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# Crop wild relative

Issue 2 July 2004


Conserving Europe's plant genetic resources
for use now and in the future

PGR Forum - EVK2-2001-00192 - Fifth Framework Programme for Energy, Environment and Sustainable Development

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**Editors**:
Shelagh Kell
Nigel Maxted
Brian Ford-Lloyd

**Design and layout**:
Shelagh Kell

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Photo: Emilio Laguna

**Correspondence address**:
Shelagh Kell, School of Biosciences, University of Birmingham, Edgbaston, Birmingham, B15 2TT, UK
Email: s.p.kell@bham.ac.uk

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# Editorial

Issue 2 of *Crop wild relative* should serve to stretch many readers' imaginations both in terms of what crop wild relatives are and how they might be conserved.

This issue begins with a plea from a representative of plant breeding for attention to be paid to the *in situ* conservation of *Beta* in order to conserve genetic diversity that may otherwise be lost (see pages 4-7), emphasising the fact that *in situ* conservation of genetic diversity is as equally important for plant genetic resource utilisation as *ex situ* conserved germplasm. Crop wild relatives are important components of the Valencian flora, and a description of management activities in the Plant Micro-Reserves of Valencia, Spain, such as habitat restoration, reintroduction and translocation illustrates that conserving these vital resources does not just involve *ex situ* storage in gene banks (see pages 10-13). It also highlights the point that genetic conservation of crop wild relatives does not have to involve the designation of vast tracts of land as protected areas. And exploration is still leading to new discoveries of resources that could be of enormous value to agriculture (see pages 14-15) - important new variation is still waiting to be discovered.

Awareness of the loss of crop wild relative diversity has never been so prominent in the plant genetic resources community, both within Europe and worldwide. This is recognised by the Conference of the Parties (COP) to the Convention on Biological Diversity (CBD) 2010 Biodiversity Target (http://www.biodiv.org/2010-target), as well as a number of other strategies and treaties, such as the Global Strategy for Plant Conservation, the International Treaty on Plant Genetic Resources for Food and Agriculture and the European Plant Conservation Strategy. As a community interested in crop wild relative conservation and use, to meet many of the 2010 biodiversity targets[1] we need to be able to assess change; therefore, a clear starting point is essential. For Europe, PGR Forum is making a significant contribution by providing baseline information and the tools required to monitor this change. We hope that the increasing number of crop wild relative projects will address this issue globally and ensure efficient conservation of these previously somewhat undervalued resources.

PGR Forum is taking the lead in establishing guidelines for the *in situ* conservation of crop wild relatives that will be as equally relevant worldwide as in Europe (see pages 8-9). A series of publications is in preparation and many will be downloadable from the PGR Forum web site (http://www.pgrforum.org). A crop wild relative information system is under construction that will not only provide information to a broad user community, but can also be used as a platform to conjoin the various crop wild relative initiatives through a common data model and web portal. Some exciting developments are underway and will be reviewed in the next issue.

We are already preparing for the third issue of *Crop wild relative* and are looking for news items and longer articles for inclusion. If you would like to contribute please contact the editors at s.p.kell@bham.ac.uk

Comments and feedback on this issue are welcomed.

[1] Particularly targets 2.1, "Restore, maintain or reduce the decline of populations of species of selected taxonomic groups"; 3.1, "Genetic diversity of crops, livestock, and harvested species of trees, fish and wildlife and other valuable species conserved ……."; and 8.2, "Maintain biological resources that support sustainable livelihoods, local food security and health care, especially of poor people"

Lothar Frese

**Above:** *Beta patellaris*, the tetraploid species of *Beta* section Procumbentes, which forms part of the relict flora of the Canary Islands. Species in this section have been shown to contain disease resistant traits of economic importance. Lothar Frese (Federal Centre for Breeding Research on Cultivated Plants) makes recommendations for urgent *in situ* management for species in this group (see pages 4-7).

# Rationale for *in situ* management of wild *Beta* species

*Lothar Frese*

Federal Centre for Breeding Research on Cultivated Plants (BAZ) - Gene Bank, Bundesallee 50, D-38116 Braunschweig, Germany

**Taxonomy, gene pools, and geographic distribution**

The wild species of the genus *Beta* (Table 1) are native to Europe and adjacent areas. The section *Beta* (primary gene pool) occurs along the shores of the Mediterranean basin and along the Atlantic coast from the Canary Islands in the most southern part of its distribution, up to the South of Sweden. The three base species and two hybrid species of section *Corollinae* (secondary gene pool) can mainly be found in Turkey, the centre of diversity of this section, and in the adjacent Caucasus and Transcaucasus region. The only species of section *Nanae* is endemic to Greece. The *Procumbentes* section (tertiary gene pool) has its major distribution area in the Canary Islands but can also be encountered in Southeast Spain and along the coast of Morocco.

*B. vulgaris* subsp. *maritima* is the ancestor of the cultivated leaf beet (*B. vulgaris* subsp. *vulgaris* Leaf Beet Group, also known as Swiss chard) as well as the garden and fodder beet. Sugar beet was developed from a fodder beet type only 200 years ago in Germany. It has become a cash crop of world-wide significance and due to its high preceding crop value it plays an important role in wheat and barley crop rotation systems. The sugar beet breeding gene pool is considered to be narrow. It mainly lacks sufficient genetic variation for resistance and tolerance to biotic and abiotic stress (Figure 1).

There are therefore political (Convention on Biological Diversity (CBD)), agricultural (farmers income, soil fertility) and environmental reasons (resistant varieties to reduce the use of pesticides) to conserve the genetic resources of sugar beet.

| | |
|---|---|
| **Primary gene pool** | Section *Beta* syn *Vulgares* Ulbrich<br><br>*B.vulgaris* L.<br>subsp. *vulgaris* (cultivated beets)<br>Leaf Beet Group<br>Garden Beet Group<br>Fodder Beet Group<br>Sugar Beet Group<br>subsp. *maritima* (L.) Arcang.<br>subsp. *adanensis* (Pamuk.) Ford-Lloyd & Will.<br>*B. macrocarpa* Guss.<br>*B. patula* Ait. |
| **Secondary gene pool** | Section *Corollinae* Ulbrich<br>Base species<br>*B. corolliflora* Zosimovich<br>*B. macrorhiza* Steven<br>*B. lomatogona* Fisch & Meyer<br><br>Hybrid species<br>*B. intermedia* Bunge<br>*B. trigyna* Wald. & Kid.<br><br>Section *Nanae* Ulbrich<br>*B. nana* Boiss. & Heldr. |
| **Tertiary gene pool** | Section *Procumbentes* Ulbrich syn. *Patellares*<br><br>*B. procumbens* Smith<br>*B. webbiana* Moq.<br>*B. patellaris* Moq. |

**Table 1.** Taxonomy of the genus *Beta*

*Lothar Frese*

**Figure 1.** Sugar beets in Germany, summer 2003, suffering from drought stress. In view of the predicted climatic change the development of drought stress tolerant sugar beet breeding lines is required to maintain the competitiveness of the crop.

Until today, *ex situ* conservation is the only method systematically applied.

***Ex situ* conservation**

Currently, 10,523 accessions of wild and cultivated forms of beet exist in gene bank collections, which is a huge *ex situ* germplasm reserve that can be tapped by breeders when need arises. In 1979 the first *Beta* germplasm collecting mission was funded by the International Plant Genetic Resources Institute (IPGRI) and a number of additional missions followed with the objective of sampling wild beets and landraces in the Mediterranean area. Between 1980 and 1990, large geographic gaps were closed by IPGRI and USDA/ARS-funded (United States Department of Agriculture/Agricultural Research Service) missions, and the collection data were entered into national databases. On the initiative of the European Cooperative Programme for Crop Genetic Resources Networks (ECP/GR) a European inventory of *Beta* collections was established in 1987, and in view of the effective collaboration achieved with the National Plant Germplasm System (NPGS) of the USA it was recommended that the inventory should assume an international role. The International Database for *Beta* (IDBB) (Frese and van Hintum,1989) contains information provided by 28 germplasm holdings in 24 countries. This central crop database includes passport data on 4,022 wild beet accessions.

**"The sugar beet breeding gene pool is considered to be narrow. It mainly lacks sufficient genetic variation for resistance and tolerance to biotic and abiotic stress"**

| Taxon | N°. of sites | Elevation (m) asl | |
|---|---|---|---|
| | *n* | Min | Mean |
| "maritima" complex [1)] | 798 | -280 | 51 |
| *B. macrorhiza* | 23 | 780 | 1,580 |
| *B. corolliflora* | 74 | 1,310 | 1,879 |
| *B. lomatogona* | 79 | 680 | 1,267 |
| *B. intermedia* | 201 | 650 | 1,121 |
| *B. trigyna* | - | - | - |
| | | | |
| *B. nana* | 51 | 1,825 | 2,292 |
| | | | |
| *B. procumbens* | 38 | 0 | 53 |
| *B. webbiana* | 14 | 0 | 21 |
| *B. patellaris* | 23 | 0 | 60 |

**Table 2.** Elevation of collection sites
[1)] includes *B. vulgaris* subsp. *maritima*, *B. vulgaris* subsp. *adanensis*, *B. patula* and *B. macrocarpa*

## *In situ* conservation

Why should wild beets be conserved *in situ* in addition to the *ex situ* holdings? There are four arguments. Firstly, in the case of the highly mobile *B. vulgaris* subsp. *maritima* only a genetic snapshot is captured during a collecting expedition and conserved *ex situ*. Hence, the genetic variation conserved *ex situ* may not encompass the genetic variation present in nature. Secondly, seeds of *Beta* species can be stored for many decades before rejuvenation is required. During this period the populations do not participate in the evolutionary process that has generated the genetic variation breeders exploit today and will need in the future. Thirdly, it is general practice of genebank managers to use small populations, i.e. 25 to 50 plants, for seed multiplication. Under these conditions genetic drift and shift can not be avoided. Fourthly, important characters such as the complex inherited *Cercospora beticola* resistance occur in areas where the disease agent is present. Genebanks produce fresh seeds in the absence of any natural selection pressure caused by diseases and it can be assumed that there is a risk of losing traits that occur at low frequencies in the accessions.

The data recorded during collecting expeditions, the taxonomic and biosystematic research and the evaluation of numerous *ex situ* accessions conducted in the past 20-25 years have created the knowledge that can be used today to organise *in situ* management measures complementing *ex situ* conservation as recommended by the CBD.

Lothar Frese

**Figure 2.** *Beta vulgaris* subsp. *maritima*, biennial form. Plant growing on the North Sea island of Helgoland.

**"important characters such as the complex inherited *Cercospora beticola* resistance occur in areas where the disease agent is present…..there is a risk of losing traits that occur at low frequencies in the accessions"**

## Ecological amplitude and habitats: some demographic data

Section *Beta*

The wild species and subspecies of this section are adapted to very different edaphic and climatic conditions. *B. vulgaris* subsp. *maritima* (Figure 2, 3) is mainly distributed along the sea shores where plants are most prevalent on beaches in a narrow band between the high tide zone and the start of the denser coast vegetation. They also occur on cliffs and on disturbed inland sites even at high altitudes and depressions (Table 2). Subspecies *maritima* and *adanensis* are adapted to high sea salt concentrations. *B. macrocarpa* seems to tolerate even more extreme conditions as it can be found growing on dams beside salt pans.

Lothar Frese

**Figure 3.** Site of *Beta vulgaris* subsp. *maritima* in the Po estuary, Italy. The sea beet distributed in this area is the donor of Leaf Spot resistance to sugar beet used in plant breeding since the 1930s

Section *Corollinae*

*B. macrorhiza* is a typical ruderal species colonising landfall areas i.e. fresh gravel and soil at the foot of hillsides or steep cliffs. The sites are humid, as slope water is available to the plants even in prolonged dry periods (Figure 4). *B. corolliflora* is a frequent weed in farm fields and also grows along field margins and roads. Only 10% of the detected sites were part of the natural vegetation (watercourse margins, hill meadows). *B. lomatogona* is specifically adapted to arid conditions. The competitiveness of the species ceases quickly with increasing humidity of the climate and soil (Buttler, 1977).

Section *Nanae*

The only species, *B. nana*, grows at high altitudes on limestone, often close to snow patches.

Section *Procumbentes*

The three species can be found on dry roadsides or ruderal places in or around villages. The species are adapted to arid conditions with annual rainfall between 100 and 300 mm.

Table 3 describes the population sizes recorded during collecting missions. The data are up to 24 years old and should be updated by surveys for two reasons. Firstly we need to ascertain that the population still exist. Secondly, a survey would enable us to learn about the demographic trends in wild beet populations. Survey data are needed to assess the conservation status of the populations and species.

**Structures of genetic diversity in *Beta***
Knowledge of the structure of genetic diversity in *Beta* can assist in planning *in situ* management. It will probably only be possible to protect and manage a very limited number of sites, but which? Our knowledge on the genetic relationships between sections, between species within sections and even between selected accessions within species has increased during the past 20 years. Section *Procumbentes* form part of the relict flora of the Canary Islands. The section is divided into diploid species which are closely related if not identical (*B. procumbens/ B. webbiana*) (Wagner, Gimbel and Wricke, 1989), and a tetraploid species (*B. patellaris*). The diploid species can only be found on the Canary Islands.


**Figure 4.** Site of *Beta macrorhiza* in Daghestan, GUS

Section *Corollinae* is considered the second oldest evolutionary group. Genetic as well as morphological differences exist between *B. macrorhiza* from Dagestan, and the Turkish distribution area. *B. corolliflora* was found to be more polymorphic and heterozygous than *B. lomatogona* and *B. macrorhiza* (Reamon-Büttner, Wricke and Frese, 1996). Due to lack of sufficient germplasm only few investigations on *B. nana* have been published. The species lacks the EcoRI satellite DNA which is common in the rest of the genus (Schmidt, Jung and Metzlaff, 1991).

The annual and predominately inbreeding species of section *Beta* (*B. macrocarpa*, *B. patula* and *B. vulgaris* subsp. *adanensis*) are less polymorphic at the population level than the widespread *B. vulgaris* subsp. *maritima* (Letschert, 1993). Within *B. vulgaris* subsp. *maritima* the macrogeographic allozyme distribution patterns were investigated by Letschert (1993) who concluded that more variation was shown to be concentrated in the Mediterranean accessions while the Atlantic accessions seemed to be less polymorphic.

| Species | *n* | Min | Mean | Max |
|---|---|---|---|---|
| ***B. macrocarpa* (ESP)** | 17 | | | |
| EPS | | 8 | 1,002 | 3,000 |
| Area (m$^2$) | | 9 | 4,445 | 10,000 |
| ***B. macrocarpa* (PRT)** | 7 | | | |
| EPS | | 7 | 232 | 1,000 |
| Area (m$^2$) | | 5 | 6,301 | 10,000 |
| ***B. vulgaris* subsp. *maritima* (PRT)** | 29 | | | |
| EPS | | 8 | 255 | 1000 |
| Area (m$^2$) | | 1 | 5,469 | 10,000 |
| ***B. nana*** | 20 | | | |
| EPS ("seed stalks") | | 6 | 73 | 10 |
| Area (m$^2$) | | 30 | 74 | 120 |

**Table 3.** Demographic data. Examples from Frese, Meijer and Letschert (1990) (*B. macrocarpa* and *B. vulgaris* subsp. *maritima*) and *B. nana* passport data recorded by Dale during a collecting mission in Greece in 1980, filed at the BAZ Gene Bank.
*n* = Number of populations, EPS = effective population size, Area = area populated by flowering and vegetative plants.

However, where does a geographic region begin and where are the limits of *B. vulgaris* subsp. *maritima* populations which are generally colonising a linear habitat ?

**Gene flow in the natural habitat**
Raybould *et al.* (1996a) were the first to investigate the genetic structure of a population of *B. vulgaris* subsp. *maritima* distributed along the coast line of Furzey Island, UK, amongst others, to better understand "the dynamics of major ecological processes such as colonisation, invasion, succession and extinction" (Avise, 1994 cited in Raybould *et al.*, 1996a). Based on isozyme and RFLP data they found strong evidence that the structure of the investigated population was determined largely by founder effects and not by isolation by distance arising from limited pollen and seed flow diminishing with increasing spatial distance between patches of plants. Raybould *et al.* (1996b) continued this kind of research with 10 populations collected on the Dorset coast in the UK and found highly significant decrease in gene flow with distance when using RFLP markers but not for isozymes. Further analysis revealed that the effects of isolation by distance are habitat dependent and only play a role in cliff populations, while in the drift-line populations in the perimeter of the harbour, founder effects are a significant source of variation between populations (Raybould, Mogg and Gliddon, 1997).

**Distribution of traits of economic importance**
Systematic germplasm screening programs were initiated in the United States in the 1980s and were complemented by an EU funded project (GENRES CT95 42) between 1996 and 2002 (Table 4). Today, there is much detailed information on the occurrence of traits useful to agriculture in the species and within the distribution area. Passport data of accessions collected after 1979 often include the geographic co-ordinates of the collection place. We can therefore present, at a fine-scaled geographic level, scientific and economic arguments why a specific population should be maintained to local administrations responsible for nature preservation.

**Urgent needs for *in situ* management of wild beets in the EU**
Highest priority: *B. nana*
Since 1980 there have been only few attempts to monitor the species. For biological reasons *ex situ* conservation is not an alternative, and we have to determine whether the species is still extant in the wild.

| Taxonomic unit | Disease resistance | | | | | | |
|---|---|---|---|---|---|---|---|
| | BMYV | BYV | Powdery Mildew | *Cercospora* Leaf spot | *Aphanomyces cochlioides* | *Pythium ultimum* | *Rhizoctonia solnai* |
| *Procumbentes* | 100 | 20 | 50 | 100 | 0 | 10 | 0 |
| *Corollinae* | 100 | 62 | 0 | 15 | 93 | 0 | 0 |
| *Beta* (wild & cult.) | 12 | 7 | 1 | 4 | 1 | 6 | 7 |
| *B. macrocarpa* | 0 | 0 | 0 | 0 | 8 | 8 | 0 |
| *B. patula* | 100 | 0 | 0 | - | 0 | 0 | 0 |
| *B. vulgaris* nt. | 17 | 8 | 0 | 0 | 2 | 6 | 4 |
| *B. vulgaris* subsp. *adanensis* | 0 | 0 | 0 | - | 0 | 8 | 0 |
| *B. vulgaris* subsp. *maritima* | 6 | 7 | 0 | 11 | 3 | 10 | 10 |

**Table. 4.** Distribution and frequency of resistant accessions (score 1-2) in *Beta*. Percentage of 400-700 tested. (Luterbacher *et al*., in press, Luterbacher *et al*., submitted)

*Lothar Frese*

**Figure 6.** Site of *Beta patellaris* in Lanzarote, Canary Islands

Second priority: *B. macrocarpa* and *Procumbentes* species

The survival of *B. macrocarpa* is to some extent linked to the traditional management of salt winning areas and it can get lost with the modernisation of sea salt production. Little is known about the *Procumbentes* populations on the Canary Islands, but with a yearly influx of around 9,000,000 visitors (Francisco-Ortego *et al*., 2000), the tourist industry is likely to have a significant impact on ruderal sites in villages and along roads.

## Conclusions

There are strong political, biological and economic reasons why wild beet populations should be considered for *in situ* management. There is detailed information available on the distribution of the species and individual populations, we have good taxonomic and biosystematic knowledge, and a Central Crop Data Base for *Beta* which could be used as an *in situ* management tool. There is a strong interest amongst European scientists to investigate the specific requirements for *in situ* management of *Beta*.

*Lothar Frese*

**Figure 5.** *Beta webbiana*, belonging to the tertiary gene pool of *Beta*. A source of disease resistances.

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Lothar Frese is a member of the PGR Forum Stakeholder Panel.

# Crop wild relative population management: PGR Forum guidelines under development

**A summary of Workshop 4, Menorca, Spain, April 2004** *Lori De Hond [1] and Shelagh Kell [2]*

[1] Departamento de Biología Vegetal, Universidad Politécnica de Madrid, Ciudad Universitaria, E-28040 Madrid, Spain
[2] School of Biosciences, University of Birmingham, Edgbaston, Birmingham, B15 2TT, UK

PGR Forum held Workshop 4, “Population Management Methodologies”, on the island of Menorca, Spain, in April 2004. Hosted by the Universidad Politécnica de Madrid, this workshop was the third in a series of five workshops aimed at assessing the taxonomic and genetic diversity of European crop wild relatives (CWRs) and developing appropriate conservation methodologies. Thirty-four PGR specialists were present, representing 20 different countries.

The main objective of this workshop was to agree on population management and monitoring methodologies appropriate for the *in situ* genetic conservation of European crop wild relatives. Using existing techniques for the generation of management plans as a starting point, the Forum examined how these might be adapted to genetic rather than traditional ecological goals.

On Day 1 of the workshop, after reviewing progress in the PGR Forum Work Packages, José Iriondo, Work Package 4 Coordinator, from the Universidad Politécnica de Madrid, gave a short introduction to the workshop, outlining its aims and programme of activities. Nigel Maxted, PGR Forum Project Coordinator, from the University of Birmingham, UK, provided the context for *in situ* crop wild relative conservation in terms of legislation, needs and existing knowledge, and proposed a model for their conservation in genetic reserves. Ehsan Dulloo from the International Plant Genetic Resources Institute (IPGRI), Rome, Italy gave a general introduction on population management methodologies to be considered in the *in situ* genetic conservation of CWRs. Practical examples were given by François Lefèvre from the Unité de Recherches Forestières Méditerranéennes, INRA, Avignon, France, on “Strategies and methodologies for the *in situ* genetic conservation of *Populus nigra*, an example CWR in forestry”, and Lothar Frese from the Federal Centre for Breeding Research on Cultivated Plants (BAZ)-Gene Bank, Braunschweig, Germany, on “Rationale for *in situ* management of wild *Beta* species”.

These presentations were followed by two parallel group discussions: “Genetic reserve location and design: integration of PGR Conservation in Protected Area management”, and "Identification of milestones for *in situ* genetic conservation: minimum baseline information for the development of a management plan."

Day 2 of the workshop was dedicated to population monitoring methodologies for the *in situ* genetic conservation of CWRs. Xavier Picó from the Centro Nacional de Biotecnología (CSIC), Madrid, Spain, spoke on “Demographic monitoring: field sampling criteria and data treatment”, including the analysis of spatio-temporal variation in life-cycle traits and the assessment of population dynamics. The group discussions that followed considered the parameters, sampling methods and data analyses for demographic and ecological monitoring of CWRs, focusing on the special needs and problems of annual, biannual, perennial, and vegetatively-propagated species.

Maria Pohjamo from the University of Helsinki, Finland, presented a review of genetic monitoring methodologies. The Forum considered genetic parameters, sampling methods and data analyses that could be used to gather baseline information on target population genetic trends as well as community trends and successional changes. Methodologies for genetic monitoring of inbreeding (autogamous) and outbreeding (allogamous) species were compared.

On Day 3 of the workshop Emilio Laguna from the Servicio de Conservación de la Biodiversidad, Generalitat Valenciana, Valencia, Spain, shared his experience in the microreserve initiative currently being carried out in the Valencia region in a presentation entitled, “From *ex situ* to *in situ* conservation: an assessment of the microreserve initiative.” Discussion groups explored habitat and species


Shelagh Kell

**Above**: Brian Ford-Lloyd from the University of Birmingham, UK facilitates a working group discussion addressing genetic monitoring methodologies for autogamous crop wild relatives recovery techniques, including back-up *ex situ* strategies, reinforcements, reintroductions and translocations.

In the afternoon PGR Forum had the opportunity to visit "Algendaret Vell", a typical Menorcan farm which uses a traditional cheese-making process to produce ecological cheese from the milk of a local cattle breed which is raised using organic farming methods, and "Canaló", a farm cultivating and promoting authocthonous fruit trees.

On Day 4 a Red List Training Workshop was led by IUCN Red List Programme Officer Craig Hilton-Taylor with the assistance of Caroline Pollock in preparation for PGR Forum Workshop 2, Threat and Conservation Assessment, to be held in Spring 2005. Case studies were examined and threat assessments were carried out for these taxa.

A major outcome of Workshop 4 is a set of draft guidelines for *in situ* population management of CWRs. Four working groups focusing on different aspects of population (and genetic reserve) management were formed to develop and publish these methodologies:

**Group 1: "Genetic reserve location and design"** will develop the criteria for the selection of genetic reserve locations among taxon localities present in protected areas and criteria for reserve delimitation and design.

**Group 2: "Minimum contents and basic structure of a management plan"** will develop guidelines for identifying genetic reserve objectives, the baseline information needed for the development of a management plan, and the minimum contents, basic structure, design and implementation of a conservation management plan.

**Group 3: "Population monitoring methodologies"** will further develop methodologies for the demographic and genetic monitoring of CWR populations.

**Group 4: "Population and habitat recovery techniques"** will establish guidelines for species recovery, habitat restoration and back-up *ex situ* measures.

A detailed report of Workshop 4 will shortly be available on the PGR Forum web site, and publication of the guidelines and methodologies are expected during 2005.

*Cristóbal González*

**Above**: Participants at PGR Forum Workshop 4 "Population Management Methodologies", held in Mahón, Menorca, Spain, April 2004

## PGR Forum Workshop 5
## Genetic erosion and pollution assessment

**8-11 September 2004, Terceira Island, Autonomous Region of the Azores, Portugal**

Genetic erosion and pollution are major threats to the diversity of European crop wild relatives. PGR Forum is tackling the critical issue of how plant genetic erosion and pollution can be predicted and assessed. The forum will build upon and refine existing methodologies for the prediction of genetic erosion; however, there are currently no established methodologies for assessing plant genetic pollution. The threat of genetic pollution or introgression, either from genetically modified organisms (GMOs) or from conventionally bred crops, to wild species has become an increasing risk to the *in situ* genetic conservation of crop wild relatives.

Co-organised by the Instituto Nacional de Investigação Agrária e das Pescas, Portugal and the University of Birmingham, UK, Workshop 5, a three day workshop, will consist of a series of presentations and working group discussions, which will result in a set of draft recommendations for the assessment and prediction of genetic erosion and pollution in crop wild relatives.

For further information visit http://www.pgrforum.org/Workshop_5.htm

# The plant micro-reserve initiative in the Valencian Community (Spain) and its use to conserve populations of crop wild relatives

*Emilio Laguna*

Servicio de Conservación de la Biodiversidad, Conselleria de Territorio y Vivienda, Generalitat Valenciana.
Francesc Cubells 7, E-46011 Valencia, Spain. Email: floraval@gva.es

Since 1994, the government of the Valencian Community, one of the 17 Autonomous Communities of Spain fully empowered by the Spanish Constitution to pass laws and develop the policy on nature conservation in its territory, has given legal protection to plants under the Plant Micro-Reserve initiative (PMR). PMRs are sites devoted to the study and conservation of rare, endangered or endemic plants of the Valencian Community; these species have been listed and described by Laguna (1998) and Serra *et al*. (2000, 2004).

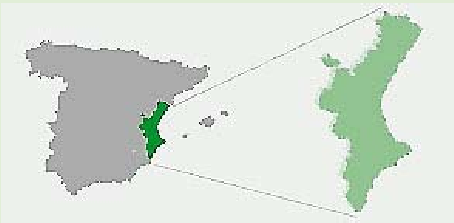

**Figure 1.** Map showing the location of Valencia, Spain.

The Valencian lands lay on the Eastern side of Spain, just opposite the Balearic Islands (Figure 1). This territory occupies 23,260 $km^2$ and hosts ca. 3.9 million inhabitants. Fifty-one percent of the Valencian territory is formed by natural areas, and the remainder 49% is covered by cities, industries and agricultural areas. The region is characterised by its wide range of altitude from sea level up to 1836 m, rainfall with annual means between 180 and 980 mm/year, and temperatures with a mean annual range in the cities of 9.0-19.5 C, combined with a wide variety of soils and rock types. As a result, it shelters an outstanding richness of wild plants, with 3,150 vascular plant taxa recorded (Mateo and Crespo, 2003), 350 of them being Spanish endemics (Laguna, 1998); 60 of these species are considered as exclusive Valencian endemic plants. The Valencian Community is a unique region of Spain sharing more than one Centre of Plant Diversity listed by Davis, Heywood and Hamilton (1994): the Javalambre Mountains and the Betic range.

### The Valencian Community and crop wild relatives (CWRs)

No accurate studies on the wild relatives of cultivated plants (CWRs) have been made on the Valencian Community. However, it is thought that at least 15% of the wild species can be considered as "classical" wild relatives i.e. related to traditional cultivated plants, mainly to vegetables; this percentage may reach up to 80-85% of the Valencian flora, if we use a "large" or more modern concept of wild relatives i.e. those species related to any cultivated plants, including ornamental plants. Following the broader definition of CWRs, the Valencian CWRs include:

- A large list of native wild species, relatives of present or past crops, ancestors of cultivated species around the Mediterranean basin (e.g. *Brassica, Raphanus, Vicia, Lathyrus, Prunus, Hordeum, Avena*, *Allium*, etc.)
- Wild species used in the past to generate the genetic pool of present crops (e.g. *Prunus insititia, Malus sylvestris, Beta maritima, Cynara cardunculus*)
- Naturalised representatives of cultivated species integrated in the natural vegetation (e.g. *Olea europaea* subsp. *oleaster, Pinus pinea, Ceratonia siliqua, Prunus avium, P. dulcis, Juglans regia*)
- A large group of neglected crops, naturalised or integrated in natural areas (e.g. *Crataegus azarollus, Mespilus germanica, Sorbus domestica, Genista tinctoria, Rubia tinctorum, Carthamus tinctorius*)
- Wild species used as food or industrial plants and cultivated/domesticated in the past (e.g. *Silene vulgaris, Portulaca oleracea, Sonchus* sp. pl, *Cichorium intybus, Scolymus hispanicus, Stipa tenacissima*, *Silybum marianum*)
- Wild or naturalised plants used as rootstocks for productive crops (e.g. *Olea europaea* subsp. *sylvestris, Prunus mahaleb, Crataegus monogyna* subsp. *brevispina, Pistacia terebinthus*)

### Valencian policy on plant conservation

The Valencian regional government is developing a plant conservation policy based on "multispecific" measures (those which simultaneously benefit a large amount of species); the "oligospecific" measures (i.e. recovery plans) are only reserved for the most threatened species. The most remarkable activities are:

- *In situ* conservation through the PMR network;
- *Ex situ* conservation through the regional germplasm bank (Botanical Garden of the University of Valencia) and the establishment of micropropagation protocols for the most endangered species (Valencian Institute for Agronomic Research);

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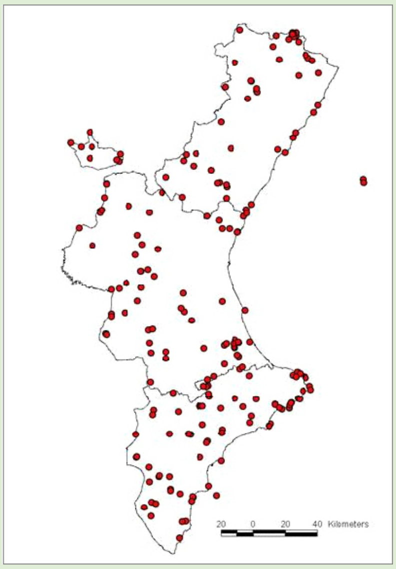


**Figure 2.** Locations of the 230 PMRs in Valencia

- Establishment of a catalogue of *ex situ* and *in situ* protocols for germination, culture and plantation of target species (endemic, rare and dominant taxa for all types of natural habitats);
- Creation of a network of experimental plots for the monitoring of restoration practices –partially overlapping with the micro-reserve network;
- Development of new crops for sustainable development; for instance, domestication of endemic species useful as scented plants, medicinal crops, etc. (e.g. *Thymus godayanus, Salvia blancoana* subsp. *mariolensis*).

All these activities are drafted and developed as inter-dependent activities, and are therefore not considered as isolated initiatives. As a result, there is a continuous relationship between *in situ* and *ex situ* activities, mainly focused on the combination of two tools: the PMR network of the Generalitat Valenciana and the germplasm bank of the Botanical Garden of the University of Valencia.

In most cases, the coordinated development and the cohesion amongst all these activities has been reached as a planned target for 3 successive LIFE-Nature projects, co-financed by the European Commission and the Generalitat Valenciana:

- LIFE93 NAT/E/000766 (1994-99): Creation of the PMR network
- LIFE99 NAT/E/006417 (1999-2003): Conservation of priority habitats
- LIFE03 NAT/E/000064 (started in 2004): Managing and restoring 3 high-mountain habitats

**The Plant Micro-Reserves**

In 1994, the Regional Wildlife Service of the Valencian Community (Servicio de Conservacion de la Biodiversidad) created a new statutory protection measure for plant conservation named a “Plant Micro-Reserve”. The objectives were two-fold:

1) The scientific monitoring of target species (ca. 600 taxa, including the 350 Spanish endemics found in the Valencian region) and vegetation types to establish long-term trends;
2) Development of experiences of active conservation: ecological restoration, population reinforcements, etc.

The micro-reserves are mainly focused on the experimental conservation of microhabitats - small sites which concentrate a significant amount of target species in a small area, e.g. Mediterranean temporary ponds, small islands, petrifying springs, coastal cliffs, relict forests. Most of these habitats are dominated by rare or endemic plants, for example, the rocky vegetation mostly comprises endemic species of *Teucrium*, *Petrocoptis*, etc. The main objective of the PMRs is not to protect plants, but for scientific study and practice in experimental conservation techniques such as habitat restoration. Some PMRs are also devoted to study “common” vegetation dominated by non-threatened endemic species (e.g. *Thymus piperella*, *Sideritis tragoriganum*, *Salvia lavandulifolia*). In addition, some PMRs are sited in areas already protected because these protected areas contain significant populations of species of interest that are already monitored (e.g. the protected endemic *Medicago citrina*, whose populations are shared by the Nature Reserve of Columbretes Islands and the Nature Park El Montgó).

Micro-reserves provide a high level of legal protection, like a classical nature reserve, but allowing the maintenance of traditional activities (e.g. livestock grazing) compatible with plant conservation. This traditional land use is needed to conserve rare or endemic species dependent on open vegetation (e.g. heliophytes that rely on vegetation clearing).

This statutory protection measure was first drafted for public lands because the natural areas directly managed by the Wildlife Service already encompass populations of more than 90% of the target species. Subsequently, it included private grounds where landowners showed a patent interest in plant conservation. In this case, only a few landowners clearly engaged with plant


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**Figure 3.** Access to the PMR “El Menejador”, included in eco-educative pathways. The PMRs visited for educative purposes are colourfully signposted and often host explanatory panels; on the contrary, other sites are land-marked with very cryptic signposts, in order to not to attract the public attention.

preservation are selected, and two kinds of grants are offered to them:

- Small compensation grants, only to be received one time for life;
- Grants to enhance the activities of plant conservation directly made or contracted by the landowners, to develop management plans drafted by experienced botanists. These grants can cover 100% of costs for plant conservation activities, environmental education, etc.

The official declaration includes a management plan, which is published in the official gazette (together with the declaration of the protected site itself). The management plan of all PMRs includes at least one or more active conservation measure; one of them is the transference of seeds of the target species from the micro-reserves to the germplasm bank of the Botanical Garden of Valencia. In addition, back-up from *ex situ* conservation is ensured through the experimental activities of population reinforcement, if required; a measure also contained by the management plan. The practices of habitat restoration and/or management of endangered species have been carried out in more than 30% of the micro-reserves during the 1999-2003 period, in the framework of the LIFE project NAT/E/006417 "Conservation of priority habitats of the Valencian Community".

Currently, 230 PMRs have been officially declared (Figure 2). They cover a surface of 1,440 ha and include examples of natural and semi-natural habitats. The maximum legal size of an individual PMR is 20 ha; however, the majority of PMRs are smaller than 4.0 ha. Over 85% of the endemic species are represented with at least one population within micro-reserves. Thirty of these micro-reserves belong to the private sub-network, occupying 201 ha. More information on the procedures to select, landmark and manage micro-reserves can be found in several books and articles published by Laguna (1999, 2001). The importance of PMRs to ensure the conservation of the most threatened species, some of them endemic to the Valencian Community (e.g. Cheirolophus lagunae, Echium saetabense, Limonium dufourii, L. perplexum, Verbascum fontqueri), is illustrated in Laguna et al. (in press).

Most of the micro-reserves host populations of CWRs, some of the most remarkable examples are:

- The world population of *Limonium perplexum;*
- The best world populations of *Thymus webbianus*, *Silene diclinis, Limonium dufourii,* and *Ferulago ternatifolia*;
- All the natural Iberian populations of *Medicago citrina* and *Silene hifacensis*;

**"micro-reserves serve as the preferred source of germplasm for seed banks, as areas for structural management of vegetation and as sites where reinforcement or reintroduction of endangered species are carried out"**

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**Figure 4.** *Kosteletzkya pentacarpos*, anciently cultivated plant around the Black Sea, and scarcely represented in the Western Mediterranean area. This species is protected by the EU's Habitats Directive. Image taken in the PMR "Llacuna del Samaruc"

- The only regional populations of *Malus sylvestris*, *Aristolochia*, and *Clematis cirrhosa*, and of the Iberian endemics, *Thymus borgiae, Asplenium seelosii* subsp. *glabrum, Berberis hispanica* and *Cotoneaster granatensis;*
- Unique Valencian representatives of Mediterranean temporary ponds, holding all the regional population of the rare and threatened *Mentha cervina;*
- The greatest proportion of the Valencian populations of *Beta patellaris, Lavatera mauritanica, Leucanthemum arundanum, Reseda hookeri* and *Sternbergia colchiciflora*;
- The best Valencian populations of high mountain trees such as *Taxus baccata, Juniperus thurifera* and *Quercus faginea*, mainly hosting forest plots of veteran trees.

### The Micro-Reserves as a meeting point for *in situ* and *ex situ* actions

Micro-reserves bring together *in situ* and *ex situ* conservation actions. For instance, micro-reserves serve as the preferred source of germplasm for seed banks, as areas for structural management of vegetation (clearance of ancient reafforestations using unsuitable species, conservation of reference trees for forestry purposes, control of alien invasive species), and as sites where reinforcement or re-introduction of endangered species are carried out; for instance, experiences developed with endangered CWRs such as *Silene hifacensis, S. diclinis* and *S. cambessedessii*. Most often, plant material for reinforcements is obtained from propagules collected within micro-reserves, stored in the germplasm bank and reared in research centres or official nurseries.

The micro-reserves can also be considered as places where practical applications of restoration ecology principles can be carried out; this practice has mainly been developed by the LIFE99 NAT/E/006417 project, whose main quantifiable results are:

- Establishment and management of 226 plots (over 966 ha) of 17 priority habitats (Directive 92/43/CEE annex I), most of them created within the boundaries of the already protected PMRs;
- 90,400 plantlets (168 species, 174 plots, 16 habitats) and

39,092 pre-treated seeds (20 species, 17 plots, 5 habitats) planted; 7,611 plants (47 species, 49 plots, 8 habitats) translocated from endangered to neighbouring safe sites for conservation;
- Experimental eradication of 6 alien invasive species in 85 ha (17 plots); vegetation clear-cutting of 119 ha (34 plots); tree removal or lowering of tree density in 19 plots;
- 152 plots signposted, 90 plots fenced (5,540 posts, 15.1 km of rope), and 17 explanatory boards installed.

Thanks to this project, the germplasm bank of the Botanical Garden of Valencia has incorporated 528 new accessions of 329 species, and the IVIA (Valencian Institute for Agronomical Research), where micropropagation research is being carried out with endangered wild plants, has developed *in vitro* germination protocols for 36 species of native orchids.

Some other notable experimental activities are:

- Population reinforcement of rock dwelling plant species (e.g. *Petrocoptis pardoi*) using different techniques for seed fixation;
- Plantation of the endemic *Pinguicula dertosensis* using leaf cuttings and basal bulbs;
- Comparative studies on brackish peat bog recovery (with very low recovery rates), using underwater plantations, floating platforms, etc.
- Establishment of protocols for the removal of *Agave americana* and *Carpobhrotus edulis* on coastal dunes; control studies with *Austrocylindropuntia bigelowii*;
- Re-creation of coastal lagoons on abandoned rice fields, restoring the site with a combination of structural, rare and protected plants, e.g. *Nymphaea alba* and *Kosteletzkya pentacarpos* (Figure 4).

In addition, the habitat restoration has been reinforced with public awareness campaigns and educational activities, with the intervention of NGOs and the Botanical Garden of the University of Valencia.

The model of protection through PMRs is currently being adapted to other European and Mediterranean lands. In Spain, the government of Castilla-La Mancha has adopted by law the model of the “micro-reserve” (also enlarged for animal protection). In a similar way, the LIFE project for the protection of habitats and species of the future Nature Park of the Slovenian Karst, is adapting the same design for plants and animal protection in Slovenia. At least three current LIFE-Nature projects for Menorca (Spain), the Aeolian Islands (Sicily, Italy) and Western Crete (Greece), include the establishment of small networks of micro-reserves. A successful experiment has been carried out in the Pribaikalsky National Park (Russian Federation), where more than forty PMRs have been legally established, being representative of the most important endemic or threatened species. Finally, a recent project to generate a network of protected areas for plant conservation in Belarus, has recommended the creation of PMRs to the national government.

**Credits**
The Valencian PMRs programme was selected as a national project of the programme MaB-UNESCO, and contributes to the Important Plant Areas (IPAs) programme promoted by Planta Europa and Plantlife International. The Valencian PMRs have been drafted, established and managed receiving grants from the European Commission, through the LIFE-Nature project and the EAGGF (=FEOGA) funds.

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**Above**: Cultivated specimens of *Apium repens*, a crop wild relative protected by the EU's Habitats Directive, Annex II. Populations of this species have been reinforced in several Plant Micro-Reserves in Valencia, Spain.

**For further information please contact**:
floraval@gva.es
http://www.microhabitats.org

# Monoecious *Pistacia terebinthus* found in Bulgaria

*Damiano Avanzato and Roberta Quarta*

Instituto Sperimentale per la Frutticoltura. Via di Fioranello 52, 00134 Roma, Italy. Email: davanzato@mclink.it

**Introduction**

The genus *Pistacia* was defined by Lineas in 1737 and includes deciduous trees, except *P. lentiscus* which is an evergreen species. The following botanical characters are common to all the species: the plants are mainly trees but there are few shrubs, the leaves are alternate, pinnate, and leathery, the female and male flowers are on separate trees; pistillate flowers are borne in loose axillary panicles and staminate flowers are axillary and more compact; the fruit is a monocarpic drupe.

The genus *Pistacia* includes (Zohary, 1952): *P. vera* L., *P. lentiscus* L., *P. terebinthus* L. (with the sub-species *P. palaestina Bois*), *P. atlantica* Desfontaine, *P. khinjuk* Stocks (sin. *P. integerrima* Stewart), *P. mutica* Fisher and Meyer, *P. chinensis* Bunge, *P. formosana* Mats, (sin. *P. philippinensis*), *P. cabulica* Stocks, *P. mexicana* H.B.K., *P. texana* Swingle, *P. oleosa* Lour Willd. Among these, *P. vera* (Pistachio) is domesticated, *P. integerrima*, *P. atlantica,* and *P. terebinthus* have agronomic uses (as pistachio rootstocks) while the other species currently have no known specific uses.

*P. terebinthus* has long historical roots (Celesia, 1910): it is described by Teofrast, Dioscoride, Plinius, and Mattioli and is cited several times in the Bible. Jacob mentions it as the tree where he hid the idols that he carried from Mesopotamia; the place where Saul fought with the Philistines, and where David toppled the giant Goliath is named “Terebinthus Valley”. In the vision which describes the birth of Mohammed, the Prophet appears in front of a *P. terebinthus* tree. In all the places in the Mediterranean basin where pistachio is grown, *P. terebinthus* is used as a rootstock. In Sicily *P. terebinthus* became very popular after the Arabic domination of the island when it was introduced as a pistachio rootstock, a tradition which still survives due to its high drought resistance.

**“In all the places in the Mediterranean basin where pistachio is grown, *P. terebinthus* is used as a rootstock”**

*P. terebinthus* is an erect tree of up to 8m in height. It has long, reddish and smooth shoots which change to an ash colour at maturity; the bark is ash grey and cracked. The plant grows in all soil types including rocky areas due its drought resistance. *P. terebinthus* crosses easily and spontaneously with *P. vera*, and some of these hybrids are used in Sicily as pollen donors for pistachio crops. The shoots carry 7-9 leaves, which are lanceolate, obtuse, dark green and shiny on the upper side and light green on the lower side. The fruit consists of a small (5mm) monocarpic drupe, which is rugose, globose, turquoise, and carried in a cluster. Flowers are carried on separate trees in panicles.

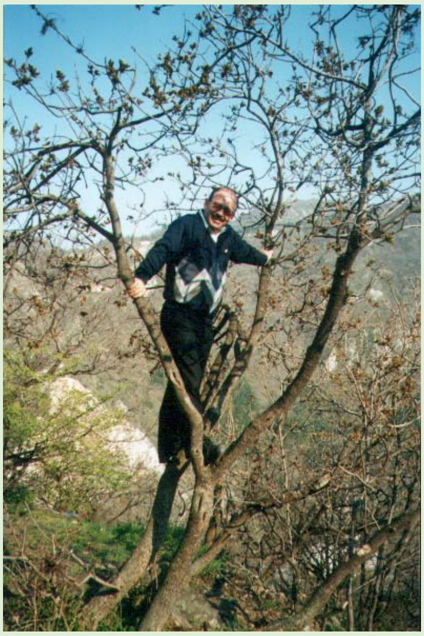

**Figure 1.** Damiano Avanzato, upon discovering a monoecious *Pistacia terebinthus* tree in the Rodopi mountains of the Plovdiv region in Bulgaria

**History of the discovery**

In the summer of 2002, during a visit to the Rodopi mountains of the Plovdiv region in Bulgaria, the author observed some *P. terebinthus* plants. To find this species in Bulgaria at a latitude so far from the areas where *P. terebinthus* is usually found, was extraordinary because the species’ usual distribution is the Mediterranean Basin. After further searches of the hill where *P. terebinthus* was found, it emerged that the area around the hill hosted several other *P. terebinthus* trees. The hill in the winter is under snow and it seemed likely that the population size should increase moving downwards from the top of the hill to the sloping valley. The hill which hosts these *P. terebinthus* populations has an altitude of about 600m above sea level with an average annual rainfall of 500 to 900mm.

During the survey, a plant was noticed which had clusters with no fruits (Figure 1), a fact that was considered strange because the other female plants had regular fruitful inflorescences. Initially this abnormal fruiting behaviour seemed likely to be related to pollination problems, considering that the climate is not typical for *P. terebinthus*. But after a careful examination, in some shoots, a dried rachis was found with residual inflorescences that seemed to be male flowers. How was it possible that rachis from male inflorescences could be present on the same plants which had fruits? Could it be that the plant consisted of a male and a female tree spontaneously grafted from the bottom of the trunk? This was the only technical explanation, but after careful examination it was clear that there was only one trunk. In this moment the author remembered that in 1958 a Turkish researcher described a monoecious tree of a hybrid *Pistacia* but was never able to provide a plant as proof of this discovery. The discovery was therefore so special that it was kept a secret until the next vegetative season in order to observe the flowers: the only proof of monoecy.

During the winter another visit was organised, and in the same tree a female inflorescence was found which had a shoot projecting from the top of the inflorescence with a male rachis. This situation was completely new, because in the previous summer the preliminary conclusion had been that the plants produced

## “an exceptional case of a monoecious tree in a normally dioecious species”

male and female inflorescences in separate shoots.

In the Spring, the plant produced both separate male and female flowers as well as some female flowers with attached male flowers; an exceptional case of a monoecious tree in a normally dioecious species.

**Description of the monoecious form**

The monoecious form of *P. terebinthus* is a plant of 2-3m which grows on dry, stony slopes. This suggests that plant has a deep root apparatus that is typical of the species. The wood has the classic characteristics of the species: dark ash colour, with branches carrying 7 lanceolate, dark green leaves. The plant seemed to be 30-50 years old, though there was no recorded data to confirm this estimate. In addition, within an area of less than 20m, 3 other younger monoecious plants were discovered.

The only differences between the monoecious form and the common *P. terebinthus* are found in the inflorescences, which were distinguished has follows (Figure 2):

- Male flowers were carried on one-year-old shoots, and originated directly from the basal rachis;
- Female flowers were carried on one-year-old shoots and originated about 5 cm from the peduncle insertion;
- Female and male flowers were present in the same inflorescence.

All the observed monoecious plants are characteristic of the typical protandry found within the species and seem to have pollination problems, because even in the second year no fruit was observed in the cluster.

Previously, other monoecious pistachios have been reported. Ozbek and Ayfer (1958) described a hybrid of *P. vera* x *P. terebinthus* but the plant was lost. In 1974 in the USA, Crane described 3 cases of monoecy in *P. atlantica*, and later this was reported by Kafkas, Perl-Treves and Kaska (2000). The peculiarity of *P. terebinthus* is that this species has genetic compatibility to *P. vera*, confirmed by the existence of spontaneous hybrids (Spina, 1982), a fact which illustrates the potential for transfer of the monoecious genetic trait into varieties of *P. vera*. This could allow the growth of pistachio orchards without using unproductive pollen donors, which account for 10% of the entire plantation, with clear advantage on yield. With this goal, a long-term breeding project has been initiated using inter - and intra-specific crossing and backcrossing.

Vegetative material has been collected from the discovered monoecious *P. terebinthus* (with official authorisation by the Bulgarian government) and introduced into the germplasm collection of the Istituto Sperimentale per la Frutticoltura di Roma by grafting it on to 10 years old rootstock of *P. integerrima* and *P. terebinthus*. The material has been subjected to molecular analysis and compared to common Bulgarian and Italian dioecious *P. terebinthus.*

Molecular analyses were carried out on *P. terebinthus* (Avanzato *et al,* 2004). DNA extracted from the leaves of the 4 monoecious Bulgarian plants (named M1, M2, M3 and M4); from dioecious male and female Bulgarian plants (named MaB and FeB); and from dioecious male and female Italian plants (named MaI and FeI). RAPD (*Random Amplified Polymorphic DNA*) have been used as molecular markers because it is possible to quickly and simply show several polymorphisms. The extracted DNA was of good quality except from M3 plants which were excluded from the investigation. The analysis shows high variability between all the tested accessions. In particular, the oligonucleotide OPK9 produced 9 band polymorphisms able to discriminate between each accession; the RAPD OPK9,2, OPK9,5, OPK9,7 and OPK9,9 show single bands characterising the accessions M4, MaB,

**Figure 2.** *Pistacia terebinthus* branch with female and male inflorescences

MaI and M1 respectively (Figure 3). The dendrogram (Figure 4) shows a 90% index of similarity between the female genotypes FeI and FeB, while the male genotype MaI is genetically distant with a similarity of 75%. The monoecious forms M1, M2 and M4 are positioned in clusters between them and in intermediate position with respect to those of the Bulgarian female (FeB) and male genotypes (MaB).

The fact that the monoecious forms have been found within a small population of *P. terebinthus* with low probability of genetic pollution from the existent genetic variability, leads to the supposition that the monoecious character is likely to be present in the progeny of the dioecious female plants. The Italian Ministry of Agriculture has funded a breeding program with the aim of transferring the monoecious character into *P. vera*.

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## “the potential for transfer of the monoecious genetic trait into varieties of *P. vera*….could allow the growth of pistachio orchards without using unproductive pollen donors, which account for 10% of the entire plantation, with clear advantage on yield”

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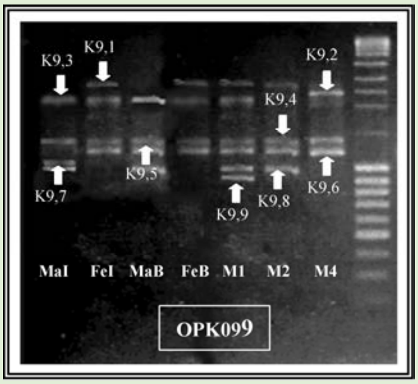


**Figure 3.** Electrophoretic banding patterns produced by PCR of OPK9

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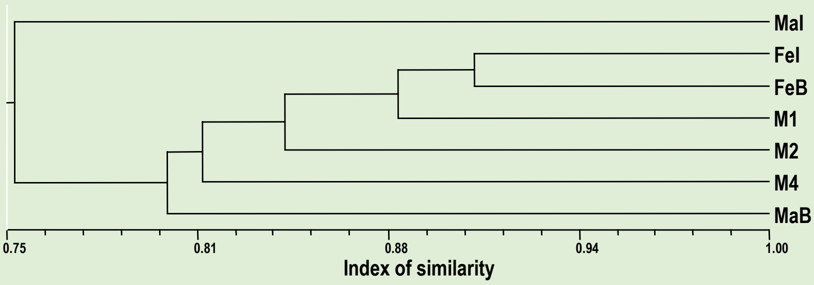



**Figure 4.** Dendrogram constructed using NTSYS-pc 2.1 and UPGMA clustering

# Making Species Databases Interoperable: an advanced workshop

**13-16 July 2004, University of Reading, UK**
**Sponsored by ENBI (European Network for Biodiversity Information) and GBIF (Global Biodiversity Information Facility)**

Shelagh Kell, University of Birmingham, UK attended the workshop "Making Species Databases Interoperable" as a representative of PGR Forum. Twenty-seven speakers and participants discussed the need for aggregation of species databases, reviewing communication architectures and protocols, progress to date and discussing next steps. Speakers included representatives of Species 2000, GBIF, FishBase, ETI, Euro+Med PlantBase, Fauna Europaea, BioCASE, NatureServe, Berlin Botanic Garden, the MEDUSA network, ILDIS, and Cardiff University. Shelagh Kell gave a short presentation introducing PGR Forum and the development of the crop wild relative information system, and links with other online resources were explored.

For more information about ENBI visit http://www.enbi.info
and for GBIF visit http://www.gbif.org

**Right:** Participants at the ENBI/GBIF sponsored workshop, Making Species Databases Interoperable, held at the University of Reading, UK, 13-16 July 2004

# Meetings and conferences

## Beyond extinction rates: monitoring wild nature for the 2010 target

**19-20 July 2004, London, UK**

http://www.royalsoc.ac.uk/events

PGR Forum presented a poster entitled "Conservation of the threatened wild relatives of socio-economically important plants in Europe" at the Royal Society scientific discussion meeting, "Beyond extinction rates: monitoring wild nature for the 2010 target", 19-20 July 2004.

To view the poster visit http://www.pgrforum.org/publications.htm

## Planta Europa: 4th European Conference on the Conservation of Wild Plants

**17-20 September 2004, Valencia, Spain**

http://www.nerium.net/plantaeuropa/index.htm

Includes a series of strategic workshops, which are devoted to a mid-term review of the European Plant Conservation Strategy. The EPCS highlights the critical loss of genetic diversity of socio-economically important plants, and the urgent need for their conservation. Brian Ford-Lloyd, University of Birmingham will present a paper and poster highlighting the progress made by PGR Forum.

## 11th OPTIMA Meeting

**5-11 September 2004, Belgrade, Serbia and Montenegro**

http://www.optima2004.org/index.html

Twelve symposia including sessions on Euro-Mediterranean plant databases, medicinal and aromatic plants, botanical networks in the Mediterranean area: collection data, geo-referenced information and interactive identification tools. Dr. Stephen Jury, University of Reading will represent PGR Forum at this meeting, presenting a poster explaining the importance of Euro+Med PlantBase as a facility for plant conservation activities in Europe, including its use as the critical taxonomic backbone to the PGR Forum crop wild relative database.

## 3rd IUCN World Conservation Congress

**17-25 November 2004, Bangkok, Thailand**

http://www.iucn.org/congress/about/welcome.htm

Included in meetings of the IUCN Species Survival Commission (SSC) will be a discussion based on a report highlighting the need for crop wild relative conservation to be addressed by the Commission, submitted by Dr. Nigel Maxted, University of Birmingham.

## First DIVERSITAS International Conference on Biodiversity

**9-12 November 2005, Oaxaca, Mexico**

http://www.diversitas-international.org/bioconf_2005.PDF

## PGR Forum Final Dissemination Conference

**Italy, September 2005**

Dates and venue to be announced

# PGR Forum Participants

(for full and up-to-date contact details visit http://www.pgrforum.org/participants.htm)

## Steering Committee

Dr Nigel **Maxted** (Project Coordinator; Work packages 1 and 6 Joint Coordinator)
The University of Birmingham, United Kingdom
**Email**: nigel.maxted@dial.pipex.com

Dr Brian **Ford-Lloyd** (Deputy Project Coordinator; Work package 5 Joint Coordinator)
The University of Birmingham, United Kingdom
**Email**: b.ford-lloyd@bham.ac.uk

Ms Shelagh **Kell** (Project Officer, Work packages 1 and 6 Joint Coordinator)
University of Birmingham, United Kingdom
**Email**: s.p.kell@bham.ac.uk

Dr Frank **Begemann** (Work package 3 Joint Coordinator)
German Centre for Documentation and Information in Agriculture, Germany
**Email**: begemann@zadi.de

Ms Sónia **Dias** (Work package 5 Joint Coordinator)
Instituto Nacional de Investigação Agrária e das Pescas, Portugal
**Email**: soridi@net.sapo.pt

Mr Craig **Hilton-Taylor** (Work package 2 Joint Coordinator)
Red List Programme, IUCN - The World Conservation Union, United Kingdom
**Email**: craig.hilton-taylor@ssc-uk.org

Prof José **Iriondo** (Work package 4 Coordinator)
Universidad Politécnica de Madrid, Spain
**Email**: jiriondo@agricolas.upm.es

Dr Kell **Kristiansen** (Work package 2 Joint Coordinator)
Danish Institute of Agricultural Sciences, Denmark
**Email**: kell.kristiansen@agrsci.dk

Ms Sabine **Roscher** (Work package 3 Joint Coordinator)
German Centre for Documentation and Information in Agriculture, Germany
**Email**: roscher@zadi.de / sabroscher@web.de

Mr Stelios **Samaras** (Work package 1 Joint Coordinator)
Greek Gene Bank, Greece
**Email**: kgeggb@otenet.gr

Mr Jozef **Turok**
International Plant Genetic Resources Institute, Italy
**Email**: j.turok@cgiar.org

## Advisory Board

Mr Luigi **Guarino**
Secretariat of the Pacific Community, Fiji
**Email**: luigig@spc.int

Dr Toby **Hodgkin**
International Plant Genetic Resources Institute, Italy
**Email**: t.hodgkin@cgiar.org

Dr Stephen **Jury**
University of Reading, United Kingdom
**Email**: s.l.jury@reading.ac.uk

Dr Helmut **Knüpffer**
The Institute of Plant Genetics and Crop Plant Research, Germany
**Email**: knupffer@ipk-gatersleben.de

Dr Dominique **Richard**
European Topic Centre on Nature Protection and Biodiversity, France
**Email**: drichard@mnhn.fr

Dr Jane **Smart**
Planta Europa, United Kingdom
**Email**: jane.smart@plantlife.org.uk

Dr Wendy **Strahm**
IUCN Species Survival Programme, Switzerland
**Email**: was@hq.iucn.org

Dr Theo **van Hintum**
Centre for Genetic Resources, The Netherlands
**Email**: theo.vanhintum@wur.nl

## Stakeholder Panel

Dr Lothar **Frese**
Federal Centre for Breeding Research on Cultivated Plants, Germany
**Email**: l.frese@bafz.de

Dr Karl **Hammer**
European Association for Research on Plant Breeding, Germany
**Email**: khammer@wiz.uni-kassel.de

Prof Vernon **Heywood**
University of Reading, United Kingdom
**Email**: v.h.heywood@reading.ac.uk

Mr Martin **Sharman**
European Commission, Belgium
**Email**: martin.sharman@cec.eu.int

## Project partners

Mr Åsmund **Asdal**
Norwegian Crop Research Institute, Norway
**Email**: aasmund.asdal@planteforsk.no

Prof Jean-Pierre **Baudoin**
Gembloux Agricultural University, Belgium
**Email**: baudoin.jp@fsagx.ac.be

Dr Frank **Begemann**
German Centre for Documentation and Information in Agriculture, Germany
**Email**: Begemann@zadi.de

Dr Daniela **Benedikova**
Research Institute of Plant Production, Slovak Republic
**Email**: benedikova@vurv.sk

Ms Sónia **Dias**
Instituto Nacional de Investigação Agrária e das Pescas, Portugal
**Email**: soridi@net.sapo.pt

Mr Dag Terje **Endresen**
Nordic Gene Bank, Sweden
**Email**: dagterje@ngb.se

Prof Carlo **Fideghelli**
Instituto Sperimentale per la Frutticoltura, Italy
**Email**: isfrmfid@mclink.it

Prof Juha **Helenius**
University of Helsinki, Finland
**Email**: helenius@mappi.helsinki.fi

Contacts

Contacts

## Project partners cont

Mr Craig **Hilton-Taylor**
IUCN - The World Conservation Union, United Kingdom
**Email**: craig.hilton-taylor@ssc-uk.org

Dr László **Holly**
Institute for Agrobotany, Hungary
**Email**: lholly@agrobot.rcat.hu

Prof José **Iriondo**
Universidad Politécnica de Madrid, Spain
**Email**: jiriondo@agricolas.upm.es

Dr Kell **Kristiansen**
Danish Institute of Agricultural Sciences, Denmark
**Email**: kell.kristiansen@agrsci.dk

Dr Juozas **Labokas**
Institute of Botany, Lithuania
**Email**: j.labokas@botanika.lt / joseph@takas.lt

Dr Nigel **Maxted**
The University of Birmingham, United Kingdom
**Email**: nigel.maxted@dial.pipex.com

Dr Martine **Mitteau**
Bureau des Ressources Génétiques, France
**Email**: martine.mitteau@inapg.inra.fr

Dr Wieslaw **Podyma**
National Centre for Plant Genetic Resources, Poland
**Email**: w.podyma@ihar.edu.pl

Prof Isaak **Rashal**
University of Latvia, Latvia
**Email**: izaks@email.lubi.edu.lv

Mr Stelios **Samaras**
Greek Gene Bank, Greece
**Email**: kgeggb@otenet.gr

Dr Tamara **Smekalova**
N.I.Vavilov Research Institute of Plant Industry, Russia
**Email**: t.smekalova@vir.nw.ru

Dr Zdenek **Stehno**
Research Institute for Crop Production, Czech Republic
**Email**: stehno@vurv.cz

Dr Silvia **Strajeru**
Genebank of Suceava, Romania
**Email**: genebank@assist.ro

Mr Jozef **Turok**
International Plant Genetic Resources Institute, Italy
**Email**: j.turok@cgiar.org

Dr Bert **Visser**
Centre for Genetic Resources, The Netherlands
**Email**: bert.visser@wur.nl

## Partner representatives and additional contributors

Mr. Damiano **Avanzato**
Instituto Sperimentale per la Frutticoltura di Roma, Italy
**Email**: davanzato@mclink.it

Mr Eliseu **Bettencourt**
Instituto Nacional de Investigação Agrária e das Pescas, Portugal
**Email**: e.bettencourt@meganet.pt

Mr Gábor Málnási **Csizmadia**
Institute for Agrobotany, Hungary
**Email:** gaborcs@agrobot.rcat.hu

Ms Lori **De Hond**
Universidad Politécnica de Madrid, Spain
**Email**: optima@tiscali.es

Mr David **Draper Munt**
Museu Nacional de História Natural, Portugal
**Email**: ddraper@fc.ul.pt

Dr Ehsan **Dulloo**
International Plant Genetic Resources Institute, Italy
**Email**: e.dulloo@cgiar.org

Mr Tarik El Atechi
University of Reading, UK
**Email:** t.elatechi@reading.ac.uk

Dr Doug **Evans**
EEA-European Topic Centre on Nature Protection & Biodiversity, France
**Email**: evans@mnhn.fr

Dr Samy **Gaiji**
International Plant Genetic Resources Institute, Italy
**Email**: s.gaiji@cgiar.org

Dr Dirk **Hinterlang**
Landesanstalt f. Ökologie, Bodenordnung und Forsten, Germany
**Email**: dirk.hinterlang@loebf.nrw.de

Dr Vojtěch **Holubec**
Research Institute of Crop Production, Czech Republic
**Email**: holubec@vurv.cz

Mr Andrew **Jarvis**
IPGRI Regional Office for the Americas, Colombia
**Email**: a.jarvis@cgiar.org

Dr Helena **Korpelainen**
University of Helsinki, Finland
**Email**: helena.korpelainen@helsinki.fi

Dr Emilio **Laguna**
Generalitat Valenciana - Servicio de Conservación de la Biodiversidad , Spain
**Email:** laguna_emi@gva.es

Dr François **Lefèvre**
Institut Nacional de la Recherche Agronomique, France
**Email:** lefevre@avignon.inra.fr

Dr Thomas **Metz**
International Plant Genetic Resources Institute, Italy
**Email**: t.metz@cgiar.org

Mr Jay **Moore**
Plantkind.com Software Consultants, United Kingdom
**Email**: jaymoore@plantkind.com

Dr Olaf **Nölle**
University of Münster, Germany
**Email**: nolleo@afi.uni-muenster.de

Mr Mauricio **Parra Quijano**
Universidad Politécnica de Madrid, Spain
**Email**: senderos@bio.etsia.upm.es

Dr Xavier **Picó**
Universitad Autonoma de Barcelona, Spain
**Email:** xavier.pico@creaf.uab.es

Ms Maria **Pohjamo**
University of Helsinki, Finland
**Email**: maria.pohjamo@helsinki.fi

Ms Caroline **Pollock**
IUCN-The World Conservation Union, United Kingdom
**Email**: caroline.pollock@ssc-uk.org

Ms Diana Camelia **Rusu**
Genebank of Suceava, Romania
**Email**: dia_sv@yahoo.com

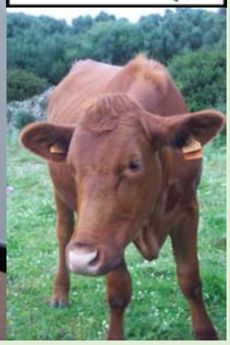
Ms Maria **Scholten**
University of Birmingham, United Kingdom
**Email**: m.a.scholten@bham.ac.uk

Dr Attila **Simon**
Institute for Agrobotany **,** Hungary
**Email**: jensen@agrobot.rcat.hu

Mr Nikolaos **Stavropoulos**
Greek Gene Bank, Greece
**Email**: kgeggb@otenet.gr

Dr André **Toussaint**
Gembloux Agricultural University, Belgium
**Email**: toussaint.a@fsagx.ac.be



**Participants at PGR Forum Workshop 4, Population Management Methodologies, April 2004, Menorca, Spain**

**Clockwise from top left**: Juozas Labokas (Speaker), Daniela Benedikova (Chair); Ehsan Dulloo; Craig Hilton-Taylor; Caroline Pollock; Working Group discussion; (Left to right) Kell Kristiansen, Dag Terje Endresen, Gábor Málnási Csizmadia**,** François Lefèvre; Lothar Frese (Speaker) **Far right**: endemic Menorcan cow used to make organic cheese (non-workshop participant)

If you would like to contribute to *Crop wild relative*, please contact the editors at s.p.kell@bham.ac.uk
Short items or longer articles are welcomed.
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