

Extension of EURISCO for Crop Wild Relatives (CWR) in situ data and preparation of pilot countries' data sets

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A crop wild relative (CWR) is defined as a wild plant taxon that has an indirect use derived from its, relatively close, genetic relationship to a crop defined either on the “Gene Pool” from Harlan and Wet (1971) or on the “Taxon Group” Maxted et al. (2006) concept. According to the former, a CWR is any species included in the primary or secondary Gene Pool of a crop while, according to the latter, any species belonging to the same genus of any crop. Being a precious source of genetic variability and of traits potentially useful for crop improvement, CWR have a high socio-economic value and are identified among the main PGR.

To generate national and international conservation plans, the first step is to create and maintain updated dedicated inventories of species. These inventories serve as the basis for an analysis of their patterns of distribution, consistency and conservation status, level of threat, current conservation actions and identification of priority sites in need of conservation (Maxted et al., 2007). A new prioritized list of wild plants of socio-economic interest for Italy has been recently drawn up by Ciancaleoni et al. (2021), see Annex A. Prioritization was made using a pragmatic approach based on species value, native status and need of protection and/or monitoring. Once the high-priority species have been defined, it is important to examine the distribution of their populations across the territory. Unfortunately, geographic distribution of species is often available only at a coarse geographic scale (e.g. occurrence or not at administrative regional level) as also emphasized by Orsenigo et al. (2021), while a precise information on punctual occurrence, sites location, and census of CWR populations need to be retrieved for the implementation of effective conservation activities.

Materials and Methods

The work is focused on the different CWR species belonging to the genera *Brassica*, *Cynara*, *Malus*, *Triticum* and *Vicia* that are considered of priority at European and global levels. All the georeferenced occurrence data of populations of CWR species belonging to these genera available in the Global Biodiversity Information Facility (GBIF) and Genesys databases were retrieved. *Secale montanum* was also considered due to the presence of known populations in a protected area and some previous contacts with the protected area manager. GBIF is an international network and data infrastructure funded by the world's governments aimed at providing open access to chorological data of all types of life on Earth that includes data from genebanks, botanic gardens, museums, and universities. Genesys is a database holding information on *ex situ* accessions conserved in genebanks worldwide; it is also fed by numerous national and international data providers.

Retrieved data were initially checked for crop nomenclature consistency and Latin names were homogenised according to the international project Catalogue of Life. Different filters were then applied to create a high-quality dataset as in Rubio Teso and colleagues (2020). The following classes were removed: i) cultivated materials; ii) not recorded in Italy; iii) with missing or low-quality geographical coordinates (i.e. ≤ 2 decimal digits or stated error > 500 meters); iv) dated before 1950 and, v) duplicates, keeping those more recent and with more available information. GBIF records with major known issue (i.e. invalid basis of record, fuzzy institution match, country coordinate mismatch) and coming from unreliable or unqualified sources (i.e. iNaturalist) were also deleted.

Data were imported into QGIS software specifying the same geographic reference system and definition of national border as described above. Filtered data were organised in a databases: “In situ database” including the records from GBIF and Genesys; as for the latter database, its inclusion is motivated by the fact that *ex situ* conserved accessions come from *in situ* populations. The status ‘inside’ or ‘outside’ protected areas was tested using the geospatial vector of Natura 2000 Network retrieved from the European Environment Agency web site (updated to March 2020) that accounts for delineations used in the Habitats Directive (92/43 / EEC) and for those of the EMERALD Network set up under the ‘Convention on the Conservation of European Wildlife and Natural Habitats’ (i.e., Bern Convention) (Council of Europe, 1979) and the ‘VI Official List of Protected Natural Areas’ (EUAP), that includes different categories of National, Regional and Interregional protected areas.

Another tool to investigate the presence of CWR populations *in situ* was the analysis of the Mediterranean Germplasm Database (MGD), the reference database for the Mediterranean Germplasm Genebank. The MGD database was reviewed for the presence of material useful to the project to determine the location where it was collected and the acquisition date. In addition, data on the presence of CWR were collected from a literature review (Landucci et al. 2014; Magrini et al. 2016) and from the results of research projects involving Italian partners in previous years.

Furtermore. an activity line was added related to mapping endemic populations of *Lactuca alpina* present in Northern Italy, specifically in the Parco Naturale Adamello e Brenta, a Protected Area in the Autonomous Province of Trentino.

Results

Data on *in situ* occurrence of population in the Italian territory were successfully retrieved from GBIF and Genesys for 16 taxa of those listed in Ciancaleoni et al. 2021 for the corresponding genera (i.e. *Brassica*, *Cynara*, *Malus*, *Triticum* and *Vicia*) and for 1 species of the genus *Secale* for a total of 224 populations (Table 1).

Table 1. List of the 17 analysed taxa listed according to the alphabetic order. For each taxa the total number of *in situ* occurrences and of *in situ* occurrences located within protected areas are reported

Species	Total number	Number within protected areas
<i>Brassica glabrescens</i>	1	0
<i>Brassica insularis</i>	64	30
<i>Brassica macrocarpa</i>	10	9
<i>Brassica montana</i>	70	43
<i>Brassica procumbens</i>	4	3
<i>Brassica rupestris hispida</i>	2	1
<i>Brassica souliei amplexicaulis</i>	2	2
<i>Brassica villosa drepanensis</i>	12	2
<i>Cynara cardunculus flavescens</i>	1	0
<i>Malus crescimannoi</i>	1	0
<i>Secale montanum</i> *	25	19
<i>Triticum uniaristatum</i>	4	3
<i>Vicia cusnae</i>	2	1
<i>Vicia dalmatica</i>	1	0

<i>Vicia giacominiiana</i>	1	0
<i>Vicia sparsiflora</i>	4	2
<i>Vicia tenuifolia elegans</i>	20	14
Total	224	129

*Not listed in Ciancaleoni et al. 2021.

According to GIS analysis results, recorded populations are distributed in a quite inhomogeneous way throughout the national territory (Figure 1). They are predominantly present in southern Italy, especially in Sardinia (64 populations) and Sicily islands (58); a relative high number of populations is also recorded in Liguria (51) and Tuscany (36).

Among the 224 recorded, 129 populations, mainly of *Brassica* species, occur in one or more different Italian as well as European protected areas that correspond to the 50 % of the total circa (Figure 1).

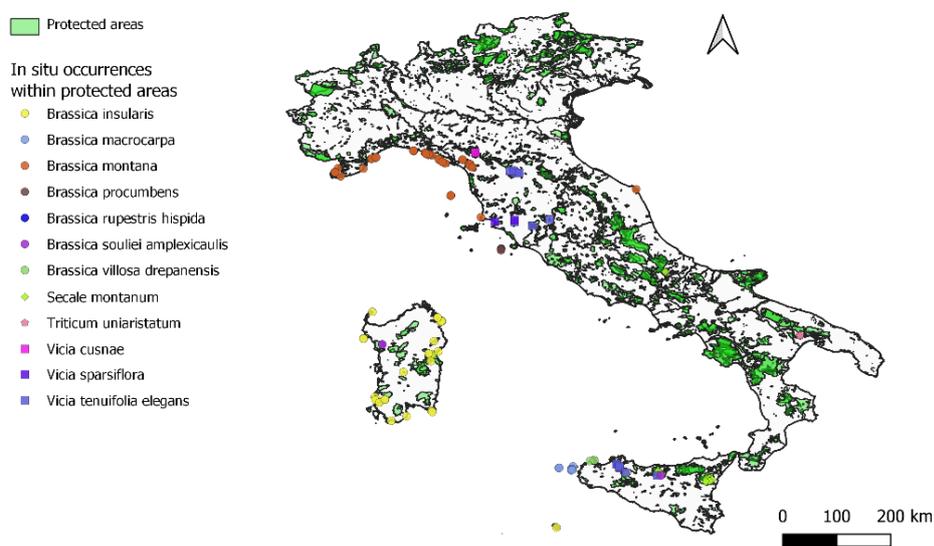


Figure 1. Distribution across Italy of the 129 populations occurring in protected areas. Species are highlighted using different colours as reported in the figure legend.

In addition to the data on *in situ* populations of 17 taxa listed in Table 1, further information on 7 taxa, distributed in Apulia and Basilicata (6 sites), were identified based on data from MGD website, in the literature and through direct observations by the project partners. Three taxa, *Vicia giacominiiana*, *Vicia serinica*, and *Triticum uniaristatum*, are listed in Annex A. *Triticum biunciale*, *Triticum ventricosum*, *Hordeum bulbosum*, and *Avena clauda* were selected because they occur in the territory of the Apulia region and are part of the gene pool of important crop species. The choice of sites fell preferably on national and regional parks or Natura 2000 sites and monitoring will be carried out in order to confirm the presence of populations *in situ* and to verify the geographical coordinates of the references (Figure 2).

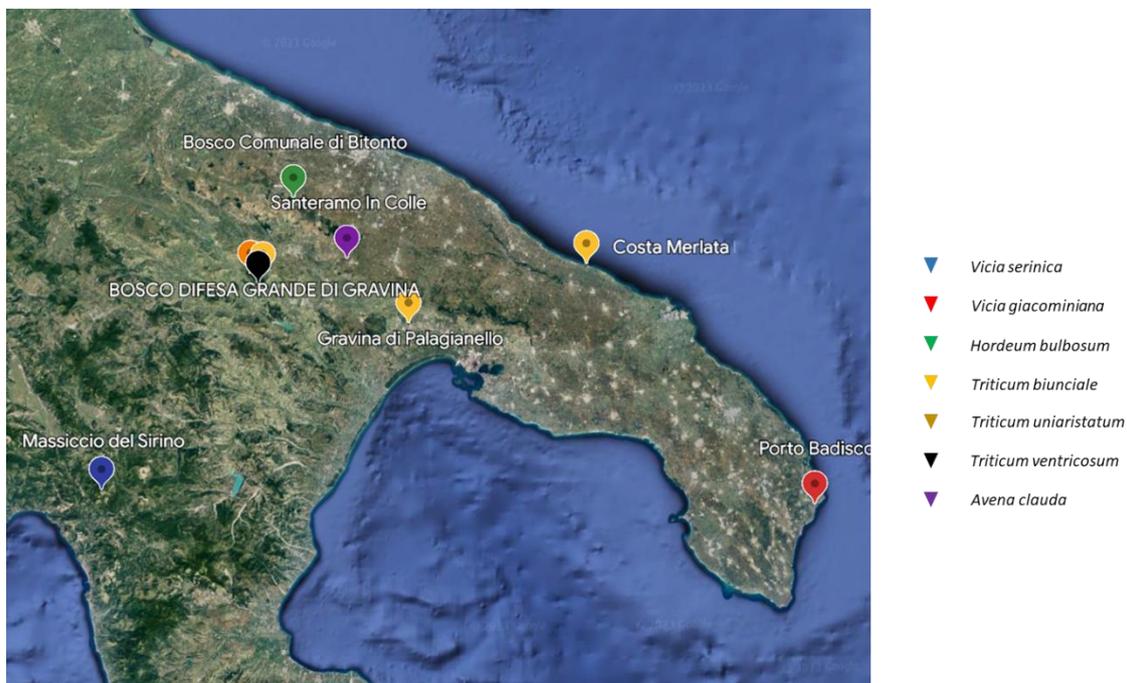


Figure 2. Distribution of the selected CWR populations on the territory of the regions Apulia and Basilicata.

The first two exploration missions were carried out in Porto Badisco (Costa Otranto - S. Maria Leuca Regional Natural Park) and in Costa Merlata to determine the presence of *in situ* populations of *V. giacominiiana* and *T. biunciale*, respectively (Figure 3).

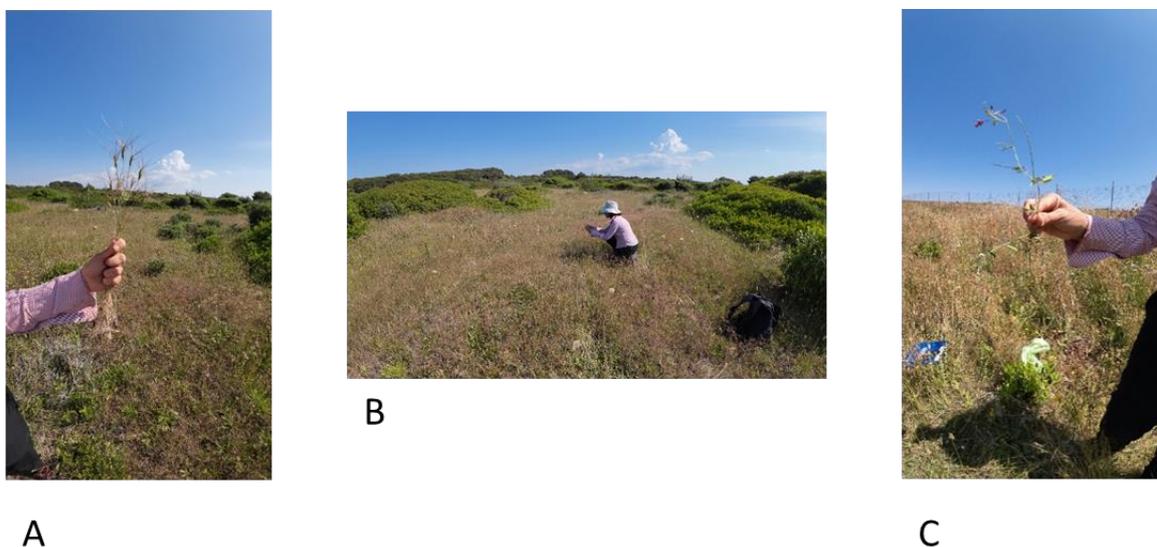


Figure 3. *In situ* investigated area for: A), B) *Triticum biunciale*; C) *Vicia giacominiiana*.

As specified in task 2 of the work plan, a draft data collection file for the national database for CWR was prepared based on the descriptors defined in the "Principles for the Inclusion of CWR Data in EURISCO", see Annex B which contains the first two provisional entries. The final structure and descriptors of Annex B will be determined based on the discussion between the Italian project partners, after all data have been collected and analysed.

Future activities

The planned activities will continue with further monitoring and integration of the collected according to standards required for inclusion in EURISCO. Another step will be to contact protected area managers in order to ask for availability to exchange materials.

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Annex A, from Ciancaleoni et al. 2021. List of CWR/WHP taxa with the highest conservation priority ("A" category) as defined in the present study for Italy. Taxa related to the crop genera included in Annex I of the ITPGRFA (FAO 2001) and ISTAT (2019), their current name, endemism (in Italy, Sardinia and Sicily) and more details about their status [*i.e.* included in the: Italian National Red Lists (Orsenigo et al. 2018, 2020; Rossi et al. 2016) and IUCN Red List (IUCN 2020) are reported.

Taxa	Endemism	Orsenigo et al. (2020)	Orsenigo et al. (2018)	Rossi et al. (2016)	IUCN Red List
<i>Agrostis canina</i> subsp. <i>aspromontana</i> Scelsi & Spamp.	Brullo, Italy		EN		
<i>Agrostis canina</i> subsp. <i>monteluccii</i> Selvi	Italy		VU		
<i>Allium agrigentinum</i> Brullo & Pavone	Sicily		EN		
<i>Allium anzaloni</i> Brullo, Pavone & Salmeri	Italy		NT		
<i>Allium calabrum</i> (N.Terracc.) Salmeri	Brullo, Pavone & Italy		NT		
<i>Allium castellanense</i> (Garbari, Miceli & Raimondo) Brullo, Guglielmo, Pavone & Salmeri	& Sicily		EN		
<i>Allium diomedeam</i> Brullo, Guglielmo, Pavone & Salmeri	& Italy		NT		
<i>Allium francinae</i> Brullo & Pavone	Sicily		NT		
<i>Allium garbarii</i> Peruzzi	Italy		NT		
<i>Allium garganicum</i> Brullo, Pavone, Salmeri & Terrasi	& Italy		EN		
<i>Allium hemisphaericum</i> (Sommier) Brullo	Sicily		VU		
<i>Allium julianum</i> Brullo, Gangale & Uzunov	Italy		EN		
<i>Allium lehmannii</i> Lojac.	Sicily		NT		
<i>Allium lopadusanum</i> Bartolo, Brullo & Pavone	Sicily		EN		
<i>Allium nebrodense</i> Guss.	Sicily		VU		
<i>Allium obtusiflorum</i> DC.	Subendemic		NT		
<i>Allium pelagicum</i> Brullo, Pavone & Salmeri	Sicily		NT		
<i>Allium pentadactyli</i> Brullo, Pavone & Spamp.	Italy		NT		
<i>Allium permixtum</i> Guss.		VU			
<i>Allium savii</i> Parl.		NT			
<i>Allium trifoliatum</i> Cirillo		NT			
<i>Allium vernale</i> Tineo	Sicily		VU		
<i>Arrhenatherum elatius</i> subsp. <i>nebrodense</i> (Brullo, Miniss. & Spamp.) Giardina & Raimondo	(Brullo, Sicily)		NT		
<i>Asparagus pastorianus</i> Webb & Berthel.		NT			
<i>Astragalus alopecurus</i> Pall.				NT	
<i>Astragalus aquilanus</i> Anzal.	Italy		EN	EN	
<i>Astragalus gennarii</i> Bacch. & Brullo	Sardinia		CR		
<i>Astragalus kamarinensis</i> C.Brullo, Miniss. & Sciandr.	Brullo, Giusso, Sardinia		EN		
<i>Astragalus maritimus</i> Moris	Sardinia		CR	CR	
<i>Astragalus nebrodensis</i> (Guss.) Strobl	Sicily		NT		
<i>Astragalus peregrinus</i> Vahl subsp. <i>peregrinus</i>		CR			
<i>Astragalus peregrinus</i> subsp. <i>warionis</i> (Gand.) Maire		CR			
<i>Astragalus raphaelis</i> G.Ferro	Sicily		CR		
<i>Astragalus siculus</i> Biv.	Sicily		NT		

<i>Astragalus tegulensis</i> Bacch. & Brullo	Sardinia		CR	
<i>Astragalus terraccianoii</i> Vals.	Sardinia	EN		
<i>Astragalus thermensis</i> Vals.	Sardinia		EN	
<i>Astragalus verrucosus</i> Moris	Sardinia		CR	CR
<i>Astragalus vesicarius</i> subsp. <i>carniolicus</i> (A.Kern.) Chater		VU		
<i>Avena insularis</i> Ladiz.		NT		
<i>Barbarea sicula</i> C.Presl	Italy, Sicily	NT		
<i>Brassica baldensis</i> (Prosser & Bertolli) Prosser & Bertolli	Italy		VU	
<i>Brassica glabrescens</i> Poldini	Italy		NT	NT
<i>Brassica insularis</i> Moris	Subendemic			NT
<i>Brassica macrocarpa</i> Guss.	Sicily		CR	CR
<i>Brassica montana</i> Pourr.		VU		
<i>Brassica procumbens</i> (Poir.) O.E.Schulz		NT		
<i>Brassica rupestris</i> subsp. <i>hispida</i> Raimondo & Mazzola	Sicily		VU	
<i>Brassica souliei</i> (Batt.) Batt. subsp. <i>souliei</i>	Subendemic	NT		
<i>Brassica souliei</i> subsp. <i>amplexicaulis</i> (Desf.) Greuter & Burdet	Subendemic	NT		
<i>Brassica trichocarpa</i> C. Brullo, Brullo, Giusso & Ilardi	Sicily		NT	
<i>Brassica villosa</i> subsp. <i>brevisiliqua</i> (Raimondo & Mazzola) Raimondo & Geraci	Sicily		NT	
<i>Brassica villosa</i> subsp. <i>drepanensis</i> (Caruel) Raimondo & Mazzola	Sicily		VU	
<i>Cichorium spinosum</i> L.		EN		
<i>Citrullus colocynthis</i> (L.) Schrad.		EN		
<i>Crambe tataria</i> Sebeók				NT
<i>Cynara cardunculus</i> subsp. <i>flavescens</i> Wiklund		VU		
<i>Daucus carota</i> subsp. <i>rupestris</i> (Guss.) Heywood	Subendemic		EN	
<i>Daucus rouyi</i> Spalik & Reduron				
<i>Diplotaxis scaposa</i> DC.	Sicily		NT	
<i>Festuca alfrediana</i> Foggi & Signorini subsp. <i>alfrediana</i>	Sardinia	NT		
<i>Festuca gamisansii</i> Kerguelen subsp. <i>gamisansii</i>	Italy		VU	
<i>Festuca gamisansii</i> subsp. <i>aethaliae</i> Signorini & Foggi	Italy		VU	
<i>Festuca humifusa</i> Brullo & Guarino	Sicily		NT	
<i>Festuca morisiana</i> Parl. subsp. <i>morisiana</i>	Sardinia		VU	
<i>Festuca rivularis</i> Boiss. subsp. <i>rivularis</i>		NT		
<i>Ipomoea stolonifera</i> (Cyr.) J.F.Gmel.		CR		
<i>Lactuca longidentata</i> Moris	Sardinia		EN	
<i>Lathyrus apenninus</i> F.Conti	Italy		NT	
<i>Lathyrus palustris</i> L.		EN		
<i>Linum katiiae</i> Peruzzi	Italy		VU	
<i>Linum mulleri</i> Moris	Sardinia		EN	EN
<i>Linum punctatum</i> C.Presl subsp. <i>punctatum</i>	Sicily		VU	
<i>Lolium interruptum</i> subsp. <i>corsicum</i> (Hack.) Banfi, Galasso, Kopecký & Ardenghi		CR		

<i>Lotus biflorus</i> Desr.			NT	
<i>Lotus peregrinus</i> L.			NT	
<i>Malus crescimannoii</i> Raimondo	Sicily			NT
<i>Medicago pironae</i> Vis.			NT	
<i>Onobrychis alba</i> subsp. <i>echinata</i> (Guss.) P.W.Ball	Italy			NT
<i>Phalaris elongata</i> Braun-Blanq.			NT	
<i>Phalaris truncata</i> Bertol.			NT	
<i>Phleum sardoum</i> (Hack.) Hack.	Sardinia			CR
<i>Pistacia atlantica</i> Desf.				NT
<i>Pistacia vera</i> L.				NT
<i>Poa remota</i> Forselles			NT	
<i>Prunus mahaleb</i> subsp. <i>cupaniana</i> (É.Huet & A.Huet)	Sicily & Arcang.			NT
<i>Prunus webbii</i> (Spach) Vierh.			VU	
<i>Ribes multiflorum</i> subsp. <i>sandaliticum</i> Arrigoni	Sardinia			EN
<i>Ribes sardoum</i> Martelli	Sardinia			CR CR
<i>Salsola oppositifolia</i> Desf.			EN	
<i>Thinopyrum flaccidifolium</i> (Boiss. & Heldr.) Moustakas			NT	
<i>Trifolium bivonae</i> Guss.	Sicily			NT
<i>Trifolium latinum</i> Sebast.				
<i>Trifolium saxatile</i> All.				EN
<i>Trifolium uniflorum</i> L. subsp. <i>uniflorum</i>	Italy, Sicily			NT
<i>Trifolium uniflorum</i> subsp. <i>savianum</i> (Guss.) Asch. & Graebn.	Italy, Sicily			NT
<i>Triticum uniaristatum</i> (Vis.) K.Richt.				
<i>Vicia consentina</i> Spreng.	Italy			NT
<i>Vicia cusnae</i> Foggi & Ricceri				
<i>Vicia dalmatica</i> A.Kern.			CR	
<i>Vicia giacominiiana</i> Segelb.	Italy			CR
<i>Vicia incisa</i> M.Bieb.				
<i>Vicia serinica</i> R.Uechtr. & Huter	Italy		EN	
<i>Vicia sparsiflora</i> Ten.			NT	
<i>Vicia tenuifolia</i> subsp. <i>elegans</i> (Guss.) Nyman	Italy, Sicily			NT
<i>Visnaga crinita</i> (Guss.) Giardina & Raimondo	Italy, Sicily			CR(PE)

Critically Endangered (Possibly Extinct) = CR(PE), CR = Critically endangered, EN = Endangered, VU = Vulnerable and NT = Nearly threatened.