

The National Crop Wild Relative Strategy for Italy: First Steps To Be Taken

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1. Introduction

1.1 Definition of a Crop Wild Relative

Crop plants are any plant species cultivated as food, medicinal, ornamental, forestry, fodder and forage species. The level of relatedness between a certain Crop Wild Relative (CWR) and a cultivated taxon influences its actual and potential use in breeding. Harlan and de Wet (1971) proposed the “gene pool concept” based on the possible breeding relationships among taxa. They identified a primary gene pool (GP1), which includes the crop and all the closely related taxa, able to freely interbreed with the crop and give rise to fully fertile progenies and which is subdivided in GP1A (cultivated form) and GP1B (wild or weedy forms of the crop), a GP2, which includes taxa more remotely related to the crop, but still capable of crossing with it and producing some fertile hybrids, and a GP3, which includes taxa remotely related to the crop and naturally incapable of interbreeding with the crop. Commonly taxa belonging to GP1 and GP2 should be considered priority CWR, along with those that have been previously used as gene donors from the tertiary gene pool (Maxted and Kell, 2009). However, since the breeding relationships with a crop have not yet been defined for the majority of the wild species complexes, Maxted *et al.* (2006) pragmatically proposed the concept of “taxon group”, where the degree of relatedness among crops and all taxa belonging to the same species; TG2 includes taxa belonging to the same series of sections the crop; TG3 includes taxa belonging to the same subgenus as the crop; TG4 includes taxa belonging to the same genus as the crop; TG5 includes taxa belonging to the same tribe as the crop, but to a different genus. Only taxa included in TGs 1 to 4 should be considered CWR *sensu lato*.

CWR species are important genetic resources. These resources have potential in future food security by providing genetic variability and material for plant breeding and therefore enhancing agricultural production for the growing world population. These new varieties may turn out to be instrumental in allowing the crops to survive in the new environmental conditions resulting from climate change.

1.2 Crop Wild Relative conservation and international treaties

Since CWR are valuable wild species, which are usually not yet included in conservation programs and are often growing in threatened habitats, they require urgent conservation action. The need to conserve CWR species has been identified by policymakers. CWR are now included in several international treaties, such as the European Strategy for Plant Conservation (Planta Europa, 2008), the Global Strategy for Plant Conservation (CBD, 2010a), CBD Strategic Plan for Biodiversity 2011-2020 (CBD, 2010b), and the International Treaty on Plant Genetic Resources for Food and Agriculture (FAO, 2001). However, practical conservation actions are still largely lacking.

The Global Strategy for Plant Conservation (GSPC) includes 16 global targets set for 2020. Most relevant to this CWR strategy are following: (Target 7) ‘at least 75 per cent of known threatened

plant species conserved in situ’; (Target 8) ‘at least 75 per cent of threatened plant species in *ex situ* collections, preferably in the country of origin, and at least 20 percent available for recovery and restoration programmes’; (Target 9) ‘70 per cent of the genetic diversity of crops including their wild relatives and other socio-economically valuable plant species conserved, while respecting, preserving and maintaining associated indigenous and local knowledge’ (CBD, 2010a).

The European Strategy for Plant Conservation 2008-2014 (ESPC) similarly recognized the importance of CWR conservation as follows: (Target 7.1) ‘60 per cent of species of European conservation priority plant and fungal species, including crop wild relatives, conserved *in situ* by 2014 through the implementation of national strategies for conserving priority species’; (Target 7.2) ‘develop database of plant micro-reserves, genetic reserves for crop wild relatives, and where relevant other small *in situ* protected areas’; (Target 9.1) ‘establishment of 25 European crop wild relative genetic reserves covering the major hotspots of species and genetic diversity’ (Planta Europa, 2008). The CWR strategy document aims to establish the Italian CWR checklist and priority list and make suggestions/provide solutions for CWR *in situ* and *ex situ* conservation in Italy. Data collected at present cannot answer the ESPC target of proposing genetic reserve sites for CWR *in situ* conservation.

1.3 Italian implementation of the plant conservation strategies

The Italian Guidelines for the Conservation and Characterization of Plant, Animal and Microbial Italian Genetic Resources for Food and Agriculture were recently published under the aegis of the Ministry of Policies for Agriculture, Food and Forestry Resources (and also submitted in summary to the International Treaty for the implementation of Article 6) (see <http://www.reterurale.it/flex/cm/pages/ServeBLOB.php/L/IT/IDPagina/9580>). All Plant Genetic Resources (PGR) (i.e. CWR included) are mentioned, but Landraces (LR) are the main focus, because in Italy wild taxa, like CWR, are under the aegis of the Ministry of the Environment and Safeguard of the Territory and the Sea.

Conservation activities of wild plant taxa are pragmatically focused on the most threatened ones, i.e. those that are included in the regional, national (Rossi *et al.*, 2013; Conti *et al.*, 1992, 1997) and European (Bilz *et al.*, 2011) Red Lists, the Bern Convention (Council of Europe, 1979), and Annexes to the 92/43/EEC Directive (EU, 1992). However, conservation of these taxa is not necessarily achieved by simply being included in special lists of protected species. Actually there are only a few action plans for a few taxa, mainly focused on *in situ* conservation in protected areas, i.e. Natura 2000 Sites established by the 92/43/EEC Directive (EU, 1992), and the Protected Areas, established by Italian law 394/91 (Ministero dell'Ambiente e della Tutela del Territorio e del Mare, 2011) and a few accessions are stored in *ex situ* collections. It should be noted that, when an *in situ* safeguard of threatened taxa is foreseen in protected areas, actual safeguard actions are always limited to ‘passive’ forms of protection (i.e. taxa are assumed to be protected just because they are included in protected areas, while this, per se, does not assure actual protection). It should also be noted that, for most of the protected areas in Italy, a list of the Flora is not available.

The Ministry of the Environment and Safeguard of the Territory and the Sea published a general National Strategy for Biodiversity (Andreella *et al.*, 2010), but it only superficially mentions CWR. Neither of the governmental institutions takes specific care of CWR. It can therefore be concluded that in spite of a huge amount of information on the Italian Flora, there is no specific concern for CWR in Italy. No government or regional entity supports conservation activities focused on CWR and no national CWR conservation strategy exists. To date, no comprehensive, updated listing of CWR taxa has been made at the national level.

1.4 Genetic resources of the Mediterranean Basin and of Italy

The Mediterranean Basin is one of the most important biodiversity hotspots in the world, including about 25000 plant species, of which around 13000 are endemic (4.3% of global plant species, estimated at 300000) (Myers *et al.*, 2000). Many plant species of the Mediterranean area are taken into account by international conservation policies such as the Bern Convention (Council of Europe, 1979) and the 92/43/EEC Directive (EU, 1992), because of their limited distribution and the current and potential threats to their survival (Bilz *et al.*, 2011). In addition, the Mediterranean area is also a hotspot of cultivated diversity (Vavilov, 1960).

The Italian Peninsula and the Islands are the second highest area of plant species richness in Europe, after the Iberian Peninsula and the Balearic Islands (Bilz *et al.*, 2011; Castroviejo, 2010; Conti *et al.*, 2005) while the total surface area is less than 3% of that of Europe, it is home to about half of the plant species found throughout Europe.

1.5 Italian protected areas and species

On the basis of the 92/43/EEC Directive (EU, 1992) in Italy by the Regions have been established 2299 Site of Community Importance (SCI) (Fig. 1) and 609 Special Protection Area (SPA) (Fig. 1): of them, 332 are C sites, otherwise SCI coincident with SPA. Overall they cover the 21% of the whole national territory (<http://www.minambiente.it>).

Within the sites are protected: 130 habitats, 92 flora species and 109 fauna species (mammals, reptiles, amphibians and fishes) and 381 birds species (<http://www.minambiente.it>).

In addition, in Italy there are National and Regional Parks and natural reserves. The “Elenco Ufficiale delle Aree Naturali Protette” (EUAP) (Fig. 1) groups all the protected areas marine and terrestrial which respect the criteria established by the Italian law 394/91 (Ministero dell'Ambiente e della Tutela del Territorio e del Mare, 2011): National Parks (PNZ), Protected Marine Natural Areas (MAR), National Natural Marine Parks (PNZ_m), National Natural Reserves (RNS), Parks and Natural Reserves Regional (PNR-RNR), submerge Natural Parks (GAPN), Other Natural Protected Areas (AAPN).

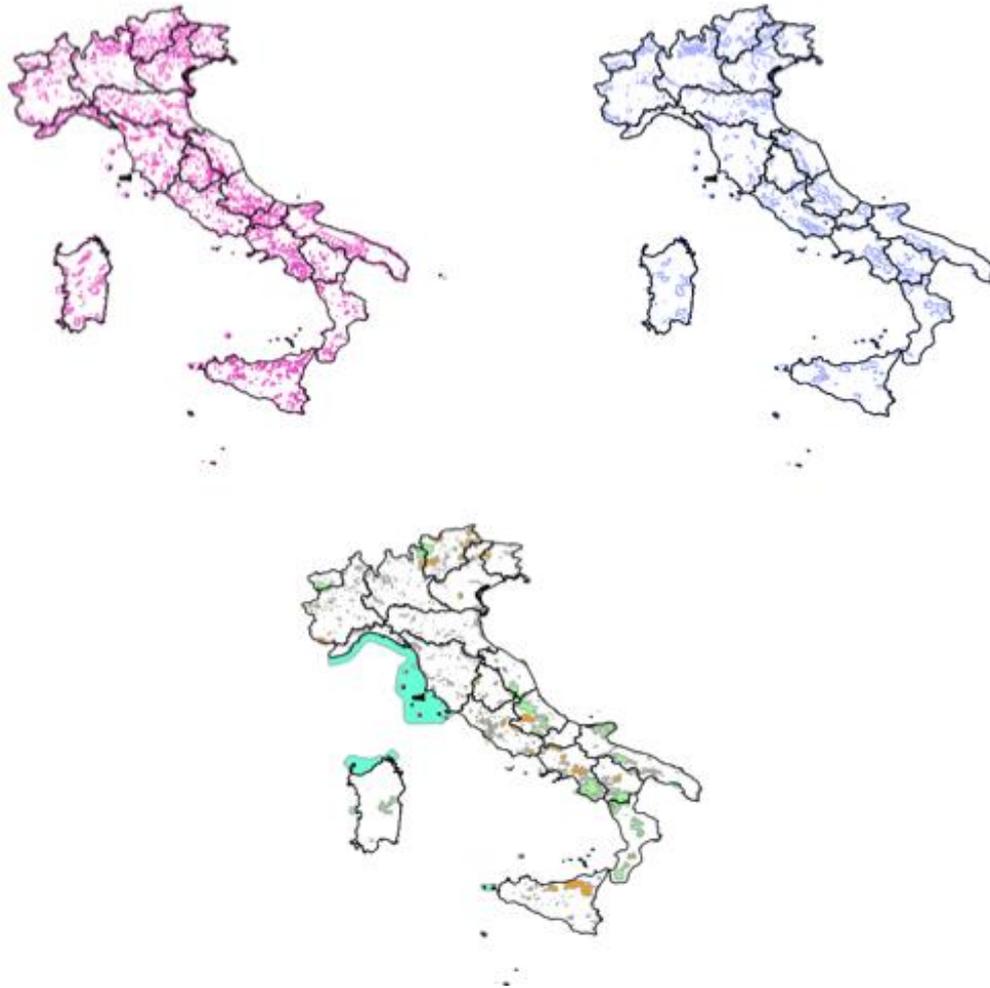


Figure 1. SCI net (<http://www.pcn.minambiente.it/GN/>), SPA net (<http://www.pcn.minambiente.it/GN/>) and EUAP net in Italy (<http://www.pcn.minambiente.it/GN/>).

2. Activities carried out for drafting the first steps towards an Italian CWR conservation strategy

For drafting the first steps towards the development of an *in situ* and *ex situ* conservation strategy it was necessary, based on previous experiences (Khoury *et al.*, 2013; Berlingeri and Crespo, 2011; Magos Brehm *et al.* 2008; Maxted *et al.*, 2007; <http://PGRsecurSpain.weebly.com/>):

1. To create an updated and complete taxonomic Working Database of the Italian Vascular Plants (since at present no taxonomic reference for the entire Italian Flora exists).
2. To create an Italian CWR checklist (Maxted *et al.*, 2007).
3. To prioritise the checklist (Maxted *et al.*, 2007).
4. To carry out a gap analysis to identify lack of information on actual existence of priority taxa populations (Maxted *et al.*, 2008), on a case study at least (2 *Brassica* species in central Italy).

2. 1The development of the Working Database of the Italian Vascular Plants

The nomenclatural foundation for this work is the digital taxonomic list for Italian botanical data available in the botanical database system anArchive (<http://www.anarchive.it/anArchive/specie/browser.jsp>; anArchive 2003-2012; Venanzoni *et al.*, 2012; Lucarini *et al.*, submitted). This digital list follows the International Plant Name Index guidelines (IPNI, 2012), takes into account European and Italian floras (Euro+Med 2006-2012; Conti *et al.*, 2005, 2007; Pignatti, 1982; Tutin *et al.*, 1968, 1972-1976, 1993). It currently includes over 11500 valid names of native, exotic, cultivated and hybrid specific/intra-specific taxa for the Italian flora (Gigante *et al.*, 2012; Landucci *et al.*, 2012), thus representing a comprehensive and suitable tool for the aims of this study.

Supplementary data sources used to develop the Working Database of the Italian Vascular Plants were: the Mansfeld's Encyclopedia of Agricultural and Horticultural Crops (Hanelt and IPK Gatersleben, 2001), the Italian CWR checklist taken from the CWR Catalogue for Europe and the Mediterranean (Kell *et al.*, 2005) and the USDA Germplasm Resources Information Network (USDA-ARS-GRIN, 2012).

In details the Working Database was developed as follows (Landucci *et al.*, 2014):

1. Matching the complete anArchive taxonomic list with the national checklist from the CWR Catalogue for Europe and the Mediterranean (Kell *et al.*, 2005) in order to harmonize taxonomy and nomenclature with the national flora and add any missing taxa. In this phase, a preliminary data set was generated, inclusive of all taxa and names recorded in both lists. Information about distribution and occurrence of the taxa reported in the CWR Catalogue for Europe and the Mediterranean was maintained.
2. Refining the preliminary list, removing duplicate records and harmonizing the taxonomic nomenclature in accordance with the most recent and accepted updating as reported in anArchive. In order to avoid misunderstandings, accepted/valid names of taxa in Italy were accompanied by their common synonyms.
3. Providing additional information for each taxon in the preliminary list, including its status (native or exotic), distribution (with the indication of endemic taxa), cultivation, economic importance, uses and if it is a CWR. The latter was ascertained by referring to both the gene pool (GP, Harlan and de Wet, 1971) and taxon group (TG, Maxted *et al.*, 2006) concepts (see also Supplementary Information). In particular, to determine if a certain taxon belongs to a certain crop GP by the <http://www.cwrdiversity.org> was consulted (Vincent *et al.*, 2013). For CWR taxa, we included information related to the GP1 (including GP1A and GP1B), GP2 and GP3. In addition, taxa that are mentioned in the Italian (Rossi *et al.*, 2013; Conti *et al.*, 1992, 1997;) and European Red Lists (Bilz *et al.* 2011), the Bern Convention (Council of Europe, 1979), and in the Annexes of the 92/43/EEC Directive (EU, 1992) were highlighted. In the absence of any specific study on the matter in Italy, this was done in order to have an indication of the risk or potential risk for the taxa. In other words, it was assumed that the simple fact that a certain taxon is included in one of the above-mentioned lists indicates that it is under threat or needs monitoring, at a certain level (IUCN 2012a, 2012b).

2.2 The development of checklist of Italian CWR/WHP

On the basis of the information collected in the Working Database of the Italian Vascular Plants, CWR (and their associated crops) and also the Wild Harvested Plants (WHP) (plant collected in nature but non cultivated) were selected and a final checklist of Italian CWR/WHP was obtained (hereafter CWR/WHP List). All taxa (both cultivated and wild, native and exotic taxa) belonging to the same genus or to the same complex as a crop cultivated anywhere in the world and/or to the primary, secondary or tertiary GP of a crop are included. However, neophyte CWR and crop species are distinguished from the native and archaeophyte taxa using a coding system. It should be stressed that one aim of this work was the identification of ways to drive strategies for PGR, which also includes cultivated plants. Similarly, all the species with one or more human uses are selected as WHP, independent of the actual commercialization of the products derived from them, following the approach of Magos Brehm *et al.* (2008).

2.3 The checklist prioritization

The Prioritized inventory (hereafter PList) was also obtained through consecutive steps from the CWR/WHP List, applying the following criteria (as reported in Landucci *et al.*, 2014): i) the importance of the crop for worldwide and Italian food security, ii) taxa autochthony and iii) the need for monitoring/protection. As in other prioritized inventories (e.g. Khoury *et al.*, 2013), the importance of the crop was the starting criterion because most of the breeding programs that rely on CWR are focused on staple crops or on crops that give a high income (see a review in Khoury *et al.*, 2013; Hajjar and Hodgkin, 2007). Autochthony was also considered as a useful criterion based on the assumption that, due to a long history of adaptation, autochthonous taxa show a higher diversity than naturalized taxa (which may have a restricted diversity as a consequence of the initial introduction of a few individuals, Amsellem *et al.*, 2001), while genetic diversity is fundamental for any breeding program. Moreover including non-autochthonous taxa would be inconsistent with general worldwide biodiversity conservation policies that invest a significant amount of resources to solve the issue of alien species invasion (Pimentel *et al.*, 2005). Finally, the third criterion directed attention to those CWR/WHP most in need of monitoring/protection in accordance with the pragmatic, economically realistic approach to conservation currently adopted in Italy.

1. In the first step all the genera of the previously developed CWR/WHP List that are both a) included in Annex I of the ITPGRFA (FAO, 2001), and b) mentioned by the Italian Institute of Statistics (ISTAT) for cultivated areas and yield in the last five years (ISTAT, 2012) were taken into account and all taxa related to those genera were selected (we crossed the two data sources because ITPGRFA Annex I does not mention some important crops for Italy, e.g. many fruit trees and horticultural crops, while it mentions crops that have no importance for Italy, e.g. pigeon pea). The fact that statistics are released for some crops was used as proof of their importance for the Italian economy. In this way a list of taxa related to crops of worldwide and national importance for food security was obtained.

2. A further selection was carried out on the resulting data set at the level of specific and infra-specific taxa: taxa that were not reported as autochthonous to the Italian territory were excluded from the list.
3. A final selection was performed considering the endemism and relative need for monitoring/protection of the taxa at the national and international level, i.e. including the taxa mentioned in the national (Rossi *et al.* 2013; Conti *et al.*, 1992, 1997) and European (Bilz *et al.*, 2011) Red Lists, the Bern Convention (Council of Europe, 1979), Annexes to the 92/43/EEC Directive (EU, 1992).

As a result of the prioritization process, three distinct categories of conservation priority were established: “A”, “B” and “C” (Tab. 1).

Table 1. Definitions of priority categories.

Code	Explanation
A	The taxon is a relative to a crop with high value according with the ITPGRFA or ISTAT and it is considered priority for conservation because already included in at least one list of endangered taxa (e.g. Red Lists, Annexes to the Directive 92/43/EEC, Bern Convention). The taxa in this category need of specific protection measures.
B	The taxon is a relative to a crop with high value according with the ITPGRFA or ISTAT and it is considered priority for its endemism restricted to whole of the Italian territory or only to a part of Italy. The taxon is not included in other lists of threatened taxa (e.g. Red Lists, Annexes to the Directive 92/43/EEC, Bern Convention). The taxa in this category not necessarily require specific protection measure but need of particular attention.
C	The taxon is native and relative to a crop with high value according with the ITPGRFA or ISTAT. The taxon is neither included in any list of threatened taxa (e.g. Red Lists, Annexes to the Directive 92/43/EEC, Bern Convention) nor endemic. The taxa in this category do not need of specific protection measures.

2.4 The gap analysis case study



Figure 2. *Brassica* populations on the Tyrrhenian coast.

Originally conservationists developed gap analysis to find gaps in the habitat or ecosystem conservation. The concept of identifying areas in which selected elements of biodiversity are underrepresented was proposed by Burley (1988) as a gap analysis methodology of first identifying and classifying biodiversity, then locating conservation areas managed for biodiversity and finally identifying the biodiversity underrepresented in those areas to set new conservation

priorities. Maxted *et al.* (2008) proposed to use gap analysis to evaluate CWR taxonomic and genetic diversity and to develop future strategies for their genetic conservation by following steps: (1) circumscription of target taxon and target area; (2) assessment of natural diversity, (taxonomic, genetic, ecogeographic and threat assessment); (3) assessment of current *in situ* and *ex situ* conservation strategies; (4) setting priorities for *in situ* and *ex situ* conservation action. We relied on the latter points to orient future steps to be immediately taken in developing a CWR conservation strategy.

2.4.1 *In situ* gap analysis

There are not current conservation efforts particularly for CWR species in Italy, to undertake an *in situ* gap analysis for all CWR species is not possible either practically or economically. Distribution data for Italian CWR are lacking. As case study to develop an *in situ* gap analysis study for priority CWR we choose two species of the genera *Brassica* (*Brassica incana* Ten. and *B. montana* Pourr.) closed related with *B. oleracea* L. and included in category “A” of PList.

To undertake *in situ* gap analysis, distribution data were initially obtained from Italian National Flora (Conti *et al.*, 2005, 2007; Pignatti, 1982), from databases (European Cooperative Program on Genetic Resources _ Brassica Database, ECPGR_BD 2012 and EURISCO) (whose data refer to populations that have been collected in the past and are presently *ex situ* conserved in genebanks) and personal communication by researchers (B. Foggi and F. Taffetani).

Subsequently, the presence of the species in some of the reported localities and populations conservation status was assessed with surveys that were carried out between June and July 2012.

The following data were collected for the two specie: name of the locality and GPS, date of the survey, species, visual estimate of the number of individuals and of the number of mature individuals, risk factors (naturals and humans) rating a score from 1 to 5 (Fig. 3).

SITO						DATA
DATI GEOGRAFICI						
Latitudine						
Longitudine						
Altitudine						
SPECIE						
POPOLAZIONE						
Area						
Substrato						
Num. Individui presenti						
Num. Individui maturi						
Stima dell'abbondanza (punteggio 1min-5max)						
FATTORI DI RISCHIO (punteggio 1min-5max)						
Antropici	Distanza centro abitato	Pastorizia	Agricoltura	Turismo	Costruzioni	Inquinamento
Naturali	Frane/Smottamenti	Mareggiate	sap. competitive	Avversità biotiche		
QUALITÀ DELL'HABITAT (giudizio complessivo 1min-5max)						
NOTE:						

Figure 3. Example of data sheet.

Finally, geographic location data, were used to determine if the *B. incana* and *B. montana* populations are included in protected areas: i.e. the Sites of Community Importance and the Special Protection Areas, established by the 92/43/EEC Directive (EU, 1992), and the Protected Areas, established by the Italian law 394/91 (Ministero dell'Ambiente e della Tutela del Territorio e del Mare, 2011).

2.4.2 *Ex situ versus in situ* gap analysis

Finally, to check which populations are safely duplicated in genebanks, an *ex situ versus in situ* gap analysis was carried out by matching *ex situ* conservation data of *B. incana* and *B. montana* with *in situ* data.

3. Results and discussion

3.1 The working database of the Italian Vascular Plants

The Working Database of the Italian Vascular Plants is downloadable at <http://vnr.unipg.it/PGRSecure> with annexed information, codes and references (Landucci et al., 2014).

The dataset includes 11710 specific and infra-specific taxa (7810 species) of which 1396 (11.9%) are indicated as being in need of monitoring/protection according to the national and European Red Lists (Rossi et al., 2013; Bilz et al., 2011; Conti et al., 1992, 1997;), the Bern Convention (Council of Europe, 1979) and/or the Annexes of the 92/43/EEC Directive (EU, 1992). In particular, the percentage of these taxa is quite high for the Italian Islands (16.3 and 13.3% for Sicily and Sardinia, respectively).

3.2 The CWR/WHP List

The full Italian CWR/WHP List is also downloadable at <http://vnr.unipg.it/PGRSecure> with annexed information, codes and references (Landucci *et al.*, 2014).

Of the total taxa in the Working Database of the Italian Vascular Plants, 92% (10779 taxa and 7128 species) are CWR and/or WHP.

It is notable that 10648 CWR taxa (7032 species) and 2212 WHP taxa (1917 species) make up 90.9% and 18.9% of the total Italian taxa, respectively. In particular, the 7032 CWR species are distributed as follows: 6353 in the Italian Peninsula, 2812 in Sicily and 2440 in Sardinia. Some species occur in more than one geographical unit.

In the CWR/WHP List, 86.0% of the taxa (9258 taxa) are native to Italy and 11.3% (1216 taxa) are in need of monitoring or protection. Out of the total of 10648 CWR taxa, 13.0% (1390 taxa) are exotic (1093 and 297 neophyte and archaeophyte taxa, respectively), 16.3% (1736 taxa) are endemic and 10.6% (1129 taxa) are protected or need monitoring.

From the above-reported data, it is evident that a relatively high percentage of the total Italian flora (11.9%), and in particular of CWR and WHP (11.3%), is in need of protection and/or monitoring.

3.3 The CWR/WHP priority List

The list of priority taxa was obtained in three steps (Landucci *et al.*, 2014). In the first step, out of the total of 10779 taxa (7128 species) recorded for Italy in the CWR/WHP List, 1357 taxa (961 species) were counted that are related to the crop genera listed in Annex I of the ITPGRFA (FAO, 2001) and to the most cultivated crops in Italy (ISTAT, 2012). In the second step, 1118 taxa (760 species) were selected because they were native to Italy. Out of them, on the grounds of their inclusion in Red Lists (Rossi *et al.* 2013; Bilz *et al.*, 2011; Conti *et al.*, 1992, 1997;), 92/43/EEC Directive (EU, 1992) and/or the Bern Convention (Council of Europe, 1979), 129 taxa (124 species, belonging to 38 genera) were indicated as in need of protection and/or monitoring (“A” category) (Appendix 1), 85 (75 species) as only in need of monitoring (“B” category) and 904 (606 species) presently in no need of protection or monitoring (“C” category).

The complete PList for Italy (“A”+“B”+“C”, including 82 genera) is reported at <http://vnr.unipg.it/PGRSecure>.

The top priority taxa are the taxa of category “A” of the PList (Appendix 1) belong to 38 genera. Several are important for food security at the international and national levels (e.g. *Aegilops* L., *Allium* L., *Asparagus* L., *Avena* L., *Brassica* L., *Cichorium* L., *Citrullus* Schrad., *Daucus* L., *Diptotaxis* DC., *Eruca* DC., *Festuca* L., *Lactuca* L., *Lathyrus* L., *Lens* Mill., *Lupinus* L., *Malus* Mill., *Medicago* L., *Prunus* L., *Poa* L., *Pyrus* L., *Trifolium* L., *Vaccinium* L. and *Vicia* L.). It should also be noted that for each of these crop genera extant LR (Negri *et al.*, 2013; Negri, 2003) and wild ecotypes exist in Italy, which corroborates their importance as PGR. *Allium* L. and *Brassica* L. (22 and 19 taxa, respectively) have a high number of endemic taxa and they can be considered high priority genera.

3.4 The gap analysis results

The gap analysis case study showed that (Landucci *et al.*, 2014):

1. Even for crops of great importance like *Brassica*, little is currently known about their relic CWR/WHP populations.
2. Not all of CWR/WHP populations are adequately protected either *in situ* or *ex situ*.
3. Some of the CWR/WHP populations that are recorded in the literature, or among genebanks holdings, may be extinct.

It is worthwhile noting that the situation for other CWR/WHP Italian populations is also largely unknown.

4. Recommendations for the implementation of a CWR conservation strategy in Italy

On the basis of the obtained results the following recommendation can be drafted:

1. Awareness on the importance of CWR is to be raised at National and Regional level.
2. Attention should be focused on the top priority taxa (“A”) taxa mentioned in Annex I (i.e. those taxa that are most in need of protection and monitoring, are native to Italy and are of importance for local and worldwide food security), as an initial step at least.
3. Since the knowledge of the distribution of CWR taxa is lacking, information on actual occurrence, precise location and census of CWR populations that are reported in the literature should be assessed in order to confirm (or reject) the priorities based on endemism and endangerment outlined on the basis of bibliographic records.
4. At the same time field investigations should also be carried out in order to detect new and extant unrecorded CWR populations.
5. Location data should then be used to identify the populations most in need of conservation: a gap analysis process, similar to that described in Landuccci *et al.* (2014) should be used to identify populations present/not present in protected area, safely duplicated/not duplicated *ex situ*.
6. Appropriate conservation plans should then be drafted, starting from top priority taxa.
7. Appropriate funding is to be raised for carrying out the activities above mentioned.

References

- Amsellem, L., Noyer, J. L., Le Bourgeois, T. and Hossaert-Mckey, M. (2001). Comparison of genetic diversity of the invasive weed *Rubus alceifolius* Poir. (Rosaceae) in its native range and in areas of introduction, using amplified fragment length polymorphism (AFLP) markers. *Mol. Ecol.* 9: 443–455.
- anArchive. (2003-2012). anArchive 5: database system – taxonomic list. Available online at <http://www.anarchive.it/anArchive/specie/browser.jsp> (Accessed February 2012).
- Andreella, M., Biliotti, M., Bonella, G., Cinquepalmi, F., Duprè, E., La Posta, A., Luchetti, D., Pettiti, L., Tartaglini, N., and Vindigni, V. (2010). *Strategia Nazionale per la Conservazione della Biodiversità*. Ministero dell’Ambiente e della Tutela del Territorio e del Mare, Roma, IT.
- Berlangeri, R. and Crespo, M. B. (2011). Inventory of related wild species of priority crops in Venezuela. *Genetic Resources and Crop Evolution.* 59: 655-681.
- Bilz, M., Kell, S.P., Maxted, N. and Lansdown, R. V. (2011). *European Red List of Vascular Plants*.
- Burley, F. W. (1988). Monitoring biological diversity for setting priorities in conservation. In: Wilson E.O. and Peter F. M. (Eds) *Biodiversity*. National Academy Press, Washington DC. 227-230.
- Castroviejo, S. (2010). La flora española: una riqueza en biodiversidad de primer orden aún en exploración. *El proyecto Flora Ibérica. Doc. Adm.* 278-279:23–38.
- CBD (2010a). *Global Strategy for Plant Conservation 2011-2020*. Secretariat of the Convention on Biological Diversity, Montreal, Quebec, Canada. Available at: www.cbd.int/gspc/
- CBD (2010b). *Strategic Plan for Biodiversity 2011-2020*. Secretariat of the Convention on Biological Diversity, Montreal, Quebec, Canada. Available at: www.cbd.int/sp/
- Conti, F., Manzi, A., and Pedrotti, F. (1992). *Libro rosso delle piante d’Italia*. WWF Italia, Società Botanica Italiana. Poligrafica Editrice, Roma.
- Conti, F., Manzi, A. and Pedrotti, F. (1997). *Liste rosse regionali delle piante d’Italia*. WWF Italia, Società Botanica Italiana. TIPAR Poligrafica Editrice, Camerino.
- Conti, F., Abbate, G., Alessandrini, A. and Blasi, C. (2005). *An Annotated Check-List of the Italian Vascular Flora*. Palombi Editore, Roma.
- Conti, F., Alessandrini, A., Bacchetta, G., Banfi, E., Barberis, G., Bartolucci, F., Bernardo, L., Bonacquisti, S., Bouvet, D., Bovio, M., Brusa, G., Del Guacchio, E., Foggi, B., Frattini, S., Galasso, G., Gallo, L., Gangale, C., Gottschlich, G., Grunanger, P., Gubellini, L., Iiriti, G., Lucarini, D., Marchetti, D., Moraldo, B., Peruzzi, L., Poldini, L., Prosser, F., Raffaelli, M., Santangelo, A., Scassellati, E., Scortegagna, S., Selvi, F., Soldano, A., Tinti, D., Ubaldi, D., Uzunov, D. and Vidali, M. (2007). Integrazione alla Checklist della flora vascolare italiana. *Natura Vicentina* 10: 5–74.
- Council of Europe (1979) *Bern Convention – The Convention on the Conservation of European Wildlife and Natural Habitats*. CoE, Strasbourg.
- EU (1992). The Council of the European Communities, Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora. Available at: <http://eurlex.europa.eu>

- EURISCO. <http://eurisco.ecpg.org/>. (Accessed May 2012).
- Euro+Med (2006-2012). Euro+Med PlantBase - the information resource for Euro-Mediterranean plant diversity. Available at: <http://ww2.bgbm.org/EuroPlusMed/> (Accessed February 2012).
- European Cooperative Program on Genetic Resources _ Brassica Database (ECPGR_BD). (2012). Center for Genetic Resources, The Netherlands (CGN). Available online at <http://documents.plant.wur.nl/cgn/pgr/brasedb/default.htm> (Accessed May 2012).
- FAO (2001). International Treaty on Plant Genetic Resources for Food and Agriculture. Food and Agriculture Organization of the United Nations. www.fao.org/AG/cgrfa/itpgr.htm
- Gigante, D., Acosta, A. T. R., Agrillo, A., Attorre, F., Cambria, V. E., Casavecchia, S., Chiarucci, A., Del Vico, E., De Sanctis, M., Facioni, L., Geri, F., Guarino, R., Landi, S., Landucci, F., Lucarini, D., Panfili, E., Pesaresi, S., Prisco, I., Rosati, L., Spada, F. and Venanzoni, R. (2012). VegItaly: technical features, critical points and some solutions. *Plant Sociol.* 49: 71–79.
- Hajjar, R. and Hodgkin, T. (2007). The use of wild relatives in crop improvement: a survey of developments over the last 20 years. *Euphytica* 156: 1–13.
- Hanelt, P. and IPK Gatersleben (Eds.) (2001). *Mansfeld's Encyclopedia of Agricultural and Horticultural Crops*. 1-6. Springer, Berlin/Heidelberg/New York, 3645 pp. Available at: <http://mansfeld.ipk-gatersleben.de>
- Harlan, J. R. and de Wet, J. M. J. (1971). Towards a rational classification of cultivated plants. *Taxon*. 20: 509–517
- IPNI (2012). The International Plant Names Index. Published on the Internet <http://www.ipni.org> (Accessed 1 July 2012).
- ISTAT (Istituto Nazionale di Statistica). (2012). Consultazione dati. <http://agri.istat.it> (Accessed December 2012).
- IUCN (2012a). IUCN Red List Categories and Criteria: version 3.1. Second Edition. IUCN Species Survival Commission. IUCN, Gland, Switzerland and Cambridge, UK.
- IUCN (2012b). Guidelines for application of IUCN Red List Criteria at regional levels: version 4.0. IUCN Species Survival Commission. IUCN, Gland, Switzerland and Cambridge, UK.
- Kell, S. P., Knüpffer, H., Jury, S. L., Maxted, N. and Ford-Lloyd, B. V. (2005). *Catalogue of Crop Wild Relatives for Europe and the Mediterranean*. University of Birmingham, Birmingham, UK. Available at: <http://www.pgrforum.org/cwris/cwris.asp>
- Khoury, C.K., Greene, S., Wiersema, J., Maxted, N., Jarvis, A. and Struik, P. C. (2013). An Inventory of Crop Wild Relatives of the United States. *Crop. Sci.* 53: 1–13. doi: 10.2135/cropsci2012.10.0585.
- Landucci, F., Acosta, A. T. R., Agrillo, A., Attorre, F., Biondi, E., Cambria, V. E., Chiarucci, A., Del Vico, E., De Sanctis, M., Facioni, L., Geri, F., Gigante, D., Guarino, R., Landi, S., Lucarini, D., Panfili, E., Pesaresi, S., Prisco, I., Rosati, L., Spada, F. and Venanzoni, R. (2012). VegItaly: the Italian collaborative project for a national vegetation database. *Plant. Biosyst.* 146: 756–763.
- Landucci, F., Panella, L., Lucarini, D., Gigante, D., Domizia, D., Kell, S., Maxted, S., Venanzoni, R., and Negri, V. (2014). A prioritized inventory of crop wild relatives and wild harvested plants of Italy. *Crop Science*. doi: 10.2135/cropsci2013.05.0355.

- Lucarini, D., Gigante, D., Landucci, F., Panfili, E. and Venanzoni, R., (submitted). The anArchive taxonomic Checklist for Italian botanical data banking and vegetation analysis: theoretical basis and advantages. *Plant Biosyst.*
- Magos Brehm, J., Maxted, N., Ford-Lloyd, B. V. and Martins Loução, M. A. (2008). National inventories of crop wild relatives and wild harvested plants: case study for Portugal. *Genet. Resour. Crop. Evol.* 55: 779–796.
- Maxted, N., Ford-Lloyd, B. V., Jury, S. L., Kell, S. P. and Scholten, M. A. (2006). Towards a definition of a crop wild relative. *Biodiversity and Conservation* 15 (8): 2673-2685.
- Maxted, N., Scholten, M. A., Cood, R. and Ford-Lloyd B. V. (2007). Creation and use of a national inventory of crop wild relatives. *Biol Cons* 140: 142-159.
- Maxted, N., Dulloo, E., Ford-Lloyd, B. V., Iriondo, J. and Jarvis, A. (2008). Genetic gap analysis: A tool for more effective genetic conservation assessment. *Divers. Distrib.* 14:1018–1030.
- Maxted, N. and Kell, S. P. (2009). Establishment of a global network for the *in situ* conservation of crop wild relatives: status and needs. Food and Agriculture Organization of the United Nations.
- Ministero dell'Ambiente e della Tutela del Territorio e del Mare (2011). Elenco ufficiale aree protette (EUAP). Available online at <http://www.pcn.minambiente.it/viewer/index.php?services=EUAP&box=78421.38684277324,4342343.1546863085,566578.6131572267,4937656.845313691> (Accessed July 2012).
- Myers, N., Mittermeier, R. A., Mittermeier, C. G., de Fonseca, G. A. B. and Kent, G. (2000). Biodiversity hotspots for conservation priorities. *Nature* 403: 853–858.
- Negri, V. (2003). Landraces in Central Italy: where and why they are conserved and perspectives for their on farm conservation. *Genet. Resour. Crop Evol.* 50: 871-885.
- Negri, V., Pacicco, L., Bodesmo, M. and Torricelli, R. (2013). The first Italian inventory of in situ maintained landraces. On CD ROM. ISBN 978-88-6074-279-7. Morlacchi Editrice, Perugia.
- Pignatti, S. (1982). *Flora d'Italia*. Edagricole, Bologna.
- Planta Europa (2008). *A Sustainable Future for Europe; the European Strategy for Plant Conservation 2008–2014*. Plantlife International (Salisbury, UK) and the Council of Europe (Strasbourg, France). www.plantlife.org.uk/ Publications Office of the European Union, Luxembourg.
- Pimentel, D., Zuniga, R. and Morrison, D. (2005). Update on the environmental and economic costs associated with alien-invasive species in the United States. *Ecological Economics* 52: 273–288.
- Rossi, G., Montagnani, C., Gargano, D., Peruzzi, L., Abeli, T., Ravera, S., Cogoni, A., Fenu, G., Magrini, S., Gennai, M., Foggi, B., Wagensommer, R. P., Venturella, G., Blasi, C., Raimondo, F. M. and Orsenigo, S. (Eds.) (2013). *Lista Rossa della Flora Italiana. 1. Policy Species e altre specie minacciate*. Comitato Italiano IUCN e Ministero dell'Ambiente e della Tutela del Territorio e del Mare.
- Tutin, T. G., Heywood, V. H., Burges, N. A., Moore, D. M., Valentine D. H., Walters S. M. and Webb, D. A. (1968). *Flora Europaea*. Vol. 2. Cambridge University Press, Cambridge.
- Tutin, T. G., Heywood V. H., Burges, N. A., Valentine, D. H., Walters S. M. and Webb, D.A (1972-1976). *Flora Europaea*. Vols. 3-4. Cambridge University Press, Cambridge.

- Tutin, T. G., Burges, N. A., Chater, A. O., Edmondson, J. R., Heywood, V. H., Moore, D. M., Valentine, D. H., Walters, S. M. and Webb, D.A. (1993). *Flora Europaea*. Vol. 1. Cambridge University Press, Cambridge.
- USDA-ARS-GRIN (2012). Online Database USDA, ARS, National Genetic Resources Program. National Germplasm Resources Laboratory, Beltsville, Maryland. Available online at <http://www.ars-grin.gov/cgi-bin/npgs/html/index.pl> (Accessed June 2012).
- Vavilov, N. I. (1960). *Izbrannye trudy. Problemy selekzii, rol Evrazii I Novogo Sveta v proiskhozhdenii kulturnykh rastenii*. Vol. 2. USSR Academy of Science Press, M.-L.
- Venanzoni, R., Landucci, F., Panfili, E. and Gigante, D. (2012). Toward an Italian national vegetation database: VegItaly. *Biodivers. Ecol.* 4: 185–190.
- Vincent, H., Wiersema, J., Dobbie, S., Kell, S. P., Fielder, H., Castenada, N., Eastwood, R., Guarino, L. and Maxted, N. (2013). A prioritized crop wild relative inventory to help underpin global food security. *Biological Conservation* 167: 265–275. Available at: www.cwrdiversity.org.

Appendix 1. List of Italian CWR/WHP taxa with the highest conservation priority

Synthetic list of CWR/WHP taxa with the highest conservation priority ("A" category) as defined in the present study: taxa within the crop genera included in Annex I of the ITPGRFA (FAO, 2001) and ISTAT (2012), their current name, endemism and endemism type [i.e. included in the: 1 = IUCN European Red List (Bilz *et al.*, 2011); 2 = Regional Red List (national catalogue, Conti *et al.*, 1997); 3 = Regional Red List (catalogue of Sicily, Conti *et al.*, 1997); 4 = Regional Red List (catalogue of Sardinia, Conti *et al.*, 1997); 5 = National Red List (Conti *et al.*, 1992); 6 = National Red List (Rossi *et al.*, 2013); 7 = Annex II of the Directive 92/43/EEC (EU, 1992); 8 = Bern Convention (Council of Europe, 1979)] (Landucci *et al.*, 2014).

Taxa	Endem.	ITPGRFA Annex I	ISTAT	1 [†]	2 [‡]	3 [‡]	4 [‡]	5 [§]	6 [†]	7	8
<i>Aegilops uniariostata</i> Vis.		x	x		EN		DD	V	VU		
<i>Allium acutiflorum</i> Loisel.			x	LC							
<i>Allium aethusanum</i> Garbari	Sicily		x		VU	EN		V			
<i>Allium agrigentinum</i> Brullo et Pavone	Sicily		x		LR	LR					
<i>Allium angulosum</i> L.			x		VU			V			
<i>Allium chamaespathum</i> Boiss.			x	DD							
<i>Allium cupanii</i> Raf. subsp. <i>hirtovaginatum</i> (Kunth) Stearn			x		VU	VU					
<i>Allium ericetorum</i> Thore			x	DD							
<i>Allium francinae</i> Brullo et Pavone	Sicily		x		LR	LR					
<i>Allium hemisphaericum</i> (Sommier) Brullo	Sicily		x		LR			LR			
<i>Allium insubricum</i> Boiss. et Reut.	Alpine		x	DD	LR			R			
<i>Allium lehmannii</i> Lojac.	Italy		x	DD							
<i>Allium lojaconoi</i> Brullo, Lanfr. et Pavone	Sicily		x	NT							
<i>Allium lopadusanum</i> Bartolo, Brullo et Pavone	Sicily		x	DD	EN	EN					
<i>Allium lusitanicum</i> Lam.			x			EN					
<i>Allium narcissiflorum</i> Vill.			x	DD	LR			R			
<i>Allium nebrodense</i> Guss.	Sicily		x		LR	LR					
<i>Allium obtusiflorum</i> DC.	Subendemic		x	DD	LR	LR					
<i>Allium parciflorum</i> Viv.	Subendemic		x	DD							
<i>Allium pendulinum</i> Ten.			x	DD							
<i>Allium pentadactyli</i> Brullo, Pavone et Spamp.	Italy		x		VU						
<i>Allium permixtum</i> Guss.	Italy Sardinia Sicily		x	DD	EX	EX					
<i>Allium sardoum</i> Moris			x			LR					
<i>Allium suaveolens</i> Jacq.			x	LC	VU			V			
<i>Allium subvillosum</i> Salzm. ex Schult. et Schult. f.			x		LR	LR		R			
<i>Asparagus acutifolius</i> L.		x	x			LR					
<i>Asparagus pastorianus</i> Webb et Berthel.		x	x			VU					
<i>Astragalus alopecurus</i> Pall.		x			LR				NT	x	x
<i>Astragalus aquilanus</i> Anzal.	Italy	x		DD	VU			V	EN	x	x
<i>Astragalus caprinus</i> L. subsp. <i>huetii</i> (Bunge) Podlech	Sicily	x			LR			V			
<i>Astragalus genargenteus</i> Moris	Sardinia	x			EN		EN				
<i>Astragalus maritimus</i> Moris	Sardinia	x		CR	CR		CR	V	CR	x	x
<i>Astragalus muelleri</i> Steud. et Hochst.		x			LR						
<i>Astragalus peregrinus</i> Vahl subsp. <i>warionis</i> (Gand.) Maire		x			EN	EN					

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<i>Astragalus raphaelis</i> G. Ferro	Sicily	x			CR	CR		V	CR		
<i>Astragalus scorpioides</i> Pourr. ex Willd.		x			EW			Ex			
<i>Astragalus sempervirens</i> Lam.		x				EN					
<i>Astragalus tegulensis</i> Bacch. et Brullo	Sardinia	x							CR		
<i>Astragalus verrucosus</i> Moris	Sardinia	x		CR	CR		CR	V	CR	x	x
<i>Atriplex rosea</i> L.		x					VU				
<i>Atriplex tornabenei</i> Tineo		x					LR				
<i>Avena barbata</i> Pott ex Link subsp. <i>castellana</i> Romero Zarco		x	x				LR				
<i>Barbarea bracteosa</i> Guss.		x		DD			LR				
<i>Barbarea rupicola</i> Moris	Sardinia	x		LC							
<i>Barbarea sicula</i> C. Presl	Italy	x		DD			CR				
<i>Barbarea verna</i> (Mill.) Asch.		x		DD							
<i>Barbarea vulgaris</i> W.T. Aiton		x					LR				
<i>Brassica fruticulosa</i> Cirillo		x	x					EW			
<i>Brassica incana</i> Ten.		x	x	DD							
<i>Brassica insularis</i> Moris	Subendemic	x	x					EN	NT	x	x
<i>Brassica macrocarpa</i> Guss.	Sicily	x	x	CR	CR	CR		E	CR	x	x
<i>Brassica montana</i> Pourr.		x	x	LC	EW				VU		
<i>Brassica procumbens</i> (Poir.) O.E. Schulz		x	x		EW			Ex			
<i>Brassica repanda</i> (Willd.) DC. subsp. <i>glabrescens</i> (Poldini) Gómez-Campo	Alpine	x	x			VU		V	NT	x	x
<i>Brassica rupestris</i> Raf. s.l.	Italy Sicily	x	x	NT							
<i>Brassica rupestris</i> Raf. subsp. <i>hispida</i> Raimondo et Mazzola	Sicily	x	x			EN	EN				
<i>Brassica souliei</i> (Batt.) Batt.	Sicily	x	x				LR				
<i>Brassica villosa</i> Biv. s.l.	Sicily	x	x	NT							
<i>Brassica villosa</i> Biv. subsp. <i>bivonana</i> (Mazzola et Raimondo) Raimondo et Mazzola	Sicily	x	x			LR	LR				
<i>Brassica villosa</i> Biv. subsp. <i>drepanensis</i> (Caruel) Raimondo et Mazzola	Sicily	x	x			LR	LR				
<i>Brassica villosa</i> Biv. subsp. <i>tinei</i> (Lojac.) Raimondo et Mazzola	Sicily	x	x			LR	LR				
<i>Brassica villosa</i> Biv. subsp. <i>villosa</i>	Sicily	x	x			EN	EN				
<i>Cichorium pumilum</i> Jacq.			x				EN				
<i>Cichorium spinosum</i> L.			x			LR	LR		R		
<i>Citrullus colocynthis</i> (L.) Schrad.			x			CR	CR				
<i>Crambe hispanica</i> L. s.l.		x					VU				
<i>Crambe tatarica</i> Sebeók		x				VU		V	NT	x	
<i>Daucus carota</i> L. subsp. <i>rupestris</i> (Guss.) Heywood		x	x				VU				
<i>Daucus lopadusanus</i> Tineo	Sicily	x	x				VU				
<i>Daucus siculus</i> Tineo	Sicily	x	x				LR				
<i>Diplotaxis scaposa</i> DC.	Sicily	x	x			CR	CR				
<i>Eruca vesicaria</i> (L.) Cav. s.l.		x	x			VU	VU				
<i>Festuca alfrediana</i> Foggi et Signorini		x				LR		LR			
<i>Festuca sardo</i> (Hack.) K. Richt.	Sardinia	x				EN		EN			
<i>Hedysarum confertum</i> Desf.		x	x			LR			R		
<i>Helosciadium repens</i> (Jacq.) W.D.J. Koch			x			CR		V	CR	x	x
<i>Ipomoea imperati</i> (Vahl) Griseb.		x	x			EW		Ex			
<i>Ipomoea sagittata</i> Poir.		x	x			EN	EN	E			
<i>Lactuca longidentata</i> DC.	Sardinia		x	DD				LR			
<i>Lathyrus amphicarpos</i> L.		x	x			LR	LR				
<i>Lathyrus cirrhosus</i> Ser.		x	x	LC							
<i>Lathyrus grandiflorus</i> Sm.		x	x	LC							
<i>Lathyrus heterophyllus</i> L.		x	x	LC							
<i>Lathyrus odoratus</i> L.	Italy Sicily	x	x	NT							
<i>Lathyrus saxatilis</i> (Vent.) Vis.		x	x				CR				
<i>Lens nigricans</i> (M. Bieb.) Godr.		x	x				LR				
<i>Lepidium hirtum</i> (L.) Sm. subsp. <i>nebrodense</i> (Raf.) Thell.		x					LR				
<i>Lepidium villarsii</i> Gren. et Godr.		x		LC							

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<i>Lotus peregrinus</i> L.		x			VU	VU		R				
<i>Lupinus cosentinii</i> Guss.		x				LR						
<i>Lupinus luteus</i> L.		x					EN					
<i>Malus crecimannoi</i> Raimondo	Sicily	x	x	DD								
<i>Malus sylvestris</i> (L.) Mill.		x	x	DD								
<i>Medicago prostrata</i> Jacq.		x	x	LC								
<i>Medicago secundiflora</i> Durieu		x	x			VU						
<i>Onobrychis viciifolia</i> Scop.		x	x	LC								
<i>Phalaris truncata</i> Guss. ex Bertol.		x		LC								
<i>Phleum arenarium</i> L.		x					VU					
<i>Phleum sardoum</i> (Hack.) Hack.	Italy Sardinia	x			EN		EN	E	CR			
<i>Pimpinella lutea</i> Desf.			x			LR						
<i>Poa remota</i> Forselles		x			VU			V				
<i>Prunus brigantina</i> Vill.			x	DD								
<i>Prunus cocomilia</i> Ten.			x	LC								
<i>Prunus padus</i> L.			x		EN							
<i>Prunus webbii</i> (Spach) Vierh.			x		EN			R				
<i>Pyrus castribonensis</i> Raimondo, Schicchi et Mazzola	Sicily		x	DD								
<i>Rorippa amphibia</i> (L.) Besser		x					VU					
<i>Rorippa sylvestris</i> (L.) Besser subsp. <i>sylyvestris</i>		x				LR	VU					
<i>Salsola vermiculata</i> L.		x			VU	VU	VU					
<i>Trifolium bivonae</i> Guss.	Sicily	x	x			LR						
<i>Trifolium brutium</i> Ten.	Italy Sicily	x	x			LR						
<i>Trifolium incarnatum</i> L.		x	x	LC								
<i>Trifolium latinum</i> Sebast.		x	x		EW			Ex	CR			
<i>Trifolium michelianum</i> Savi		x	x			CR						
<i>Trifolium mutabile</i> Port.		x	x			LR						
<i>Trifolium ornithopodioides</i> L.		x	x				CR					
<i>Trifolium saxatile</i> All.		x	x	NT	LR			R	EN	x	x	
<i>Trifolium uniflorum</i> L. subsp. <i>savianum</i> (Guss.) Nyman	Italy Sicily	x	x			CR						
<i>Vaccinium oxycoccos</i> L.			x		VU			V				
<i>Vicia altissima</i> Desf.		x	x			VU						
<i>Vicia amphicarpa</i> L.		x	x				CR					
<i>Vicia cusnae</i> Foggi et Ricceri		x	x		LR			R	VU			
<i>Vicia giacominiiana</i> Segelb.	Italy	x	x		CR			V	CR			
<i>Vicia laeta</i> Ces.		x	x		VU	LR						
<i>Vicia oroboides</i> Wulfen		x	x	LC								
<i>Vicia sativa</i> L. subsp. <i>incisa</i> (M. Bieb.) Arcang.		x	x		VU			V	CR			
<i>Vicia serinica</i> R. Uechtr. et Huter	Apennine	x	x		LR			R				
<i>Vicia sicula</i> (Raf.) Guss.		x	x			LR						
<i>Vicia tenuifolia</i> Roth subsp. <i>dalmatica</i> (A. Kern.) Greuter		x	x		CR							

† IUCN 2001 (used in Bilz *et al.*, 2011 and Rossi *et al.*, 2013): EX=Extinct, EW=Extinct in the wild, CR=Critically endangered, EN=Endangered, VU=Vulnerable, NT=Nearly threatened, LC=Least concern, DD=Data deficient.

‡ IUCN 1994 (used in Conti *et al.*, 1997; 2=Italy, 3=Sicily and 4=Sardinia): EX=Extinct, EW=Extinct in the wild, CR=Critically endangered, EN=Endangered, LR=Lower risk.

§ IUCN 1978 (used in Conti *et al.*, 1992): Ex=Extinct, E=Endangered, V=Vulnerable, R=rare, I=Indeterminate.