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Short note

The role of small reserves in plant conservation in a region of high diversity in eastern Spain

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Abstract

The Valencian region, in eastern Spain, is home to ≈3050 vascular plant species, 68 of which are listed under the critically endangered IUCN category. To afford protection to our endangered, rare and endemic flora, a network of small (2–20 ha) statutory reserves has been created by the Regional Wildlife Service. These are termed ''micro-reserves'' and encompass a large number of individual species and natural habitats. The objective is to monitor long term changes in the plant populations and to carry out active management of the protected plants. In the selection of plots, criteria of distinctiveness and endangerment of plants was followed. Eight years after the onset of this initiative, plant micro-reserves have become an essential tool for the effective protection of the diverse flora of this Mediterranean region.

Keywords: Endemic plants; Mediterranean; Plant micro-reserves; Plant conservation; Threatened flora; Spain

1. Introduction

The five Mediterranean regions of the world – the Mediterranean basin, South Africa, Southwest Australia, California and Central Chile – comprise <2% of the earth's surface, yet shelter almost 20% of the world's known total vascular plant species (Cowling et al., 1996; Médail and Quézel, 1997, 1999). Within the Mediterranean basin, the Valencian region has an area of 23.260 km^2 (Fig. 1) and is home to ≈3050 vascular plant species, 60 of which can be considered strictly endemic (Laguna, 1998). These figures make this region one of the richest botanical territories of Western Europe.

The plant heritage of the Valencian region is at risk. In addition to a long history of human intervention, the territory is currently subject to severe pressure from agriculture and tourism (Rosselló, 1995). This has translated into highly modified landscapes and fragmented habitats. Total numbers of threatened and vulnerable species at regional level following IUCN categories and criteria (IUCN, 2001) exceed 225 (Laguna et al., 1998), of which 68 species are listed as critically endangered (CR). The list includes narrowly distributed endemics as well as widely distributed but rare species. Relict species of the tertiary – *Ruscus hypophyllum* – or glacial periods – *Galanthus nivalis* – are included in the latter group.

Protection of flora in the Valencian region has been addressed by laws and agreements on international, national and regional levels such as the Washington and Bern Conventions (Anon, 1973, 1979) and the Spanish National Catalogue of Threatened Species (Anon, 1990) which together cover 61 taxa. Additionally, the Regional Wildlife Service issued a protection decree listing 25 species (Anon, 1985). The latest initiative of supranational legislation covering threatened Spanish flora is the Habitats Directive (Anon, 1992) whose Annex II lists 431 species of which 10 occur in the Valencian region. However comprehensive this legal frame might seem, the outcome is that only 39% of the taxa listed under the IUCN CR category are protected. Moreover, as in other regions of the Iberian Peninsula or other countries (Castro et al., 1996; Nantel et al., 1998), the existing

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Fig. 1. Location of the Valencian region within Spain.

regional network of 15 Natural Protected Areas fails to secure the bulk of our provincially rare, endemic or endangered plants.

To answer the needs of protection of these species the Regional Wildlife Service put forward in 1994 a proposal to create a network of protected areas, which would encompass the maximum number of individual species and natural habitats. The name awarded to these plots was Plant Micro-Reserve (PMR) (Microrreservas de Flora).

In the present paper, the distribution of the plant taxa that meet the IUCN CR criteria in the Valencian region is collated with that of the Natural Protected Areas. The results show that the distribution of protected areas fails to provide protection to a high percentage of the studied taxa. The PMR approach is described, analysed and discussed.

2. The technical concept of plant micro-reserves

PMRs are small land plots (up to 20 ha) of peak value in terms plant species richness endemism or rarity, given over to long term monitoring and conservation of plant species and vegetation types. This new statutory protection feature was created by the Regional Wildlife Service by means of a Decree (Anon, 1994). The legal frame confers PMRs a permanent status and provides strong protection to plants and substrates while allowing traditional activities compatible with plant conservation. According to IUCN criteria, PMRs would fall into type Ib and IV categories, that is, designations where the administrations and/or the landowners play a major role in conservation by means of active management.

PMRs represent a network of plots mainly located in public land, although they can also be established on private grounds, by means of permanent and irrevocable contracts with landowners. These contracts cater for the need to provide incentives for those who wish to manage their properties on behalf of plant species, so that they are not deterred by the cost of doing so (Ruecker and Wittman, 1995; Wilcove and Chen, 1998).

PMRs are not to be considered Natural Protected Areas, but permanent plots for plant conservation in which protection of the substrate is a means to achieve this goal. In contrast with classical protected areas, PMRs need not await the approval of laborious management plans, so that a proclamation decree can simultaneously approve the boundaries of the protected area and its management plan. Once proclaimed, PMRs are clearly labelled with boundary landmarks.

Within PMRs, active management of vegetation plots and protected plant populations is carried out – seed collection and storage, population reinforcements and introductions, herbivore exclusion, scrub clearance, restoration of suitable environmental conditions, population monitoring. Thus, PMRs are designed to conserve vegetation and to develop or test active conservation methods that bring together ex situ and in situ actions.

3. PMR selection procedure

PMR setting requires continuous field work to identify plant rich sites that must be preserved. Information on the taxonomic status, chorology, ecology, population censuses and threats to survival of rare, endangered and endemic taxa in the Valencian region is continuously gathered. Fieldwork is carried out to map those species (on a 1 km UTM square grid) whose distribution data is vague or which show the most restricted distributions. Additionally, their biotopes are characterized, the specific threats assessed and the assigned IUCN red data book categories to each taxon are revised and updated (IUCN, 2001). The PMR network is open to new incorporations and new PMRs are proclaimed every year.

Distribution records of the rare, endangered and endemic species are transposed onto 1:50,000 topographic maps and digitized into a geographic information system (Arc View GIS v3.2 for Windows). Thus as a first step, and using full distributional ranges, the pattern of species and endemic species richness is examined and searched for hotspots. Subsequently, this pattern is collated with polygonal data themes – vegetation types, arable land, land ownership and Natural Protected Areas – which provide additional information for the design of the PMR network. Whenever land is available around the targeted plant populations or vegetation

types PMRs are made as large as possible (20 ha). However, ownership and the presence of human infrastructures, especially along the coastline, often condition their size.

4. The distribution of CR plant species vs. existing protected areas

Table 1 lists the 68 vascular plants present in the Valencian region which meet the IUCN CR criteria. This group of plants has been chosen on account of their high conservation interest. The list includes narrowly distributed endemic species, restricted to the Valencian region – group A – as well as eastern Iberian, and Iberian endemics – groups B and C – and widely distributed species – group D. Species with populations <200 individuals account for 44% (30) of the total. Additionally, only one population is known for 32% (22) of the listed species. The combination of these two facts gives an idea of the vulnerability to extinction of these species at regional level. The listed species are widely scattered in the territory, a fact that doubtless challenges any protection scheme based on the protection of a small number of large areas. In fact, a large number (70%) of CR taxa fall outside existing Natural Protected Areas (Fig. 2). So far, 207 PMRs have been proclaimed. At the species level, PMRs confer protection to 39 out of 68 (57%) of the most important populations of IUCN CR species. Of these species, 23 are exclusively protected by PMRs, whereas just four are found only within Natural Protected Areas. Therefore, a high coverage of our sensitive flora is achieved through the protection of 1249 ha, 0.05% of the total surface of the Valencian region. On the other hand, large Natural Protected Areas occupy an area of 112,284 ha or 4.83% of the territory, and confer protection to 30.8% of CR plant species.

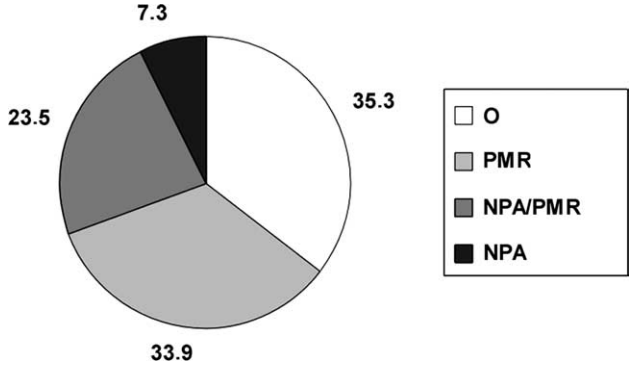

Fig. 2. Percentage of critically endangered taxa present in the Valencian region included in natural protected areas (NPA), PMR within natural protected areas (NPA/PMR), PMR or outside natural protected areas and plant micro-reserves.

5. Discussion

In the Valencian region, a territory of high habitat and plant diversity, regional networks of large protected areas do not provide protection to 70% of the most endangered plant species. To achieve a more comprehensive protection of plant diversity in plant-rich territories, a small scale approach to plant conservation is required, as suggested by Médail and Quézel (1999). The PMR network protects 57% of CR most important plant populations, and this percentage is expected to increase with new additions to the network. Additionally, the PMR initiative has allowed the inventory of all the sites that contain the most threatened plants and habitats or areas of exceptional plant and habitat richness in the Valencian region, a requirement of most biodiversity conservation strategies.

The PMR network is the first such conservation initiative, supported by strong legal and institutional structures, where floristic criteria have been given priority in the selection of protected areas. Similar initiatives, such as botanical reserves in Marche (Italy) (de Klemm, 1997) have been carried out in Europe, although they have a lower protection status than PMRs or have never been officially declared. This is particularly important in the Iberian Peninsula, where Natural Protected Areas are biased towards the conservation of vertebrates, geological formations or alpine landscapes (Domínguez-Lozano et al., 1996). The PMR network exemplifies how small units can encompass a large share of regional plant biodiversity and provide effective protection (Laguna, 2001). Since the onset of the initiative, no PMRs have been destroyed and only six have been affected to some degree by wildfires. In environments of high human disturbance, like some patches of coastline, PMRs have abutted transformation, and are the only wild remnants that survive. Because their location is published in the official journal of the Regional Government and they are clearly labelled in the field, PMRs preempt aggressions in the form of large scale afforestations, invasion by cattle, creation of tracks or firebreaks or installation of power lines.

Some conservation biologists argue that small protected areas are able to include more species than a large block of equivalent size (Järvinen, 1982; Simberloff and Gotelli, 1984; Falkner and Stohlgren, 1997). Opposing this viewpoint, the extreme proponents of large reserves argue that small reserves are of no value, because they cannot provide long term support of populations. The consensus view is that reserve size will depend on the group of species under consideration and the scientific and environmental circumstances (Game and Peterken, 1984; Soulé and Simberloff, 1986).

In the Valencian region, numerous small protected areas are required to provide effective protection to our

Table 1
Conservation data on CR species present in the Valencian community following IUCN criteria (2001)

Species	Group[a]	Number of individuals	Number of populations	Area	Presence in protected areas[b]
Cheirolophus lagunae	A	<500	1	<1 ha	PMR
Echium saetabense	A	<2500	5	<10 ha	PMR
Limonium dufourii[c]	A	<1500	5	<500 m^2	PMR/NPA
Limonium perplexum[c]	A	<200	1	<100 m^2	PMR/NPA
Linaria orbensis	A	<10,000	7	<5 ha	
Silene diclinis[c]	A	<5000	9	<5 ha	PMR
Thymus webbianus	A	<1000	2	<2 ha	PMR/NPA
Verbascum fontqueri	A	<1000	4	<5 ha	PMR
Armeria fontqueri	B	<200	1	<1 ha	PMR
Centaurea lagascae	B	<100	2	<1 ha	PMR
Diplotaxis ibicensis[e,f]	B	<5000	4	<5 ha	PMR
Medicago citrina[g]	B	<500	3	<1 ha	PMR/NPA
Silene cambessedesii	B	<1000	2	<1 ha	PMR
Silene hifacensis[e,g,f]	B	<100	4	<200 m^2	PMR/NPA
Cotoneaster granatensis	C	<50	1	<1 ha	PMR
Euphorbia boetica	C	<500	3	<2 ha	
Ferulago ternatiflora	C	<1000	2	<500 m^2	PMR
Halimium atriplicifolium	C	<10	1	<10 m^2	
Thymus borgiae	C	<100	1	<1 ha	PMR
Ajuga pyramidalis	D	<50	2	<1 ha	
Anarrhinum fruticosum	D	<200	1	<500 m^2	
Apium repens[e,f]	D	<5000	2	<2 ha	
Aristolochia clematitis	D	<250	1	<200 m^2	PMR/NPA
Asplenium marinum	D	<50	1	<200 m^2	
Asplenium seelosii ssp. *glabrum*	D	1	1	<2 m^2	PMR
Berberis hispanica	D	<50	1	<5 ha	PMR
Biarum dispar	D	<100	2	<200 m^2	
Boerhavia repens	D	20	1	<100 m^2	
Cheilanthes tinaei	D	<100	2	<1 ha	NPA
Cistus heterophyllus[g]	D	1	1	<2 m^2	
Clematis cirrhosa	D	<1000	4	<2 ha	PMR
Clematis recta	D	<250	1	<500 m^2	
Coeloglossum viride[d]	D	<50	1	<100 m^2	
Corema album	D	<100	1	<1 ha	PMR
Damasonium polyspermum	D	<2000	4	<1000 m^2	PMR
Epipactis cardina[d]	D	<250	10	<1 ha	PMR/NPA
Genista umbellata	D	<100	1	<1 ha	
Halopeplis amplexicaulis	D	<5000	2	<1 ha	PMR/NPA
Himantoglossum hircinum[d]	D	<2000	3	<1 ha	
Isoetes velatum	D	<1000	1	<1 ha	PMR
Juniperus oxycedrus ssp. *macrocarpa*[c]	D	<250	6	<10 ha	PMR/ NPA
Launaea arborescens	D	<50	4	<1 ha	
Laurus nobilis	D	<50	4	<1 ha	
Lavatera mauritanica	D	<250	5	<1 ha	MR/ NPA
Lemna trisulca	D	<2500	3	<100 m^2	NPA
Leucanthemum arundanum	D	<100	1	<1 ha	MR
Limodorum trabutianum[d]	D	<500	8	<1 ha	MR/ NPA
Listera ovata[d]	D	<50	5	<500 m^2	PMR
Marsilea strigosa[e,f]	D	<1000	1	<1 ha	PMR
Maytenus senegalensis ssp. *europaeus*	D	<200	2	<1 ha	
Mercurialis perennis	D	<50	1	<1 ha	
Ophioglossum lusitanicum[d]	D	<5000	2	<1 ha	PMR/NPA
Orchis cazorlensis[d]	D	<50	3	<1 ha	
Orchis collina[d]	D	<50	2	<100 m^2	NPA

Table 1 (*continued*)

Species	Group[a]	Number of individuals	Number of populations	Area	Presence in protected areas[b]
Orchis conica[d]	D	<500	4	<1 ha	PMR
Orchis papilionacea[d]	D	2	2	<100 m^2	
Orchis purpurea[d]	D	<1000	2	<2 ha	NPA
Phyllitis scolopendrium	D	<250	11	<1 ha	MR
Platanthera chlorantha[d]	D	<250	3	<1 ha	MR
Reseda hookeri	D	< 250	2	<500 m^2	PMR/ NPA
Reseda lanceolata	D	<50	1	<1 ha	
Scutellaria galericulata	D	<500	3	<1 ha	PMR/ NPA
Serapias lingua[d]	D	<1000	2	<1 ha	
Serapias parviflora[d]	D	<5000	4	<2 ha	
Spiranthes aestivalis[e,d,f]	D	<50	2	<1 ha	
Sternbergia colchiciflora[d]	D	<300	5	<1 ha	PMR/ NPA
Thelypteris palustris	D	<500	4	<1 ha	NPA
Utricularia australis	D	<5000	2	<5 ha	PMR/ NPA

[a] Group (A – endemics exclusively restricted to the Valencian community; B – eastern Iberian endemics of narrow distribution, nearly exclusively endemic to the Valencian community; C – widely distributed eastern Iberian endemics; D – widely distributed species).
[b] Protected areas (NPA – natural protected areas, PMR – plant microreserves).
[c] Included in the Valencian Region Catalogue of Threatened Species (Anon, 1985).
[d] Included in the Washington Convention, CITES (Anon, 1979).
[e] Included in the Bern Convention (Anon, 1979).
[f] Included in the Habitats Directive (Anon, 1992).
[g] Included in the Spanish National Catalogue of Threatened Species (Anon, 1990).

rare, endemic and endangered flora since most of these species are scattered across the territory and occupy micro-environments. Gomez-Campo and Herranz-Sanz (1993) suggested that small reserves were the best way to protect plant rich spots in the Iberian Peninsula. This is also the case with other plant-rich territories, such as the Cape region. Tansley (1988), showed that the protection of the Cape flora could only be achieved if small reserves were used. Cowling et al. (2003) also stress the value of small areas in this territory, capable of supporting plant populations as well as important ecological processes. Well-managed small nature reserves have been shown useful for invertebrates, small vertebrates and plants (Reznicek, 1987; Tansley, 1988; Lessica and Allendorf, 1992). More recently, Nantel et al. (1998), concur that the best way to achieve a comprehensive protection of the flora of Newfoundland (Canada), was the delimitation of 79 areas of 1 km^2. Our view is that small reserves should not be seen as an alternative to large protected areas, but as a complement. That is why some PMRs are located within existing Natural Protected Areas. PMRs allow closer monitoring of plant diversity and actions tailored to the needs of particular species or vegetation types. Additionally, in many instances there is no choice other than to accept the challenge of managing species in small reserves when land around them is unavailable for conservation purposes. This is particularly true in places with a long history of human intervention like the Valencian region.

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