical background

On the site of today's Malfatano inlet, there used to be situated *Herculis Portus*, a staging post named after the sanctuary dedicated to the Semitic god Melquart, corresponding to the Heracles of the Greeks and Romans. In the inlet, the remains of port infrastructures partially buried by the alluvial deposits of Rio di Malfatano have been found; in places these remains are visible at ground level and in part they are submerged in a few centimetres of water along the coastline. They consist of embankments which line the banks and piers which extend from the latter towards the central portion of the inlet constructed by the massing of large quantities of small pebbles of different size according to the use the

structure was put to. Other traces of ancient embankments are to be found along the last section of the Rio di Malfatano.

In the upper portion of the headland, at 65 metres ASL, we find the Tower of Malfatano which was constructed around 1580, and which, between 1593 and 1595 was also known as the "Fortalessa de Marfatta" and "Fortallessa de San Francisco de Marfatta". It was constructed on the instructions of De Mocanda, the King's envoy charged with identifying suitable places for the construction of coastal towers for the defence of the Sardinian coasts. The tower, whose name is said to derive from a medieval staging point utilised by traders from Amalfi, commands a wide-ranging view which in the past allowed it to establish visual contact with the towers of the sector of Piscinnì, Porto Scudo, Budello, Punta Cala Piombo and with the Guardia di Las Cannas situated on Capo Spartivento. At the present time, the tower, which has a base diameter of about 12 m, is not in a good state of repair and, bearing in mind the maintenance works which have been performed on other structures of this kind, it would be advisable to take steps to avoid its further degradation.

In the area involved in our investigation, the characteristic "furriadroxius" are to be found, that is groups of rural dwellings which have an agricultural and pastoral function. These structures, which are typical of Southern Sardinia, in particular of the Sulcis district, represent the elementary settlement unit giving rise to scattered groups of habitations (Le Lannou 1941).

Flora

Numerous bibliographical researches enable us to state that the area included in this study is almost entirely unknown from the botanical point of view and only recently have some data been reported in information sheets dealing with the endemic plant life of Sardinia (Arrigoni & al. 1976-1991). Moreover the approximately 40,000 *exsiccata* present in the *Herbarium* CAG do not include any samples from this locality.

Our research began, with monthly visits, in April 1998 and concluded in December 2001. The samples we collected, the most significant of which are deposited in CAG, were chosen using the classic floras such as Nuova Flora Analitica d'Italia (Fiori 1923-1927), Flora d'Italia (Pignatti 1982), *Flora Europaea* (Tutin & al. 1964-1980; 1993) and the information sheets of the endemic plants of Sardinia (Arrigoni & al. 1976-1991). We also consulted, as far as possible, works regarding contributions and various monographs which are included in the floristic list.

The systematic order followed in the floristic list is that of Pichi Sermolli (1979) and Ferrarini & al. (1986) for *Pteridophyta* and of Tutin & al. (1964-1980; 1993) for *Magnoliopsida* and *Liliopsida*. Moreover, Cronquist (1981) for *Magnoliopsida* and Dahlgren & al. (1985) for *Liliopsida* were at times consulted to acquire more detailed information on the description and distribution of some taxa.

For each entity, listed in alphabetical order within the family to which it belongs, besides the specific or intra-specific binomial, we have provided the following information: the biological form found in the field and reported using Raunkiaer's abbreviations, the chorological element, locality where found, frequency, diffusion and, with final (*), its presence, if any, on the walls of the tower.

PTERIDOPHYTES

SINOPTERIDACEAE

Cheilanthes maderensis Lowe — H ros — W-Medit-Macaron — Internal area of the headland, in the vicinity of Punta Perdosu, in sunny areas; very rare.

SELAGINELLACAE

Selaginella denticulata (L.) Link — Ch rept — Steno-Medit — Northern sector of Punta Perdosu; very rare.

POLYPODIACEAE

Polypodium cambricum L. subsp. ***serrulatum*** (Sch. *ex* Arcang.) Pic.-Serm. — H ros — Euri-Medit — Rocky crevices between the humid area and the eastern sandy coast; not common.

ASPLENIACEAE

Asplenium obovatum Viv. — H ros — Steno-Medit — With selaginella on Punta Perdosu; very rare.

MAGNOLIOPHYTA-MAGNOLIOPSIDA

CUPRESSACEAE

Juniperus turbinata Guss. — P caesp — Euri-Medit — Present on most of the headland; in the northern sector, examples of considerable size were found.

URTICACEAE

Parietaria judaica L. — H scap — Euri-Medit-Macaron — At the foot of the headland tower; rare.(*)

Urtica membranacea Poiret — T scap — V S-Medit — Pasturelands and areas used to shelter livestock in the northern sector; common.

POLYGONACEAE

Polygonum maritimum L. — H rept — Subcosmop — Extremely rare examples in the southern sector of the sandy, eastern central coast.

CHENOPODIACEAE

Beta vulgaris L. subsp. ***maritima*** (L.) Arcangeli — H scap — Euri-Medit — Along the edges of the northern marsh area; not very widespread.(*)

Chenopodium murale L. — T scap — Subcosmop — Between the humid zone and the sandy coast; not common.

Salsola kali L. — T scap — Paleotemp — Eastern sandy coast; very rare.

Salsola soda L. — T scap Paleotemp — Eastern sandy coast; rare.

AIZOACEAE

Mesembryanthemum crystallinum L. — T scap — S-Medit-Sudafr-Austral — To the south of the tower and on the southern tip of the headland; rare.

Mesembryanthemum nodiflorum L. — T scap — S-Medit-Sudafr — The inlet of Caletta is Ollastus and on the edges of the humid area; widespread.(*)

CARYOPHYLLACEAE

Cerastium glomeratum Thuill. — T scap — Subcosmop — To the north of the tower between low and creeping garrigue; rare.

Petrorhagia prolifera (Guss.) P. W. Ball et Heywood — T scap — Euri-Medit — Between Punta Perdosu and the humid area; rare.

Silene gallica L. — T scap — Subcosmop — Widespread almost everywhere.(*)

Silene vulgaris (Moench) Garcke subsp. ***angustifolia*** (Miller) Hayek — H scap — E-Medit — Flat internal areas to the east of Punta Tonnara; not common.

Spergularia marina (L.) Griseb. — T scap — Subcosmop — Rare examples on the borders of the humid area and along the sandy eastern coast.(*)

Stellaria media (L.) Vill. — T rept — Cosmop — Flat areas, detritus, among the low brush; common.

RANUNCULACEAE

Anemone hortensis L. — G bulb — N-Medit — Flat northern sector and central and eastern central garrigue; widespread.

Clematis cirrhosa L. — P lian — Steno-Medit-Turan — Southern sector of Punta Perdosu; not common.

Nigella damascena L. — T scap — Euri-Medit — Along the edges of the path in the vicinity of the calicotome formation in the central sector; very rare.

Ranunculus paludosus Poiret — H scap — Steno-Medit-Turan — Meadows in the central sector; not common.

PAPAVERACEAE

Fumaria bastardii Boreau — T scap — Medit-Atl — Among the brush and the garrigue; scattered examples.

Fumaria capreolata L. — T scap — Euri-Medit — Among the brush and the garrigue; scattered examples.

Hypecoum procumbens L. — T scap — Paleotemp — Eastern sandy coast; very rare.

Papaver hybridum L. — T scap — Medit-Turan — Examples scattered throughout the whole northern sector of the headland.

CRUCIFERAE

Brassica tournefortii Gouan — T scap — Medit-Saharo-Sind — CE sandy coast; extremely rare.

Cakile maritima Scop. subsp. ***aegyptiaca*** (Willd.) Nyman — T rept — Medit-Atl — CE sandy coast; not common.

Coronopus didymus (L.) Sm. — T rept — Subcosmop — Along the edges of the path leading to the tower; not very widespread.

Hirschfeldia incana (L.) Lagrèze-Fossat — T scap — Medit-Macaron — Rare examples along the edges of the path leading to the tower.

Lobularia maritima (L.) Desv. — Ch suffr — Steno-Medit — Rocky inlets in the western and eastern sectors; widespread.

Matthiola tricuspidata (L.) R. Br. — T scap — Steno-Medit — CE sandy coast; widespread.(*)

Sisymbrium irio L. — T scap — Paleotemp — Among the big oleasters at Punta Perdosu; rare.

Succowia balearica (L.) Medicus — T scap — SW-Medit-Macaron — Southern sector of Punta Perdosu; very rare.

RESEDACEAE

Reseda alba L. — T scap — Steno-Medit — To the west of the northern salt marsh area; rare.

Reseda luteola L. — H scap — Circumbor — Between the stretches of calicotome in the central flat area; rare.

CRASSULACEAE

Sedum caeruleum L. — T scap — SW-Medit — Crevices and small meadows in the lithic soils; not very widespread.

Sedum litoreum Guss. — T scap — Steno-Medit-Centro-Orient — Among the crevices to the south of the tower and along the CW coast; rare.(*)

Umbilicus horizontalis (Guss.) DC. — G bulb — Steno-Medit — Rocky crevices and small soil deposits; very rare.

ROSACEAE

Pyrus spinosa Forssk. (=*Pyrus amygdaliformis* Vill.) — P caesp — Steno-Medit — Between the expanse of calicotome and to the south of Punta Perdosu; common.

Rubus ulmifolius Schott — NP — Euri-Medit — Between Punta Tonnara and Punta Perdosu; not very widespread.

Sanguisorba minor Scop. — H scap — Subcosmop — Among the low garrigue just before the tower; rare.

LEGUMINOSAE

Astragalus hamosus L. — T scap — Medit-Turan — Extremely rare examples in the NW uncultivated areas.

Calicotome villosa (Poiret) Link — P caesp — Steno-Medit — Widespread almost everywhere and in particular to the south of Punta Tonnara.

Genista ephedroides DC. — NP — Endem — Found exclusively in an impluvium to the north of the tower at level 24.

Lathyrus cicera L. — T scap — Euri-Medit — Uncultivated areas, clearings, formerly cultivated areas; not common.

Lotus cytisoides L. — Ch suffr — Steno-Medit — Rocky and sandy coastal areas; common.

Lotus edulis L. — T scap — Steno-Medit — Flat clearings to the north of the salt marsh area; not very widespread.

Lotus ornithopodioides L. — T scap — Steno-Medit — In the vicinity of the CE sandy area; rare.

Lupinus micranthus Guss. — T scap — Steno-Medit — Along the edges of the road leading to the tower; not very widespread.

Medicago marina L. — Ch rept — Euri-Medit — Extremely rare examples along the short sandy coast in the vicinity of Caletta is Ollastus.

Medicago polymorpha L. — T scap — Subcosmop — Present almost everywhere but not very widespread.

Ononis reclinata L. — T scap — S-Medit-Turan — Among the garrigue near the tower; rare.

Ornithopus compressus L. — T scap — Euri-Medit — Clearings in the low brush to the south of Punta Perdosu; common.

Scorpiurus muricatus L. — T scap — Euri-Medit — Clearings, edges of pathways, meadows in the vicinity of Punta Tonnara; common.

Trifolium angustifolium L. — T scap — Euri-Medit — Uncultivated areas, clearings, formerly cultivated areas; not common.

Trifolium arvense L. — T scap — Paleotemp — Rocky crevices and granite weathering soils of Cala Crabittu and Punta Tonnara; rare.

Trifolium campestre Schreber — T scap — W-Paleotemp — Among the garrigue and brush clearings; scattered examples.

Trifolium cherleri L. — T scap — Euri-Medit — Edges of the road leading to the tower and Punta Tonnara; common.

Trifolium scabrum L. — T rept — Euri-Medit — Uncultivated areas and brush and garrigue clearings; common.

Trifolium stellatum L. — T scap — Euri-Medit — Uncultivated areas, clearings, formerly cultivated areas; common.

Trifolium subterraneum L. — T rept — Euri-Medit — Flat area to the north of the CE sandy coast; rare.

Vicia benghalensis L. — T scap — Steno-Medit — Among the rockrose in the clearings of the formerly cultivated areas; rare.

Vicia bithynica (L.) L. — T scap — Euri-Medit — Among the uncultivated sites to the north of the salt marsh area and in the garrigue in the vicinity of the tower; not common.

Vicia tenuissima (Bieb.) Schinz & Thell. — T scap — Euri-Medit — Clearings in the brush; very rare.

OXALIDACEAE

Oxalis pes-caprae L. — G bulb — S-Afr — In the salt marsh area among the reeds where there is a strong sandy component; not common.

GERANIACEAE

Erodium botrys (Cav.) Bertol. — T scap — Steno-Medit — Among the garrigue in the central sector of the headland; rare.

Erodium chium (L.) Willd. — T scap — Euri-Medit — Flat clearings between the sandy areas and Punta Tonnara; rare.

Erodium cicutarium (L.) L'Hér. — T scap — Subcosmop — Meadows, clearings, edges of the paths; common.

Erodium malacoides (L.) L'Hér — T scap — Medit-Macaron — Clearings and breaks in the brush in the north eastern sector; rare.

Erodium salzmannii Delile — T scap — Medit-Atl — Coastal meadows, relatively sandy, of Punta Tonnara; rare.

Geranium molle L. — T scap — Subcosmop — Scattered examples throughout the headland; common.(*)

Geranium purpureum Vill. — T scap — Euri-Medit — In the vicinity of the limestone formations; rare.

Geranium robertianum L. — T scap — Subcosmop — Flat clearings in the NE sector; common.

Geranium rotundifolium L. — T scap — Paleotemp — Along the edges of the path leading to the tower and in the neighbouring clearings; common.

LINACEAE

Linum bienne Miller — H bienn — Euri-Medit-Subatl — Meadows and breaks in the brush in the northern and central sectors; rare.

Linum strictum L. — T scap — Steno-Medit — Scattered examples, but rare throughout the headland. This is a very variable species as to inflorescence and size of the floral pedicels.

EUPHORBIACEAE

Euphorbia dendroides L. — NP — Steno-Medit-Macaron — Northern and central sectors; widespread.

Euphorbia exigua L. — T scap — Euri-Medit — Flat sector to the west of the central sandy coast; rare.

Euphorbia helioscopia L. — T scap — Cosmop — Clearings, meadows near the oleasters to the west of Cala Crabittu; common.

Euphorbia peplus L. — T scap — Cosmop — In the vicinity of the tower and where livestock graze; common.(*)

Mercurialis annua L. — T scap — Paleotemp — Rare examples in the NE flat sector.

ANACARDIACEAE

Pistacia lentiscus L. — P caesp — Steno-Medit — Common all over the headland.

MALVACEAE

Althaea hirsuta L. — T scap — Euri-Medit — Near Punta Tonnara; very rare.

Malva parviflora L. — T scap — Euri-Medit — Clearings in the central sector; not very widespread.

THYMELAEACEAE

Daphne gnidium L. — P caesp — Steno-Medit-Macaron — Northern sector, slightly to the west of the salty marsh area; rare.

Thymelaea hirsuta (L.) Endl. — NP — S-Medit-W-Asiat — Flat sector to the west of the sandy coast; not very widespread.

CISTACEAE

Cistus monspeliensis L. — NP — Steno-Medit-Macaron — Common all over the headland.

Cistus salvifolius L. — NP — Steno-Medit — CW inlet, Caletta is Ollastus, with slight sandy component; rare.

TAMARICACEAE

Tamarix africana Poiret — P scap — W-Medit — In the vicinity of the salty marsh area and an eastern inlet just before the slope up to the tower; rare. This tamaricacea is continually being cut down to make open fires, particularly in the summer period.

FRANKENIACEAE

Frankenia intermedia DC. — Ch suffr — Steno-Medit-Centroas-Sudafr -Sandy and salty coastal meadows; common.

Frankenia pulverulenta L. — T scap — Steno-Medit-Centroasiat-Sudafr — In the salty-sandy area; very rare.

CACTACEAE

Opuntia ficus-indica (L.) Miller — P succ — Neotrop — To the north of the CE sandy coast; rare.

MYRTACEAE

Myrtus communis L. — P caesp — Steno-Medit — In the vicinity of the bay between the two 24 levels; very rare.

THELIGONACEAE

Theligonum cynocrambe L. — T scap — Steno-Medit — Among the brush of the CE sector in the vicinity of level 24; rare.

UMBELLIFERAE

Bupleurum semicompositum L. — T scap — Steno-Medit-Turan — Among the brush of the CE coast; rare.

Crithmum maritimum L. — Ch suffr — Euri-Medit — CW coast; not very widespread.(*)

Daucus carota L. subsp. ***carota*** — H bienn — Subcosmop — Examples scattered throughout the headland; not very widespread.(*)

Daucus carota L. subsp. ***maritimus*** (Lam.) Batt. — H bienn — W-Medit -Cliffs of the western sector; very rare.

Daucus carota L. subsp. ***maximus*** (Desf.) Ball — H bienn — Euri-Medit — Uncultivated areas and pasturelands; very rare.

Eryngium campestre L. — H scap — Euri-Medit — Internal flat areas, well trodden and intensively grazed; common.

Eryngium maritimum L. — G rhiz — Medit-Atl — CW and eastern sandy sector; very rare. Wind erosion, which is particularly evident in the western sector, contributes to weaken increasingly the plants of this and many other species which grow in this sector of the headland.

Ferula communis L. — H scap — S-Medit — Examples scattered all over the headland.

Scandix pecten-veneris L. — T scap — Euri-Medit divenuta Subcosmop — Internal zone of the headland in the vicinity of Punta Perdosu in a cool, shady vale; not very widespread.

Thapsia garganica L. — H scap — S-Medit — Central flat area; rare.(*)

PRIMULACEAE

Anagallis arvensis L. — T rept — Subcosmop — Meadows, edges of the paths, breaks in the brush; common.(*)

Asterolinon linum-stellatum (L.) Duby — T scap — Steno-Medit — Amidst the coastal garrigue and the brush; common.

PLUMBAGINACEAE

Limonium malfatanicum Erben — Ch suffr — Endem — CE coast; common.

Limonium tigulianum Arrigoni *et* Diana — Ch suffr — Endem — Along the coasts and rarely in the interior; common.(*)

OLEACEAE

Olea europaea L. var. ***sylvestris*** (Miller) Brot. — P caesp/P scap — Steno-Medit — Especially widespread in the northern sector where some examples of considerable size are to be found.

Phillyrea angustifolia L. — P caesp — Steno-W-Medit — Some examples in the zone to the east of Punta Tonnara and along the slope leading to the tower; rare. Some examples vary considerable as to leaf size and shape.

Phillyrea latifolia L. — P caesp — Steno-Medit — In the vicinity of a small cool valley to the north of Punta Perdosu; very rare.

GENTIANACEAE

Centaurium maritimum (L.) Fritsch — T scap — Steno-Medit — Clearings, breaks in the brush; not very widespread.

RUBIACEAE

Galium aparine L. — T scap — Eurasiat — Northern flat area; common.
Galium verrucosum Hudson — T scap — Steno-Medit — Slightly to the east of Punta Tonnara; rare.
Rubia peregrina L. — P lian — Steno-Medit-Macaron — Widespread among the lentisk and generally in the tall brush; common.
Sherardia arvensis L. — T scap — Subcosmop — Meadows, clearings, under large bushes; common.
Valantia muralis L. — T scap — Steno-Medit — At the foot of the tower and in some clearings near the limestone formations; not very widespread.(*)

CONVOLVULACEAE

Convolvulus althaeoides L. — H scand — Steno-Medit — Internal and coastal meadows; more widespread than the next plant quoted.
Convolvulus arvensis L. — G rhiz — Cosmop — Northern flat zone; very rare.
Convolvolus siculus L. — T scap — S-Medit — Along the edges of the pathway near the calicotome stand; rare.

BORAGINACEAE

Cerinthe major L. — T scap — Steno-Medit — Northern clearings, formerly cultivated; very rare.
Cynoglossum creticum Miller — H bienn — Euri-Medit — Untilled areas and clearings to the south of Punta Perdosu; very rare.
Echium plantagineum L. — T scap — Euri-Medit — Internal and coastal zones; common.
Echium sabulicola Pomel — T scap — W-Steno-Medit — CE sandy areas; very rare.(*)
Heliotropium europaeum L. — T scap — Euri-Medit-Turan — Under the trees where livestock is temporarily sheltered; rare.

LABIATAE

Lavandula stoechas L. — NP — Steno-Medit — With rockrose and calicotome; common.
Mentha pulegium L. — H scap — Subcosmop — Central and eastern meadows sporadically damp; common.
Prasium majus L. — Ch frutt — Steno-Medit — Amongst the lentisk bushes and, rarely, in the breaks in the brush; common.

SOLANACEAE

Solanum nigrum L. — T scap — Cosmop — In the vicinity of Punta Perdosu; not very widespread.

SCHROPHULARIACEAE

Bellardia trixago (L.) All. — T scap — Euri-Medit — Flat area to the north of Punta Tonnara; not very widespread.

Misopates orontium (L.) Rafin. — T scap — Euri-Medit — Rocky crevices and arid meadows with a large sand component; common.

Parentucellia viscosa (L.) Caruel — T scap — Medit-Atl — Meadows and clearings in the central zone, sporadically damp; common.

Verbascum pulverulentum Vill. — H bienn — Centro e S-Eurp — Northern pasturelands near Punta Perdosu; very rare.

Verbascum sinuatum L. — H ros — Euri-Medit — Flat areas, amongst the brush and at the edges of the pathways; common.

OROBANCHACEAE

Orobanche minor Sm. — T par — Subcosmop — Grass meadows amongst the brush to the east of Punta Tonnara and Caletta is Ollastus; rare.

PLANTAGINACEAE

Plantago coronopus L. subsp. ***coronopus*** — H bienn — Euri-Medit — Internal flat areas; common.

Plantago coronopus L. subsp. ***commutata*** (Guss.) Pilger — T scap Steno-Medit — Rocky crevices along the coast and C. E. sandy areas; common.

Plantago lagopus L. — T scap — Steno-Medit — Internal meadows, edges of the pathways; not very widespread.

Plantago macrorhiza Poiret — H ros — W-Steno-Medit — Rocky coasts slightly to the south of Punta Tonnara; rare.(*)

VALERIANACEAE

Centranthus calcitrapa (L.) Dufresne — T scap — W-Steno-Medit — Clearings to the NE of Punta Tonnara and near the limestone outcrops; very rare.

DIPSACACEAE

Scabiosa maritima L. — H bienn — Steno-Medit — Extremely rare examples in the CW sandy areas to the south of Punta Tonnara and Caletta is Ollastus.

COMPOSITAE

Aetheorhiza bulbosa (L.) Cass. — G bulb — Steno-Medit — Particularly widespread in the eastern coastal strip.

Anthemis arvensis L. — T scap — Subcosmop — Meadows, edges of pathways, breaks in the brush; common.

Artemisia arborescens L. — NP -S-Medit — Present almost everywhere but especially in the southern sector.(*)

Bellis annua L. — T scap — Steno-Medit-Macaron — Meadows, breaks in the brush, edges of pathways; common.

Bellis perennis L. — H ros -Circumbor — Amongst the tall brush in the central sector of the headland; not very widespread.

Bellium crassifolium Moris — Ch suffr — Endem — Found only a location in the S of Caletta is Ollastus, in the fissuras of the rock; very rare.

Calendula arvensis L. — T scap — Euri-Medit — NE dumps, meadows, edges of pathways; common.

Carduus argyroa Biv. — T scap — Steno-Medit — Flat area to the SW of Punta Perdosu; very rare.

Carduus pycnocephalus L. — H bienn — Medit-Turan — Flat area to the west of the eastern sandy coast; rare.(*)

Carlina corymbosa L. — H scap — Steno-Medit — In all the flat areas; common.

Carthamus lanatus L. — T scap — Euri-Medit. — In the vicinity of the limestone areas; rare.

Centaurea calcitrapa L. — H bienn — Subcosmop — Along the edges of the pathway leading to the tower; not very widespread.

Chamaemelum mixtum (L.) All. — T scap — Steno-Medit — CE sandy areas; very rare.

Chrysanthemum coronarium L. — T scap — Steno-Medit — Dumps, temporary shelters for livestock and intensely grazed areas; not very widespread.

Chrysanthemum myconis L. — T scap — Steno-Medit — Northern and central flat areas; very rare.

Cichorium intybus L. — H scap — Cosmop — To the SW of the salty marsh area; rare.

Crepis vesicaria L. subsp***. hyemalis*** (Biv.) Babcock — H bienn — S-Medit — Clearings, edges of pathways, pasture areas; not very widespread.

Cynara cardunculus L. — H scap — Steno-Medit — Among the CE sandy areas and at the edges of the calicotome slope; widespread.

Dittrichia graveolens (L.) W. Greuter — T scap — Medit-Turan — Flat area in the northern sector; rare.

Dittrichia viscosa (L.) W. Greuter — H scap — Euri-Medit — Degraded environments, dumps, sandy areas; common.

Evax asterisciflora (Lam.) Pers. — T rept — Steno-Medit — At level 50 along the Punta Perdosu — Punta Tonnara pathway; very rare.

Evax pygmaea (L.) Brot. — T rept — Steno-Medit — Along the road leading to the tower; common.

Galactites tomentosa Moench — H bienn — Steno-Medit — Scattered examples among the brush and along the pathways; common.

Hedypnois cretica (L.) Dum.-Courset — T scap — Steno-Medit — Scattered examples in the flat pasture areas; rare.

Helichrysum italicum (Rot.) G. Don subsp. ***microphyllum*** (Willd.) Nyman — Ch suffr — W-Medit — Scattered examples; does not form garrigues as on other headlands or small islands of Sardinia.

Hyoseris scabra L. — T ros — Steno-Medit — Coastal meadows to the south of the sandy areas; rare.

Hypochoeris achyrophorus L. — T scap — Steno-Medit — Amongst the brush, along the edges of pathways, in the vicinity of the tower; common.(*)

Inula crithmoides L. — Ch suffr — SW-Europ — Among the sands of the salty marsh area; not very widespread.

Leontodon tuberosus L. — H ros — Steno-Medit — Common throughout the headland.

Logfia gallica (L.) Cosson & Germ. — T scap — Euri-Medit — Meadows, breaks in the brush; common.

Pallenis spinosa (L.) Cass. — H bienn — Euri-Medit — Edges of pathways and intensely grazed zones; common.

Phagnalon saxatile (L.) Cass. — Ch suffr — W-Medit — Rocky crevices in the central sector of the headland; very rare.

Reichardia picroides (L.) Roth — H scap — Steno-Medit — Rocky coastal crevices and breaks in the brush; common.(*)

Scolymus grandiflorus Desf. — H scap — SW-Medit — Northern and central flat areas; widespread.

Senecio leucanthemifolius Poiret — T scap — Steno-Medit — Common along the coasts.(*)

Senecio vulgaris L. — T scap — Cosmop — To the north, in the vicinity of the large oleasters; rare.

Sonchus asper (L.) Hill — T scap — Subcosmop — In crevices and meadows to the SW of Punta Perdosu; rare.

Sonchus oleraceus L. — T scap — Subcosmop — Scattered examples throughout the headland; common.(*)

Tragopogon hybridus L. — T scap — Steno-Medit — Flat grassy clearings to the east of Punta Tonnara; very rare.

Urospermum dalechampii (L.) Scop. — H scap — Euri-Medit — Clearings near the tower; very rare.(*)

JUNCAGINACEAE

Triglochin bulbosa L. subsp. ***barrelieri*** (Loisel.) Rouy — G bulb — Steno-Medit — Meadows which are sporadically damp and arid during the summer; rare.

MAGNOLIOPHYTA-LILIOPSIDA

POSIDONIACEAE

Posidonia oceanica (L.) Delile — I rad — Steno-Medit — Along all the submerged coasts and in particular the sandy coasts; common.

LILIACEAE

Allium commutatum Guss. — G bulb — E-Steno-Medit — CW rocky and sandy sector; widespread.

Allium roseum L. — G bulb — Steno-Medit — Amongst the brush and garrigue; rare.

Allium subhirsutum L. — G bulb — Steno-Medit — Amongst the brush and garrigue; rare.

Allium triquetrum L. — G bulb — W-Steno-Medit — Cool damp areas to the south of Punta Perdosu; very rare.

Asparagus acutifolius L. — G rhiz — Steno-Medit — Among the calicotome stand; very rare. For this genus, the key suggested by Bozzini (1959) was used.

Asparagus albus L. — Ch frut — W-Steno-Medit — Scattered examples over the whole headland; common.

Asparagus horridus L. (=*Asparagus stipularis* Forssk.) — Ch frut — S-Medit — Extremely rare examples in the vicinity of Punta Tonnara and to the south of the CE sandy coast.

Asphodelus aestivus Brot. — G rhiz — Steno-Medit — Common throughout the headland.

Muscari comosum (L.) Miller — G bulb — Euri-Medit — Flat area to the NE of Punta Tonnara; rare.

Ornithogalum corsicum Jord. *et* Fourr. — G bulb — Endem — Meadows to the north of the tower; widespread.

Ornithogalum narborense L. — G bulb — Steno-Medit — Immediately after the eastern sandy area towards the tower; very rare.

Ruscus aculeatus L. — G rhiz — Euri-Medit — Internal area of the headland, in the vicinity of Punta Perdosu in a damp channel; rare.

Scilla autumnalis L. — G bulb — Euri-Medit — Amongst the coastal garrigue in the vicinity of the tower; not very widespread.

Smilax aspera L. — NP — Paleo-Subtrop — Amongst the lentisk bushes; common.

Urginea fugax (Moris) Steinh. — G bulb — Steno-Medit — Arid meadows and rocky crevices in the central sector; very rare.

AMARYLLIDACEAE

Leucojum autumnale L. — G bulb — Steno-Medit — Small plains between Punta Perdosu, Punta Tonnara and the salty marsh area; rare.

Narcissus tazetta L. — G bulb — Steno-Medit — Central sector of the headland at level 24; very rare.

Pancratium maritimum L. — G bulb — Steno-Medit — WC coastal sector; not very widespread.

DIOSCOREACEAE

Tamus communis L. — G rad — Euri-Medit — In a small cool valley in the vicinity of Punta Perdosu; not very widespread.

IRIDACEAE

Gynandriris sisyrinchium (L.) Parl. — G bulb — Steno-Medit — Clearings, meadows, edges of pathways; common.

Iris germanica L. — G rhiz — In the vicinity of the tower where it was certainly at one time introduced and now flourishes spontaneously.

Romulea ligustica Parl. — G bulb — W-Steno-Medit — Among the tall brush and garrigue; not very widespread.

Romulea requienii Parl. — G bulb — Endem — Grassy meadows, uncultivated areas and pastures; rare.

Romulea rollii Parl. — G bulb — W-Steno-Medit — In a small meadow at the edges of the path near the eastern sandy area; very rare.

JUNCACEAE

Juncus acutus L. — H caesp — Euri-Medit — NE salt marsh area; common.

Juncus hybridus Brot. — T caesp — Medit-Atl — Meadows near the sandy eastern coast; not very widespread.

Juncus pygmaeus L.C.M. Richard — T caesp — Medit-Atl — Flat damp areas which dry out in the summer; very rare.

GRAMINEAE

Aegilops geniculata Roth — T scap — Steno-Medit-Turan — To the west of the salt marsh area; widespread.

Aira elegantissima Schur — T scap — Euri-Medit — Breaks in the brush and flat areas; rare.

Avena barbata Pott — T scap — Euri-Medit-Turan — Scattered examples throughout the headland; common.(*)

Avena sterilis L. — T scap — Euri-Medit-Turan — Amongst the brush and in the flat areas; not very widespread.

Brachypodium distachyon (L.) Beauv. — T scap — Steno-Medit-Turan — Among the garrigue in the vicinity of the tower and generally in the flat areas; common.

Briza maxima L. — T scap — Paleo-Subtrop — Flat area between Punta Perdosu and the salt marsh area; rare.

Briza minor L. — T scap — Subcosmop — Brush and cool areas to the south of Punta Perdosu; rare.

Bromus hordeaceus L. — T scap — Subcosmop — Grassy clearings and breaks in the brush; rare.

Bromus madritensis L. — T scap — Euri-Medit — Pasturelands, uncultivated areas, edges of pathways; common.

Bromus maximus Desf. — T scap — Paleo-Subtrop — Small plain running from Punta Tonnara and Caletta is Ollastus; rare.

Cynodon dactylon (L.) Pers. — G rhiz — Cosmop — Flat interior clearings between Tonnara and the CE sandy areas; not very widespread.

Cynosurus echinatus L. — T scap — Euri-Medit — Scattered examples throughout the headland; not very widespread.

Dactylis glomerata L. — H caesp — Paleotemp — Common.

Dasypyrum villosum (L.) P. Candargy — T scap — Euri-Medit-Turan — NE flat area; not very widespread.

Desmazeria marina (L.) Druce — T scap — Medit-Atl — Coastal meadows with rich sandy component; common.(*)

Elymus farctus (Viv.) Runemark — G rhiz — Euri-Medit — Sandy areas of the CE coast; rare and becoming rarer.

Hordeum marinum Hudson — T scap — W-Euri-Medit — Sandy areas in the salty marsh area; rare.(*)

Hordeum murinum L. subsp. ***leporinum*** (Link) Arcangeli — T scap — Euri-Medit — Meadows, pasturelands, uncultivated areas and mounds of earth; common.(*)

Hyparrhenia hirta (L.) Stapf — G rhiz — Euri-Medit — Crevices and arid meadows, rich in sand between Cala Crabittu and Caletta is Ollastus; rare.

Lagurus ovatus L. — T scap — Euri-Medit — Common throughout the area covered by our survery.

Lamarkia aurea (L.) Moench — T scap — Steno-Medit-Turan — Sandy meadows, crevices, edges of pathways; not very widespread.

Lolium rigidum Gaudin — T scap — Paleo-Subtrop — Pasturelands and uncultivated areas; common.

Lophochloa cristata (L.) Hyl. — T caesp — Subcosmop — Flat central and northern areas; common.

Parapholis incurva (L.) C. E. Hubbard — T scap — Medit-Atl — Crevices and sandy and rocky coastal meadows; widespread.

Phragmites australis (Cav.) Trin. — G rhiz — Subcosmop — Extremely rare examples in a small depression in the vicinity of Caletta is Ollastus.

Piptatherum miliaceum (L.) Cosson — H caesp — Steno-Mesdit-Turan — Among the tall brush to the south of Punta Perdosu; not very widespread.

Poa annua L. — T caesp — Cosmop — Among the brush, garrigue and pasturelands; common.

Poa bulbosa L. — H caesp — Paleotemp — Flat area between Punta Perdosu and the salt marsh area; not very widespread.

Polypogon maritimus Willd. — T scap — Steno-Medit-Macaron — Coastal meadows and sandy areas of the salt marshland; not very widespread.

Stipa capensis Thunb. — T scap — Steno-Medit — Flat area to the east of Punta Perdosu; rare.

Sporobolus pungens (Schreber) Kunth — G rhiz — Subtrop — CE sandy areas; common.

Vulpia myuros (L.) C.C. Gmelin — T caesp — Subcosmop — Pasturelands to the south of Punta Perdosu; not very widespread.

ARACEAE

Ambrosinia bassii L. — G rhiz — W-Steno-Medit — Pathway leading to the tower in the vicinity of the limestone outcrops; not very widespread.

Arisarum vulgare Targ.-Tozz. — G rhiz — Steno-Medit — Common throughout the headland.

Arum pictum L. *fil*. — G rhiz — Endem — Among the brush, under the lentisk bushes, in the sandy area; common.

CYPERACEAE

Carex distachya Desf. — H caesp — Steno-Medit — Cool areas of the southern sector of Punta Perdosu; rare.

Carex divisa Hudson — G rhiz — Euri-Medit-Atl — Flat area slightly to the west of the salt marsh area; rare.

Carex flacca Schreber subsp. ***serrulata*** (Biv.) W. Greuter — G rhiz — Europ — Edges of pathways, arid coastal meadows, breaks in the brush; not very widespread.

ORCHIDACEAE

Ophrys bombyliflora Link — Meadowlands of the EC sector; rare.

Ophrys tenthredinifera Willd. — G bulb — Steno-Medit — Flat clearings to the east of Punta Tonnara; not very widespread.

Orchis papilionacea L. — G bulb — Euri-Medit — Meadows at the edges of pathways; rare.

Serapias parviflora Parl. — G bulb — Steno-Medit — Among the low brush and in meadowlands, at times damp; rare.

Notes on the Flora

The 255 entities found during the course of our researches, excluding the brackish marsh area, are all indigenous. *Iris germanica*, the only species introduced some time ago and present at Capo Teulada and Capo Carbonara, also fulfils its vital cycle in a normal manner, is spreading increasingly and may therefore be included among the spontaneous species which make up the flora of the headland. Taken overall, the flora observed falls into 57 families and includes 186 genera. In this territory also the families richest in taxa are *Compositae*, *Gramineae* and *Leguminosae* which include respectively 40, 32 e 23 species. Of particular importance is also the considerable presence of *Liliaceae,* 15, the high number of which might indicate the state of degradation of Capo Malfatano due to the irrational use of its territory caused by grazing, brush fires and the indiscriminate felling of trees carried out during the last century.

To better classify the flora of Capo Malfatano, in Table 2 we show numerical consistency referred to families, genera and species (the latter including any sub-species or varieties) of some of the headlands of Sardinia.

Analysis of this table and the associated works mentioned in the bibliography makes it possible to establish the fact that notwithstanding lithological, extension and siting differences, the flora of Capo Malfatano is numerically similar to that of Capo Caccia (Valsecchi 1964, 1966), but it differs decidedly from it in the irrelevant endemic component found in the headland subject of our research. In fact at Capo Malfatano, the only endemic species

Table 2. The flora of Capo Malfatano in comparison with that of other headlands of Sardinia.

Locality	*Families*	*Genera*	*Entities*
Capo Malfatano	57	186	255
Capo Teulada	80	284	466
Capo di Pula	91	338	506
Capo Carbonara	62	248	321
Capo Ferrato	70	247	367
Capo Mannu	69	263	446
Capo Frasca	76	297	517
Capo Caccia	53	166	231

Table 3. Floristic composition of the flora of Capo Malfatano.

	Families.	*Genera*	*Species*	*Subspecies*	*Varieties*
Pteridophyta	4	4	3	1	-
Gymnospermae	1	1	1	-	-
Dicotyledones	41	129	168	10	1
Monocotyledones	11	52	68	3	-
Total	57	186	240	14	1

we found were *Arum pictum* L. *fil., Bellium crassifolium* Moris*, Genista ephedroides* DC., *Limonium malfatanicum* Erben, *Limonium tigulianum* Arrigoni *et* Diana, *Ornithogalum corsicum* Jord*. et* Fourr. and *Romulea requienii* Parl. Another difference between these two headlands is their H/T ratio (Sabato & Valenziano 1975): indeed the Mediterranean characteristics of Capo Malfatano are decidedly more marked than those of Capo Caccia.

But whereas endemisms are present in limited number, it should be noted that some species present at Capo Malfatano are extremely rare for Sardinia. This is the case of *Scolymus grandiflorus* Desf., noted by Fiori (1923-1927) and Pignatti (1982) in the territory of Pula (Santa Margherita) but not found recently (Bocchieri 1984). Moreover, some species which were thought to form an integral part of the floristic patrimony of the headland, such as *Rhamnus alaternus* L., *Erica arborea* L.*, Arbutus unedo* L. and, in particular, *Bellium bellidioides* L., one of the most widespread endemisms in Sardinia, were not observed.

In comparison with Capo Carbonara and Capo Ferrato, where entities belonging to the *Rosaceae* families are completely lacking, Capo Malfatano is noteworthy as a result of the presence of *Pyrus spinosa* Forssk.*;* the latter is, indeed, reasonably widespread and is often grafted by the shepherds with more productive and commercial varieties.

As regards floristic composition, Table 3 highlights the fact that the Dicotyledons, as noted in other areas, are the most numerous and, analysing the floristic listing, the most significant component.

The biological forms noted at Capo Malfatano are shown in Table 4 where, compared with those of other headlands, we note that the therophytes reach the highest percentages whereas all the others fall within the extreme values. The considerable incidence of therophytes in the context of the flora of this headland was also observed recently on a small island about 8 km distant (Bocchieri & Iiriti 2000), where this biological form accounts for

Table 4. Biological spectrum table of the flora of Capo Malfatano as compared with that of other headlands of Sardinia.

Locality	Entities	T	H	G	Ch	P	Misc.
Capo Malfatano	255	51.2	17.7	16.5	5.5	8.7	0.4
Capo Teulada	466	43.52	21.60	16.90	7.28	9.42	1.28
Capo di Pula	506	49.8	22.8	12.5	3.7	8.9	2.3
Capo Carbonara	321	49.5	24.6	12.8	5.6	7.5	-
Capo Ferrato	367	50.0	17.0	15.9	6.3	8.7	2.1
Capo Mannu	446	50.89	17.04	13.45	9.64	7.17	1.56
Capo Frasca	517	51.7	18.8	13.6	4.7	7.9	3.3
Capo Caccia	231	43.0	23.9	10.4	5.2	10.4	-

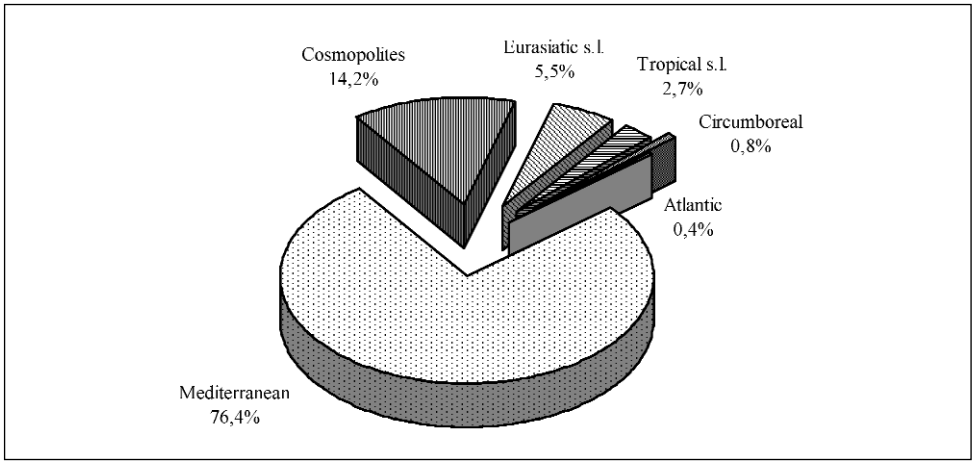

Fig. 5. General chorological spectrum.

55 % of the total and, in particular, has increased by about 5 % on 50 years ago. The species with annual cycles are also those which to a greater degree are subject to variations as noted by Bocchieri (1998) and by Bocchieri, Paradis & Mossa (2000) as regards some small islands off the coast of Sardinia.

As regards chorological elements, Figures 5 and 6 show the high percentage of Mediterranean chorotypes and, surprisingly, almost 15 % of cosmopolitan elements. This latter aspect may be explained if we consider vegetation cover as the result of the balance which is created between the intensity of stress, disturbance and the competition between the various species. In fact, by applying to the flora of Capo Malfatano the C-R-S model (Grime 1979, 1984) we note that the R-strategy species, those capable of adapting to habitats in which factors of disturbance predominate, and the S-strategy species, in which limiting factors prevail, are those most frequently represented. All this would seem to confirm statements made previously regarding the territory under examination in which errors of utilisation and management are compromising its natural balance and, consequently, permitting the settlement of cosmopolitan species (Fig. 7).

On the southern tip of the headland stands a tower which was built at the end of the16th century, on the walls of which numerous phanerogams have taken root. These plants, included among biological deteriorating agents, create problems for the recovery, conservation and enhancement of this building of artistic and historic value. From the floristic listing we may see that on the walls of the tower 28 entities have been noted, represented mainly by *Compositae*, *Gramineae* and *Umbelliferae*. Some of these, as observed on other monuments, represent the ruderal flora of historic structures (Di Martino 1994, 1999) and have a considerably significant danger index (Lo Giudice & al. 1999) since they represent a potential hazard for the structures in question. Since the floristic survey of the headland is completely new, it is not possible to make comparisons or evaluate the arrival or disappearance of new species in order to identify biological and chorological types, the ecological element or eventual strategies of adaptation and hence draw conclusions on the

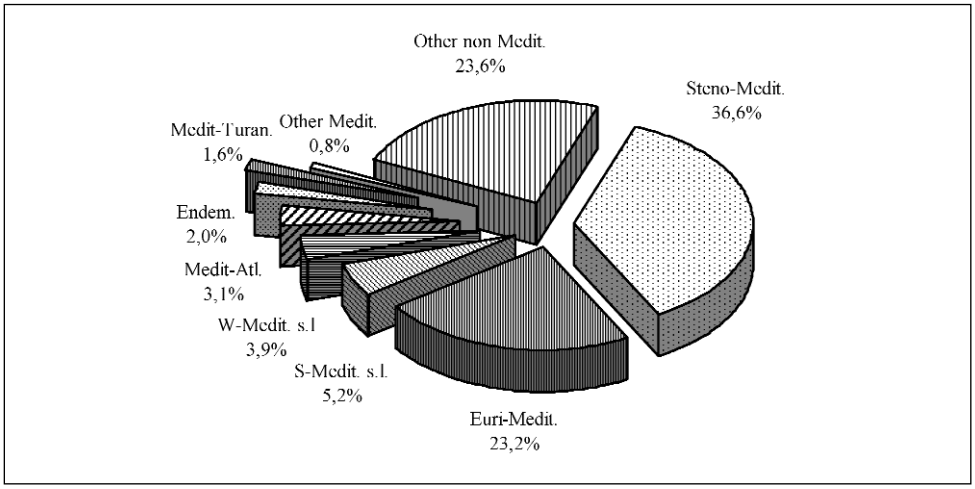

Fig. 6. Chorological spectrum of Mediterranean sub-elements.

changes which have characterised this headland over time. The floristic modifications, verified by means of current monitorings, are an aspect of the vegetation cover which many botanists take into account during their surveys in which any comparisons with different sites must of necessity involve areas displaying similar ecological characteristics.

Taking into account the most significant similar headlands to be found in Southern Sardinia (Capo Teulada and Capo Carbonara), we find that over all these three headlands have a floristic diversity of about 600 entities of which 6 % are exclusive to the area which

Values %	
C	22
R	41
S	37

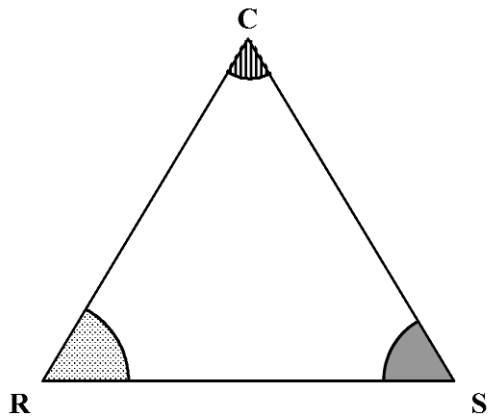

Fig. 7. Grime's diagram.

is the subject of our research, whereas 23 % are common to all three headlands. Moreover, if we apply Jaccard's coefficient, we find that with a value of 0.33, the similarity of the flora of the 3 headlands is medium-low.

The vegetation cover of the headland is marked by phytocoenoses widely present along the whole of the coastal strip of Sardinia, since they are typical of the thermo-Mediterranean bioclimate in which aridity is the determining factor on the development of vegetation. The scarcity of water, the mainly rocky soil and the winds are the climatic factors which have mainly conditioned the vegetation cover of the headland, limiting its natural spread or slowing down its growth. The area of the headland has been involved in the felling of timber which in times gone by represented an important raw material for the production of tools used in farming. In the zones which border the headland there are areas which are cultivated primarily to create pasturelands for grazing livestock. The practice of grazing livestock at the present time involves the whole headland on which there are evident traces of the animals which graze regularly in the meadows and on the low bush growths, a practice leading to a situation of stasis in the dynamics of vegetation. There are also traces of brush fires which in the past broke out in this area.

Vast areas of the headland thus present scrub vegetation cover consisting of *Juniperus turbinata* Guss., *Olea europaea* L. var. *sylvestris* (Miller) Brot., *Calicotome villosa* (Poiret) Link, *Pistacia lentiscus* L. and *Cistus monspeliensis* L. This formation gives rise to vegetation cover marked by the presence of shrubs of average height of 1.5 m consisting of rockrose, lentisk and calicotome, out of which emerge the junipers and oleasters which can reach 2.5 m in height. Observing the dynamic relationships between these plants we note a vegetation cover in a progressive phase since entities belonging to more evolved plant groups dominate over others belonging to less evolved coenoses. In fact, rockrose is in a clear situation of stress since it is "suffocated" by the calicotome and lentisk which dominate it; probably in the past the thickets of rockrose were much more widespread and have been replaced by others of calicotome and lentisk.

The latter however have in turn been overcome by floristic entities belonging to more evolved plant formations such as the olive and juniper which have created difficult conditions of life above all for calicotome, of which numerous withered examples are to be seen. Calicotome plays a key role in the evolution of vegetation cover since in the early phases it creates the ideal environment for the growth of junipers and oleasters, eliminating species such as rockrose.

In a second phase it offers shelter and protection for the growth of plantules of juniper and oleaster. Then comes the phase of dominance of the olive and oleaster which replace the calicotome and thus give rise to a process of colonisation leading to significant modifications in the vegetation cover, which tends towards climax formations. This low woodland is enriched by other plants such as *Phyllirea angustifolia* L. in the western sector in the area of level 32, or *Genista ephedroides* DC. which is only found in populations located in a small depression in the eastern part of the headland.

The greatest evolution of vegetation on the headland is represented by a wood of *Olea europaea* L. var. *sylvestris* (Miller) Brot. and *Juniperus turbinata* Guss. with *Smilax aspera* L., *Clematis cirrhosa* L., *Pistacia lentiscus* L., *Prasium majus* L., *Asparagus acutifolius* L. and *Arisarum vulgare* Targ.-Tozz. At times we find some floristic entities such as *Calicotome villosa* (Poiret) Link and *Euphorbia dendroides* L. which are characteristic

of large areas of the headland. The formations in which oleasters dominate are to be found between Punta Perdosu and Punta Tonnara, in the low portion, along the strips at the edges of pasturelands, where there are some examples of considerable size. On the other hand, juniper predominates in the strips in the eastern portion of the headland between level 24 and the tower.

The growths of *Euphorbia dendroides* L. are located in very sunny areas with rocky substrate and an average slope of 25°. The species which penetrate in this formation, which is at times almost single-species, are lentisk, calicotome, and various species of asparagus with isolated examples of juniper and oleaster.

A dense formation of *Calicotome villosa* (Poiret) Link occupies the flat area in the lower part of Punta Tonnara, where deforestation initiated by man and subsequently abandoned has probably led to the emergence of this degraded aspect of the vegetation cover. The colonising capacity of calicotome has been observed in some meadows where numerous plantules of this species were noted.

The vegetation cover of the headland is marked also by the presence of formations of low bushes and meadows utilised for grazing, generally in contact with each other. The low brush consists of *Lavandula stoechas* L., *Helichrysum italicum* (Rot.) G. Don subsp. *microphyllum* (Willd.) Nyman, *Cistus monspeliensis* L. with isolated examples of *Pyrus spinosa* Forssk. In the areas in which human disturbance is greater we find *Thymelaea hirsuta* (L.) Endl. The meadows on the other hand consist of numerous species in which we find predominance of *Asphodelus aestivus* Brot., *Stipa capensis* Thunb. and *Scolymus grandiflorus* Desf., as well as numerous therophyte species. Along the pathways and in the clearings we frequently find small meadows of *Evax pygmaea* (L.) Brot., *Plantago coronopus* L. and numerous species of *Trifolium*.

Along the coasts we find traces of psammophilous vegetation whose development is conditioned by the processes of erosion currently under way. Species present are *Cakile maritima* Scop. subsp. *aegyptiaca* (Willd.) Nyman, *Agropyron junceum* (L.) Beauv. and *Sporobolus pungens* (Schreber) Kunth, while the growths of *Matthiola tricuspidata* (L.) R.Br. are to be found in the area immediately behind the beaches. Again along the strictly coastal strip where the soil becomes more compact and is gradually replaced by a rocky substrate, vegetation cover consists mainly of *Crithmum maritimum* L. which grows above all in rock fissures, *Lotus cytisoides* L., *Limonium tigulianum* Arrigoni *et* Diana which, at the edges of the pathways, penetrates also into the interior of the headland.

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