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Farmer's Pride

Networking, partnerships and tools to enhance *in situ* conservation of European plant genetic resources

Landrace conservation in Europe – first localities for inclusion in a regional *in situ* PGR network

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Summary

Based on 19,335 records of landraces maintained *in situ* from 14 different European countries, 100 landrace diversity hotspots, and other sites of interest were identified and used as a starting point for interactions with collaborators in the Farmer's Pride project to provide expert input into the process of identifying potential localities for inclusion in the European network for *in situ* conservation and sustainable use of plant genetic resources. The initial identification of the hotspots was based on a percentile analysis of distribution of the average number of species per 625 km² grid cell. The cells with the highest number of different landrace species cultivated and located in the different ecogeographic regions of Europe were selected. Additionally, to consider the European breadth of diversity, we listed the sites with the highest numbers of species cultivated as landraces for those countries containing none of the identified landrace diversity hotspots. Particular attention was given to sites where landraces are still cultivated and located in protected areas of the Natura 2000 network. In this document, we report the results of the interactions with collaborators in the Farmer's Pride project regarding the identification of activities/sites of landrace cultivation in Europe most relevant for initial inclusion in the European network and some recommendations on the implementation process.

Introduction

With the term plant genetic resources for food and agriculture (PGRFA) we generally refer to the portion of between and within species plant diversity that is used by humans in agriculture. They include the wild progenitors and relatives of cultivated species – also commonly named crop wild relatives (CWR) – and crop landraces, also known as local or farmers' varieties. Given conservation priority for their intrinsic and actual adaptive diversity value, this critical diversity resource at species and population levels is at risk of extinction, and both CWR and landraces are in urgent need of protection (Veteläinen *et al.*, 2009; Kell *et al.*, 2012). A means of protecting such materials is conserving them *in situ* in the sites where they evolved their distinctive characteristics over time (CBD, 1992). For landraces, farms where they have been cultivated for generations are the sites where *in situ* conservation should occur. This type of conservation is seen as a means of capturing the evolutionary adaptation of resources that are exposed to a changing environment, thereby providing a valuable reservoir of adaptive traits for varietal improvement (Gepts, 2006; Tiranti and Negri, 2007; Vigouroux 2011).

Although cultivation of landraces has strongly declined in recent decades, such resources – together with obsolete cultivars and a variety of other heterogeneous materials that can be regarded as landraces in a broad sense, as formalized into the *ECPGR Concept for on-farm conservation and management of PGRFA* by the European Cooperative Programme for Plant Genetic Resources (ECPGR, 2017) – are still grown at significant levels in numerous European countries. However, several factors, such as landrace replacement with high yielding varieties, inadvertent implications of seed legislation, widespread industrial level agricultural activities, and the effects of climate change, are still associated with the loss of landrace diversity. Furthermore, in many countries, no formal government agency has direct responsibility for landrace conservation, highlighting the need for a European strategy and action plan for genetic resources conservation and sustainable use. This is particularly urgent in the Mediterranean basin, partially included in the European countries, as it is one of the most important biodiversity hotspots (Myers *et al.*, 2000), where both landraces (Vavilov, 1927; Pacicco *et al.*, 2018) and CWR (Vavilov, 1927; Vincent *et al.*, 2013; 2019; Castañeda Alvarez *et al.*, 2016) are present.

Taking advantage of data produced in the frame of the Farmer's Pride project, this document provides a backbone of precisely located conservation activities/sites which are suggested to be nominated for inclusion in the first platform of a European network for *in situ* conservation and sustainable use of plant genetic resources.

Materials and Methods

The methodology to identify *landrace diversity hotspots* and the *other sites of interest* was first to circulate an *ad hoc* landrace (LR) data collation template (Raggi *et al.*, 2020a) to collaborators in the Farmer's Pride project and ECPGR National Coordinators asking for data on known sites of LR cultivation (records) of broad sense landraces (i.e. true landraces, conservation and amateur varieties, populations and old cultivars – ECPGR, 2017) conserved on-farm in their respective countries. Information on landraces name, genus, species, location of cultivation (including geographic coordinates, where available) and country were collected. Collected data went through standardization and a consistency analysis to verify that cultivation records were correctly recorded from within borders of the declared country.

Second, Europe was divided geographically using a grid of 25 x 25 km cells (areas of each identified cell equal to 625 km²) obtained starting from those available at the European Commission website that are used as mapping standard (EEA reference grid – eea.europa.eu/data-and-maps/data/eea-reference-grids-2). The analysis of spatial correspondence between the records and the national administrative units allowed the identification of all the cells containing landraces (≥ 1 record). Each identified cell was attributed to one of the different European biogeographical regions (www.eea.europa.eu/data-and-maps/data/biogeographical-regions-europe-3).

Landrace diversity hotspots were selected considering the cells with values of *number of species by cell* ≥ 90 th percentile and, among these, the 100 cells characterized by the highest *number of records by cell*. Presence or absence in Natura 2000 protected areas was checked for each included landrace cultivation site. Finally, for all those countries not containing diversity hotspots, or a significant number (i.e. United Kingdom and Spain), a list of sites characterized by the highest number of species cultivated as landraces was produced using collected data (i.e. we listed the sites where the highest number of different species are cultivated as landraces). The same above-described analyses were carried out for these sites.

The list of identified *landrace diversity hotspots* and *other sites of interest* was shared with the Farmer's Pride collaborators and ECPGR National Coordinators that originally provided the data, asking for their consensus, or not, on the relevance of the identified sites for inclusion in the European network for *in situ* conservation and sustainable use of plant genetic resources.

A total of 19,335 records of landraces (broad sense) cultivation was provided by 17 Institutions from 14 European countries (Figure 1). The records belong to 190 crop species; among these *Triticum spelta* (1,820 records), *Phaseolus vulgaris* (1,785), *Malus domestica* (1,061), *Solanum lycopersicum* (838), *Fagopyrum esculentum* (775), *Pyrus communis* (748), *Secale cereale* (669), *Zea mays* (623), *Cucumis melo* (574) and *Papaver somniferum* (560) are the 10 species accounting for the highest numbers of records.

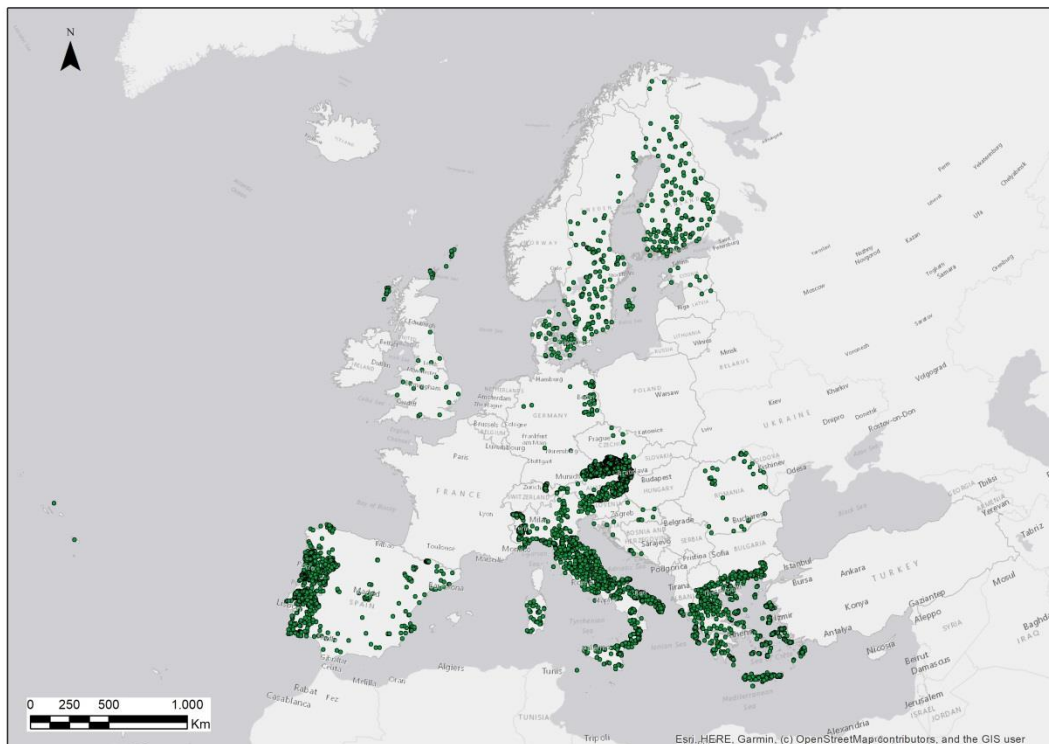


Figure 1 Geographical location of the 19,335 landrace records. Multiple records with the same geographic coordinates appear as a single locality.

Although the results should be treated with some caution since not all the European countries provided data and not all landrace cultivation sites were possibly recorded (see Discussion), standardization and consistency analysis allowed the correct positioning of all the records within their respective countries, and the density analysis showed that the 19,335 landrace cultivation records occur in 1,261 cells. The highest number of cells containing ≥ 1 landrace records was observed in Italy (325 cells) followed by Greece (232), Portugal (141), Finland (130) and Austria (108). Characterized by the presence of 107 and 93 different crop species still cultivated as landraces, Italy and Greece are clearly the two countries holding the highest diversity in terms of number of species, followed by Portugal (45) and Spain (45) (Table 1).

Table 1. Summary statistics of the 1,261 identified cells grouped by country.

#	Country code	Number of cells	Number of records			Number of species		
			Total	Mean	S.D.	Total	Mean	S.D.
1	AT	108	4,489	41.6	64.60	23	6.16	3.90
2	CZ	7	196	28.0	22.69	11	3.00	1.63
3	DE	22	214	9.7	8.75	11	2.55	1.44
4	DK	38	103	2.7	3.69	21	1.74	1.67
5	EE	8	17	2.1	1.46	10	1.63	1.06
6	EL	232	4,688	20.2	27.11	93	9.65	8.27

7	ES	87	377	4.3	5.97	45	2.36	2.87
8	FI	130	213	1.6	1.27	20	1.28	0.58
9	HR	13	24	1.8	1.99	7	1.31	1.11
10	IT	325	5,435	16.7	39.76	107	4.21	4.16
11	PT	141	3,050	21.6	28.43	45	7.59	7.02
12	RO	29	128	4.4	6.30	21	2.31	2.32
13	SE	90	137	1.5	1.06	13	1.19	0.49
14	UK	31	264	8.5	18.11	26	2.68	3.03

With a total of 583 cells, scattered over only five countries, the Mediterranean biogeographical region is the most represented, followed by the Continental (231 cells) and the Boreal (217 cells) (Table 2).

Table 2. Number of cell (25 × 25 km) assigned to each European biogeographic region, with the mean numbers of records and of crop species (in brackets). Cells are grouped by country.

Country code	Alpine	Atlantic	Boreal	Continental	Macaronesia	Mediterranean	Steppic	Totals
AT	63 (15.4; 4.4)	-	-	45 (78.1; 8.7)	-	-	-	108
CZ	1 (1.0; 1.0)	-	-	6 (23.7; 3.3)	-	-	-	7
DE	-	2 (10.0; 2.5)	-	20 (9.3; 2.6)	-	-	-	22
DK	-	5 (1.6; 1.2)	-	33 (2.9; 1.8)	-	-	-	38
EE	-	-	8 (2.1; 1.6)	-	-	-	-	8
EL	9 (32.2; 12.9)	-	-	12 (23.7; 8.8)	-	211 (19.5; 9.6)	-	232
ES	8 (6.4; 1.9)	15 (1.9; 1.1)	-	-	-	64 (4.6; 2.7)	-	87
FI	3 (1.3; 1.0)	-	127 (1.6; 1.3)	-	-	-	-	130
HR	3 (1.7; 1.0)	-	-	6 (1.3; 1)	-	4 (2.0; 2.0)	-	13
IT	55 (12.0; 3.5)	-	-	88 (10.9; 3.7)	-	182 (21.0; 4.7)	-	325
PT	-	17 (31.7; 5.9)	-	-	2 (1.5; 1.0)	122 (20.6; 7.9)	-	141
RO	3 (1.0; 1.0)	-	-	23 (5.2; 2.6)	-	-	3 (1.7; 1.3)	29
SE	4 (1.0; 1.0)	-	82 (1.5; 1.2)	4 (1.3; 1.3)	-	-	-	90
UK	-	31 (8.5; 2.7)	-	-	-	-	-	31
Total	149	70	217	237	2	583	3	1261

The 100 cells identified as hotspots of landrace *in situ* diversity in Europe correspond to the 8% of the total cells only, but hold a significant percentage of the 'total number of records' (40%) and a high percentage of the total number of crop species (70%). Hotspots are located in six countries: 45 are in Greece, 29 in Portugal, 16 in Italy, 8 in Austria, 1 in United Kingdom and 1 in Spain (Figure 2).

A total of 7,732 landrace *in situ* records are present in the 100 hotspots, and the highest number have been recorded in Greece (2,737), Portugal (1,767) and Austria (1,570) (Table 3). Greece is also the country where landraces cultivated in the hotspots belong to the highest number of different crop species (82) followed, in this case, by Italy (73) and Portugal (43). Fifty-three out of the 100 identified hotspots are at least partially included in the Natura 2000 network.

Hotspots encompass all the major European biogeographical regions, except the Boreal, Macaronesia and Steppe regions. Seventy-five hotspots are in the Mediterranean region, 15 in the Continental region, eight in the Alpine region, and two in the Atlantic region. The absence of hotspots in the Boreal, Macaronesia and Steppe regions may be due to the low occurrence of landraces in these areas or simply a lack of availability of landrace presence data from these regions in this study.

Table 3. Number of records and crop species in the 100 identified hotspots.

Country	Number of hotspots	TOTAL number of records	Total number of different crop species (by country)	Mean number of records by cell	Mean number of crop species by cell
EL	45	2,737	82	60.8	23.1
PT	29	1,767	43	60.9	19.1
IT	16	1,536	73	96.0	16.8
AT	8	1,570	22	196.3	14.1
UK	1	92	16	92.0	16.0
ES	1	30	15	30.0	15.0
Total	100	7,732	251	-	-

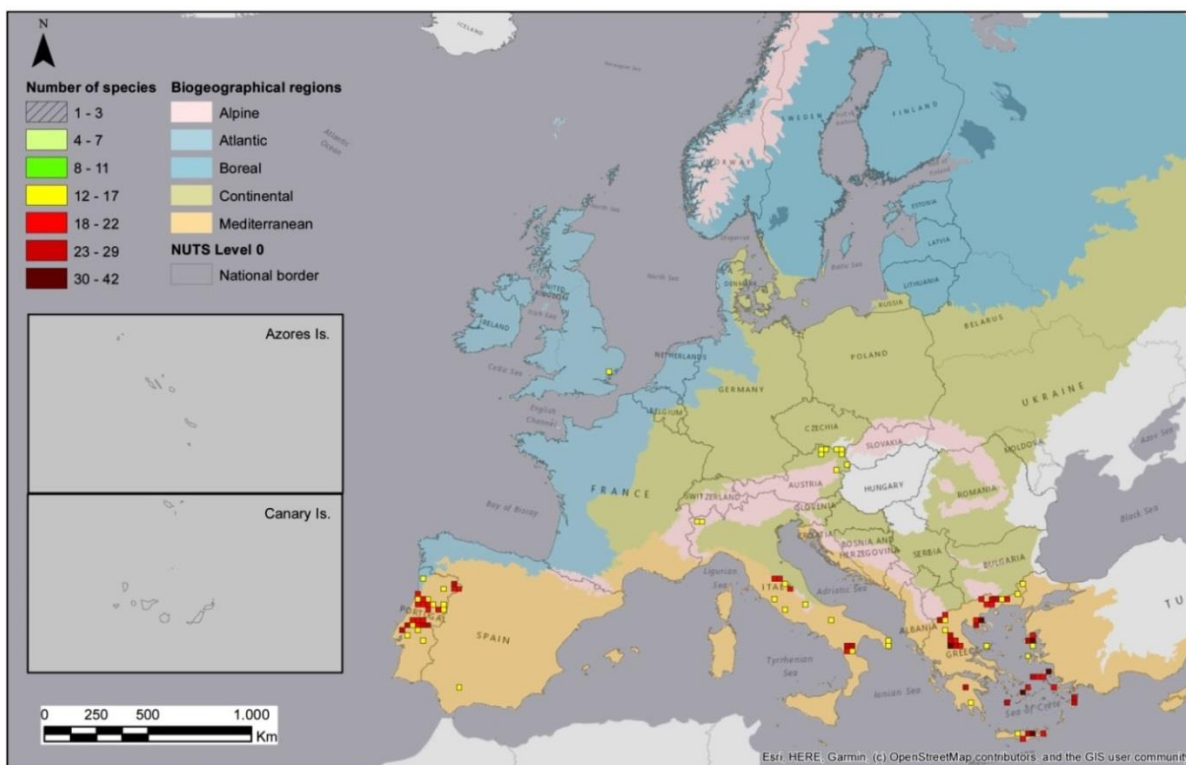


Figure 2. Location of the 100 identified landrace diversity hotspots (coloured cells)

In addition to these landrace diversity hotspots which are mainly located in Greece, Portugal, Italy and Austria, other sites of interest are also proposed for all the countries that provided data on *in situ* occurrence of landraces (Figure 3). Although by applying the parameters used in this study they cannot be considered diversity hotspots, these sites deserve attention because they are characterized by the cultivation of the highest numbers of different crop species in comparison to all the other sites in the same country. Further, in

the case of the UK, where there are lower numbers of LR, the fact that the UK is based on islands separated from continental Europe, means they are at least partially isolated and on the periphery of European cultivation, and so likely to contain some unique allelic diversity.

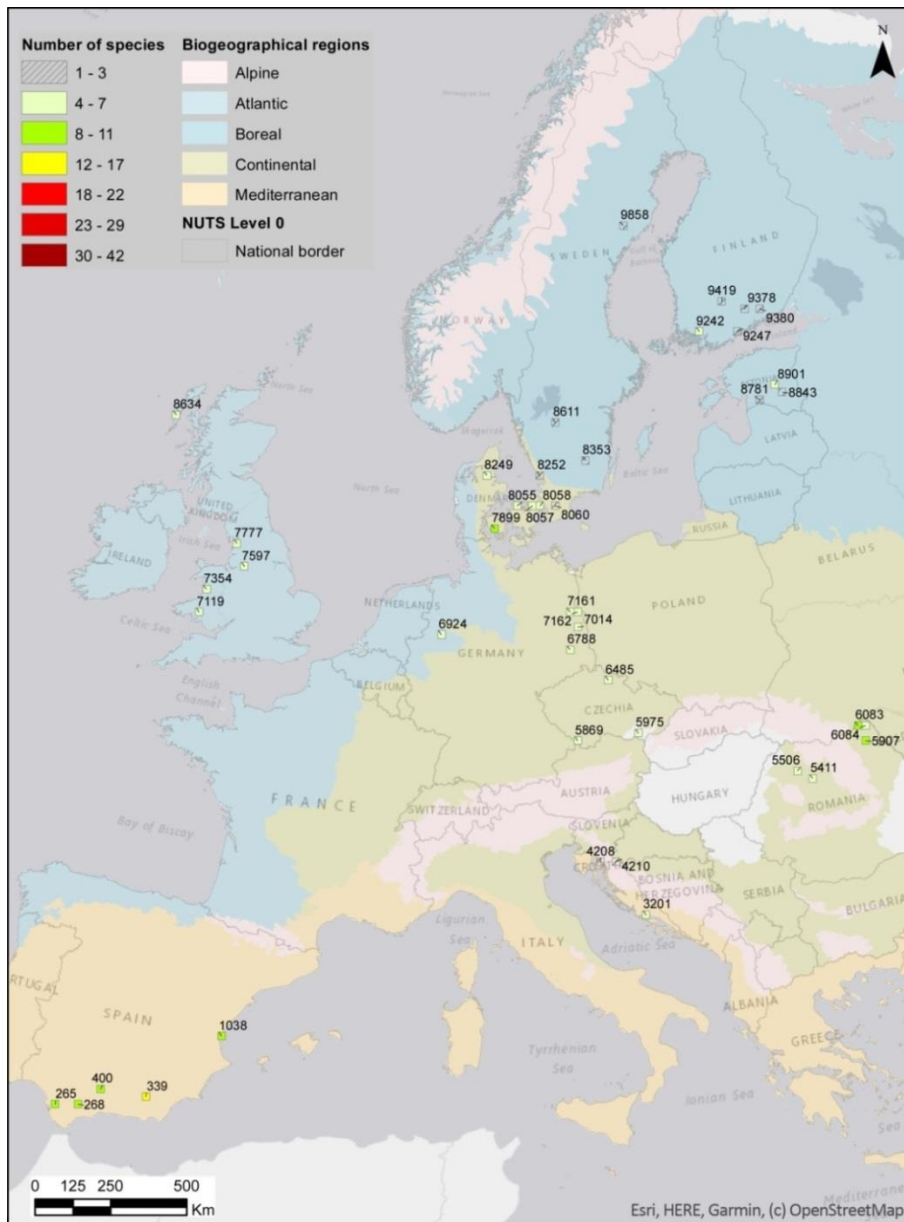


Figure 3 Location of the additional sites of interest. For each cell, a unique ID (i.e. cell number) is also reported.

Most of the contacted Farmer’s Pride collaborators and ECPGR National Coordinators involved in the research provided their comments on the utility or not of considering the identified landrace diversity hotspots and other sites of interest in the future European network for *in situ* conservation and sustainable use of plant genetic resources, confirming their interest in most of the case. In some other cases additional sites were also proposed.

Proposed landrace sites

Austria

Contact: Helene Maierhofer (ARCHE NOAH)

Main characteristics of the 8 sites initially identified for Austria.

#	ID Cell	Number of records	Number of crop species	Records/ species	Country	Biogeographic area	Rank, number of crop species	Rank, number records	Natura 2K site
1	5484	123	13	9.5	AT	alpine	91	13	yes
11	5585	162	14	11.6	AT	continental	84	8	yes
12	5775	386	14	27.6	AT	continental	83	1	yes
13	5779	93	14	6.6	AT	continental	85	18	no
14	5873	382	17	22.5	AT	continental	60	2	no
15	5874	246	13	18.9	AT	continental	95	5	yes
16	5876	79	15	5.3	AT	continental	75	25	no
17	5877	99	13	7.6	AT	continental	96	16	no

All the 8 sites initially identified have been confirmed of interest by the concerned Farmer's Pride collaborator, with the only exception of hotspot 5484 due the extensive cultivation of a single buckwheat variety named 'Billy'. Involved regions are characterized by a high proportion of arable land in flat or slightly hilly topography, which causes the large area of field agriculture, and the high absolute number of rare species and landraces. Further, these areas can be characterized as disadvantaged areas with a high proportion of farmers, lack of industry, need for unique market opportunities, and in case of cells 5775, 5873 and 5874, also marginal soils which favour the cultivation of rare species and landraces.

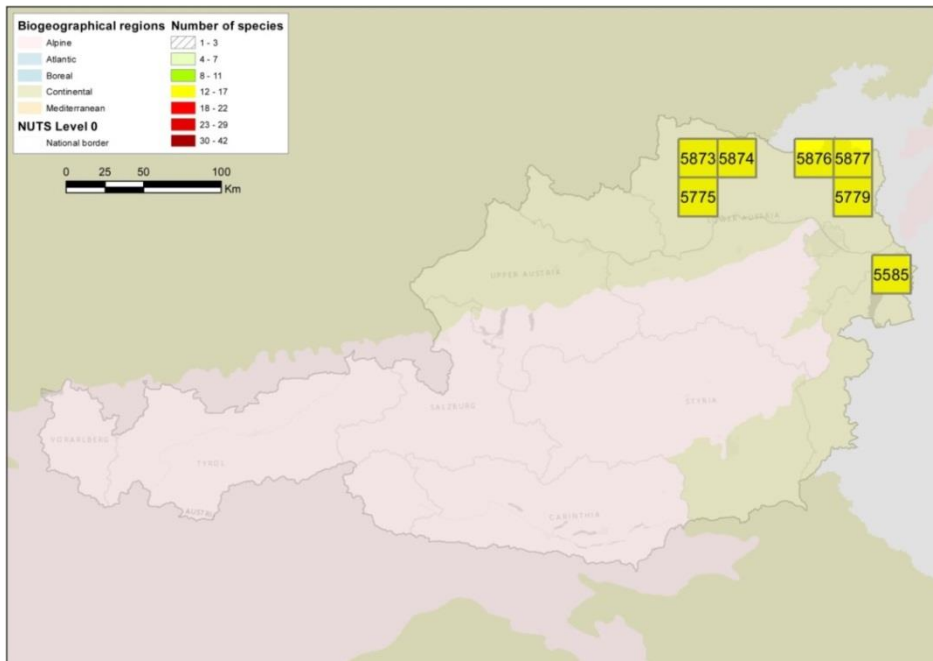


Figure 4. Location of sites of interest for inclusion in the European network

Croatia

Contact: Hrvoje Kutnjak, University of Zagreb – Faculty of Agriculture, Zagreb

Main characteristics of the 3 sites initially identified for Croatia.

ID Cell	Number of records	Number of crop species	Records/species	Country	Biogeographic area	Natura 2K site
3201	8	5	1.6	HR	Mediterranean	no
4208	3	1	3	HR	Mediterranean	yes
4210	1	1	1	HR	Alpine	yes

All the sites have been confirmed of interest by the concerned Project collaborator (Figure 5).

It has been also pointed out that:

- more sites should exist in Croatia but their identification would require further investigations, field work and time;
- information on other farmers cultivating landraces (mainly vegetables, fruits) has been recently recorded;
- once the network will be established, many farmers will be reasonably proud and glad to be involved;
- a relatively high percentage of the lands in this country is part of Natura 2000 sites (36.67%);
- in this country multi biogeographical regions may occur in 25×25 km cells.

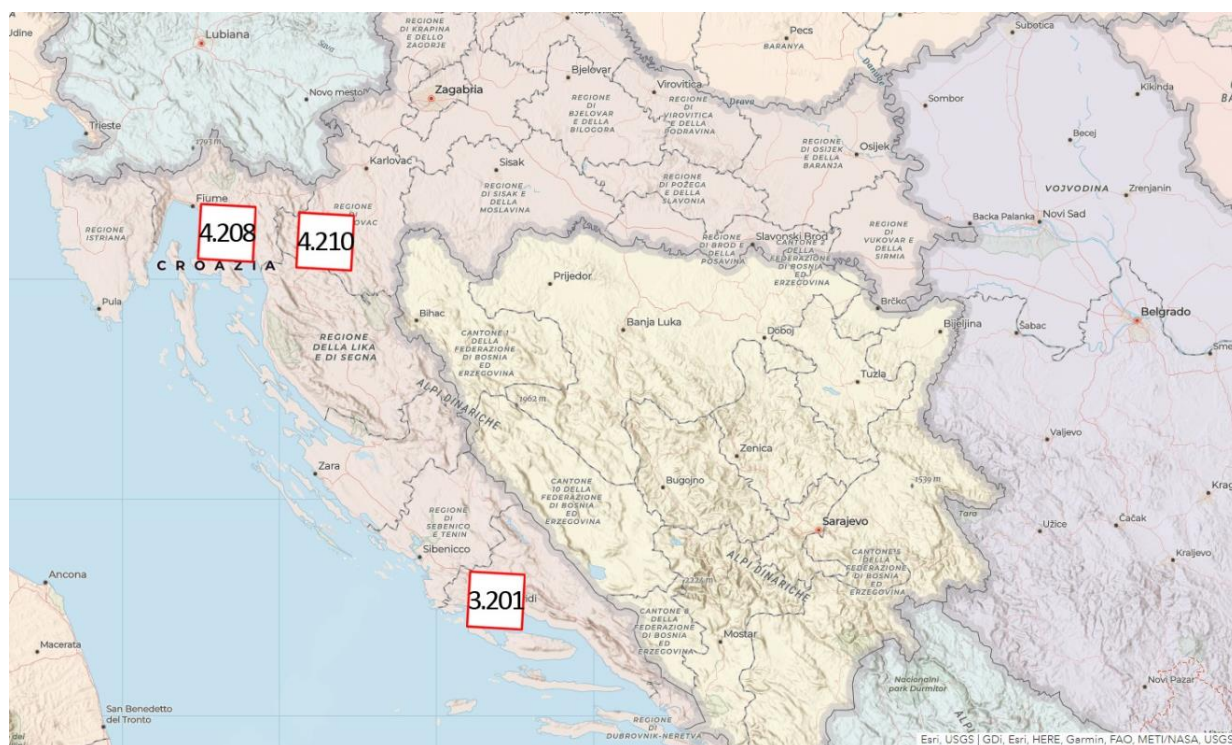


Figure 5. Location of sites of interest for inclusion in the European network. In the map cells have been magnified to make the image more readable.

Czech Republic

Contact: Vojtech Holubec from Gene bank, Crop Research Institute, Prague - Ruzyne

Main characteristics of the 3 sites initially identified for Czech Republic.

ID Cell	Number of records	Number of crop species	Records/species	Country	Biogeographic area	Natura 2K site
6485	57	5	11.4	CZ	Continental	no
5869	49	4	12.3	CZ	Continental	yes
5975	16	4	4	CZ	Continental	yes

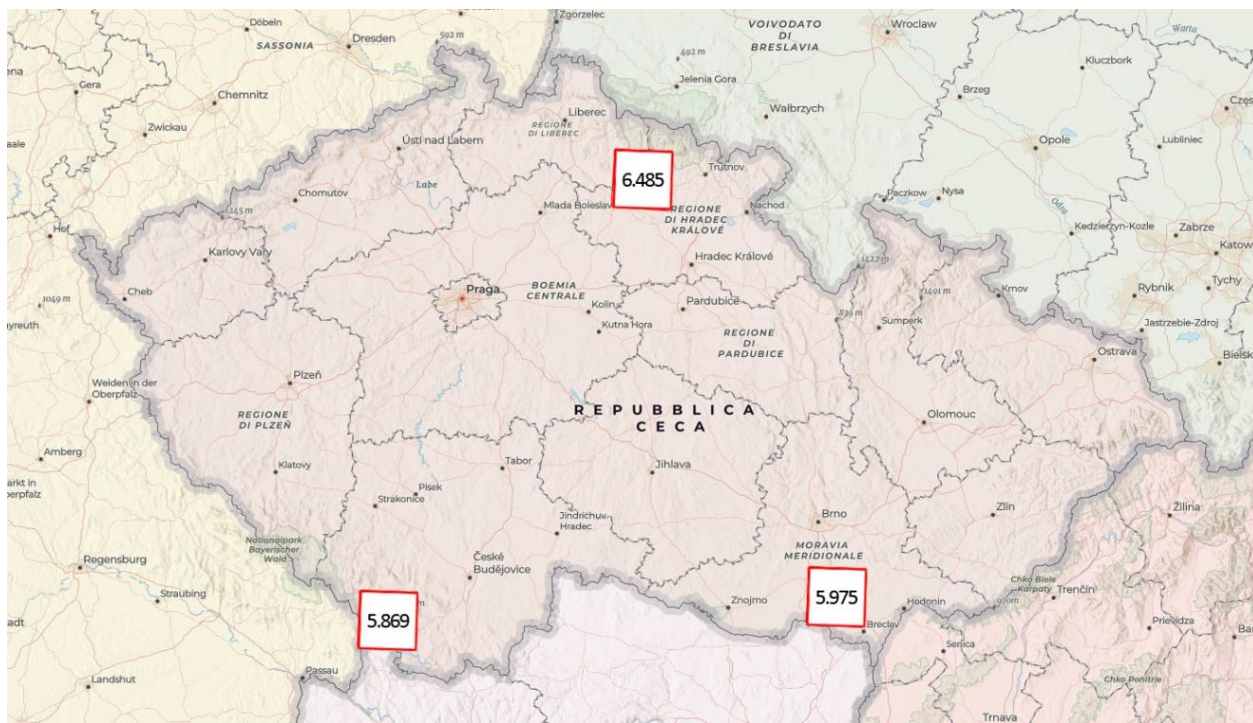


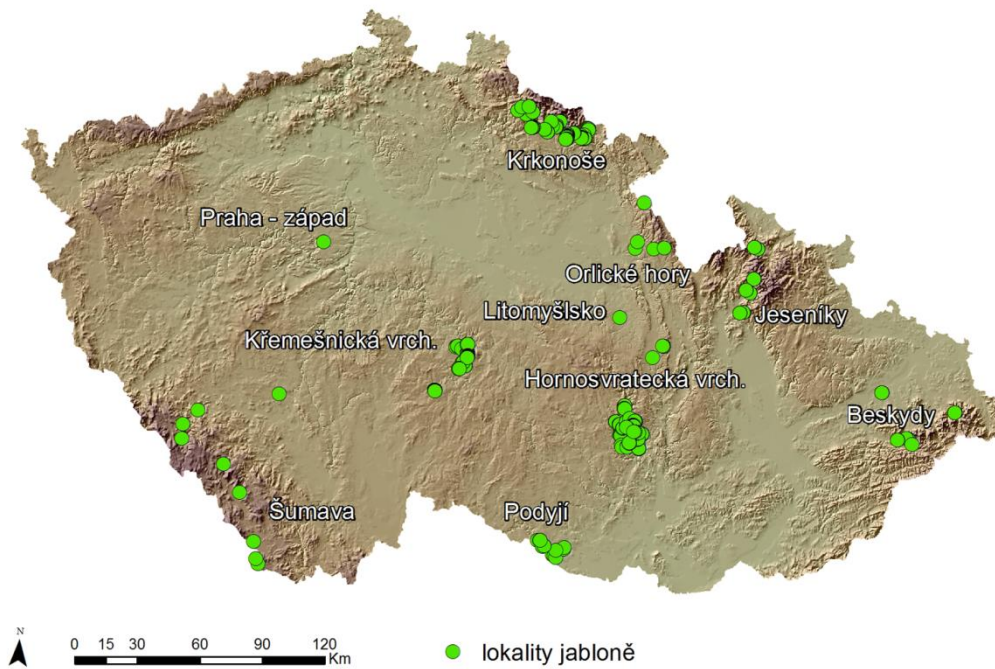
Figure 6. Location of sites of interest for inclusion in the European network (white squares). In the map cells have been magnified to make the image more readable.

Beside these sites, that were confirmed of interest, some additional proposals were made by the concerned Ambassador:

- Hradec Kralove Region (North-West part of the country)
- Sumava National Park (South-West part of the country)
- Krkonose National Park (North part of the country)
 - <https://aopkcr.maps.arcgis.com/apps/webappviewer/index.html?id=399328f6b35646c2910ddb0995b2bf6>

A total of about 1,100 fruit trees are monitored in Czechia, mostly on public and accessible land and historical orchards. An interactive GIS map was generated. Maps of monitored landraces in the country follow.

a Mapování krajových odrůd ovoce - JABLONĚ



b Mapování krajových odrůd ovoce - TŘEŠNĚ

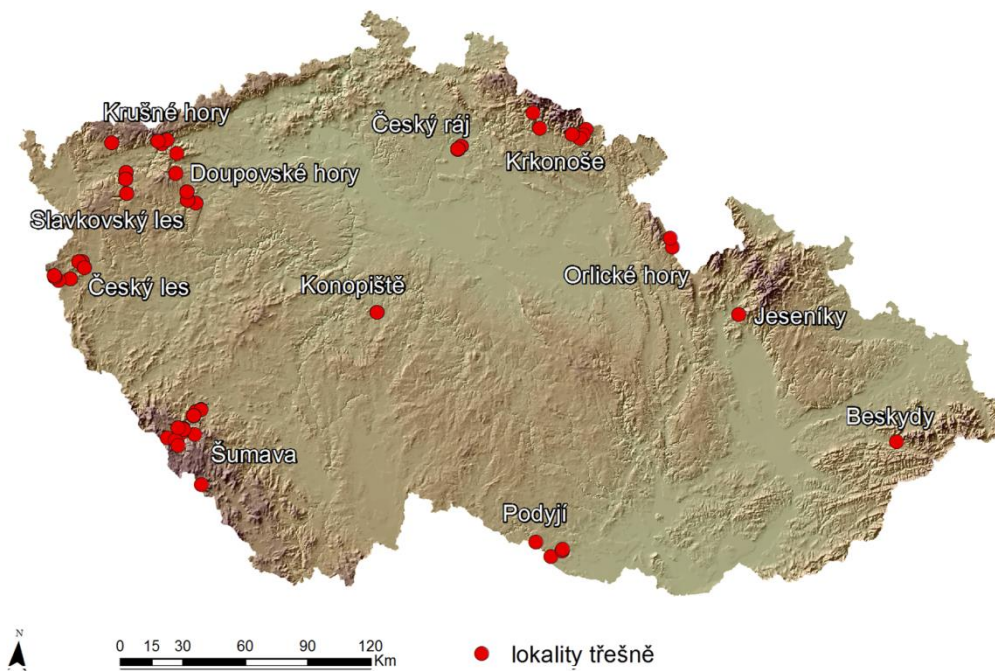
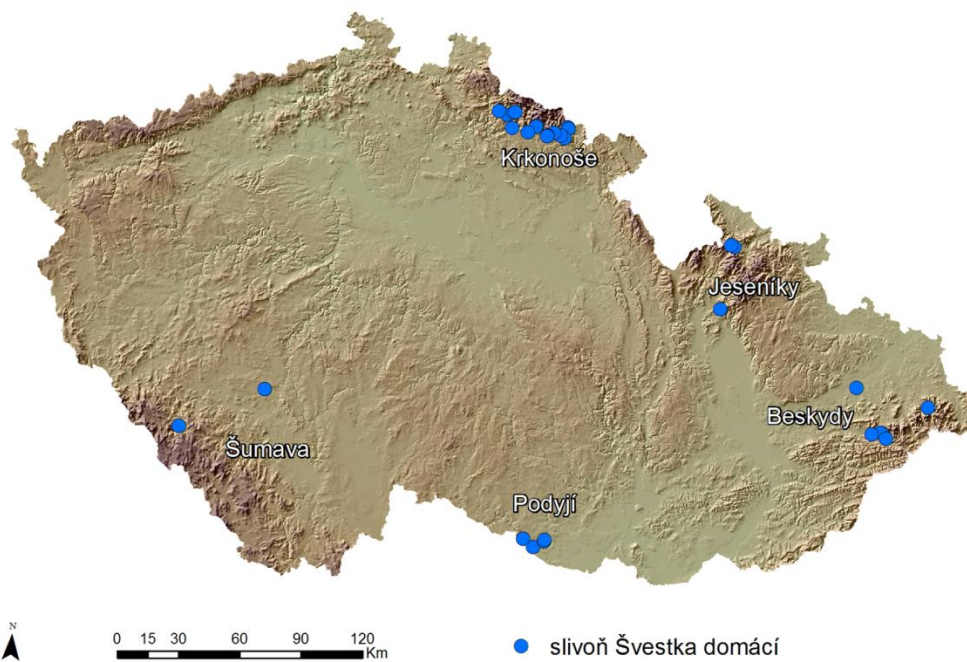


Figure 8. Maps of regional fruit varieties (a) apple(green dots); (b) cherry(red dots).

a

Mapování kraiových odrůd ovoce - ŠVESTKA DOMÁCÍ



b

Mapování kraiových odrůd ovoce - HRUŠNĚ

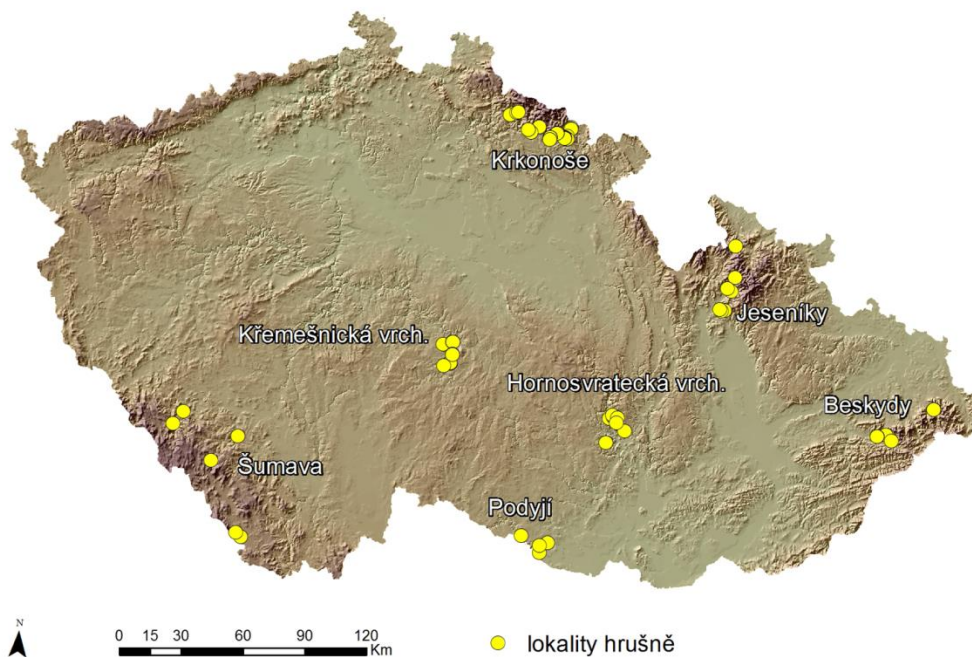


Figure 9. Maps of regional fruit varieties (a) Common plum (blue dots); (b) pear (yellow dots).

Denmark

Contact: Gert Poulsen from Frøsamlere

Main characteristics of the 5 sites initially identified for Denmark.

ID Cell	Number of records	Number of crop species	Records/species	Country	Biogeographic area	Natura 2K site
7899	21	9	2.3	DK	Continental	no
8057	7	5	1.4	DK	Continental	yes
8058	5	5	1	DK	Continental	no
8055	4	4	1	DK	Continental	yes
8249	5	4	1.3	DK	Continental	no

All the 5 sites initially identified have been confirmed of interest by the concerned Project Partner with the only exception of site 8058 placed in the area of Copenhagen city.

Some details about landrace cultivation in the proposed areas follow:

- 7899: Rural area where cultivation has taken place for a long time. However, our results relies on only few growers;
- 8055: Many large farms operate in this region;
- 8057: Area close to Copenhagen, there are a number of small farmers growing for the city, some of them also grow for conservation.
- 8249: Area where cultivation has taken place for a long time. Different individual growers;



Figure 10. Location of sites of interest for inclusion in the European network (white squares). In the map cells have been magnified to make the image more readable.

Estonia

Contact: Külli Annamaa from Estonian Crop Research Institute

Main characteristics of the 3 sites initially identified for Estonia.

ID Cell	Number of records	Number of crop species	Records/species	Country	Biogeographic area	Natura 2K site
8901	5	4	1.3	EE	Boreal	yes
8781	3	2	1.5	EE	Boreal	no
8843	3	2	1.5	EE	Boreal	no

All the 3 sites have been confirmed of interest by the concerned Project Partner; position of the 3 sites is reported in Figure 11.

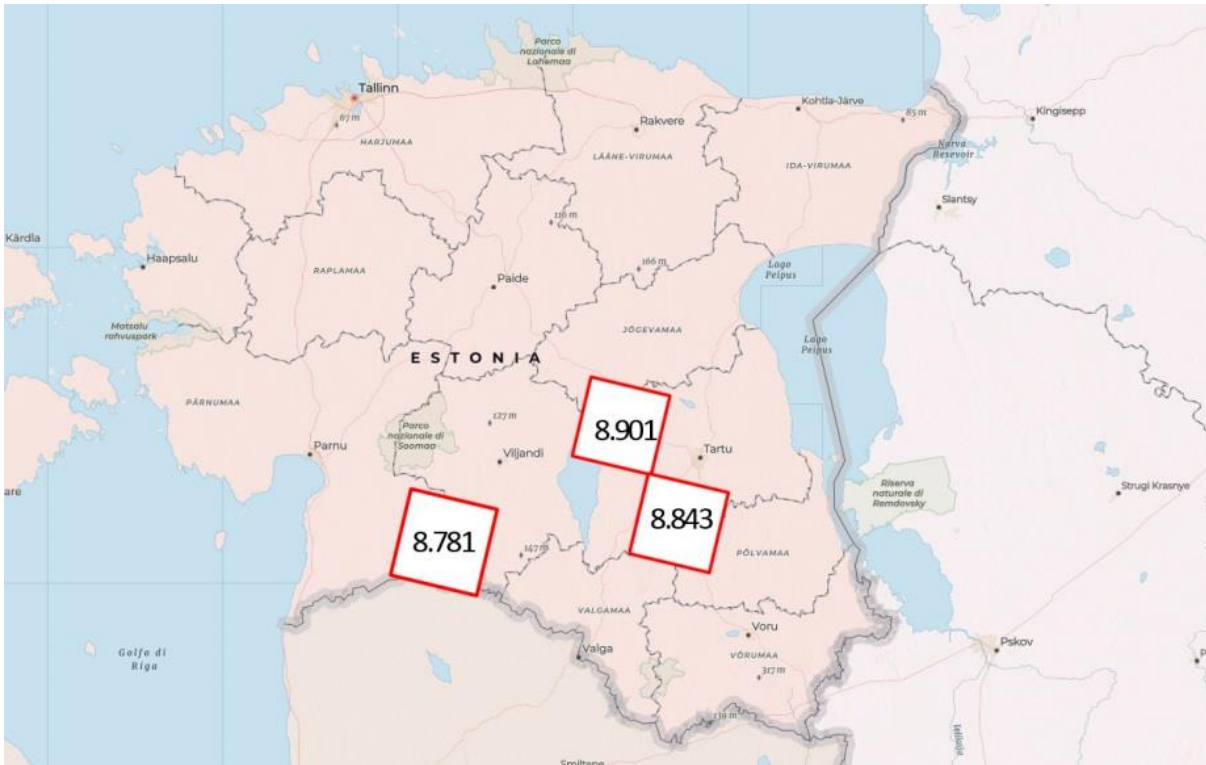


Figure 11. Location of sites of interest for inclusion in the European network (white squares). In the map cells have been magnified to make the image more readable.

Finland

Contact: Maarit Heinonen from Natural Resources Institute, Helsinki

Main characteristics of 5 sites initially identified for Finland.

ID Cell	Number of records	Number of crop species	Records/species	Country	Biogeographic area	Natura 2K site
9242	9	4	2.3	FI	Boreal	no
9247	3	3	1	FI	Boreal	no
9378	3	3	1	FI	Boreal	no
9380	3	3	1	FI	Boreal	no
9419	6	3	2	FI	Boreal	no

All the sites have been confirmed of interest by the concerned Project Partner.

It has been also pointed out that:

- more sites should exist in Finland. The inventory of landraces of pears have not been done fully and some vegetables have not inventoried at all (*e.g.* asparagus, Jerusalem artichoke, top onions, berries and musk strawberry) although known that there are some landraces still in cultivation/maintenance
- The sites identified are mainly due to the inventoried birth sites of local apple varieties (Figure 12). Sites are single home gardens except the in situ national back up collection (apple garden) of 30 local apple varieties in the area no. 9.247 owned by a NGO
- other potential sites:
 - Liesjärvi national park. A Natura 2000 area having several landraces in cultivation (winter rye, oat, potato onions, potatoes, horse beans, fiber flaxes) in a heritage farm
<https://julkaisut.metsa.fi/assets/pdf/lp/Esitteet/liesjarvieng.pdf>

Nearby of the national park some farmers and home gardeners cultivating landraces
 - Seitsemien national park. A Natura 2000 area having several landraces in cultivation (potato onions, apples) in a heritage farm
<https://julkaisut.metsa.fi/assets/pdf/lp/Esitteet/seitsemineneng.pdf>

Nearby of the national park some farmers and home gardeners cultivating landraces
 - Telkkämäki Nature reserve where some landraces (rye, turnip) in cultivation in a heritage farm
<https://www.nationalparks.fi/telkkamaki>

Nearby of the nature reserve some farmers and home gardeners cultivating landraces

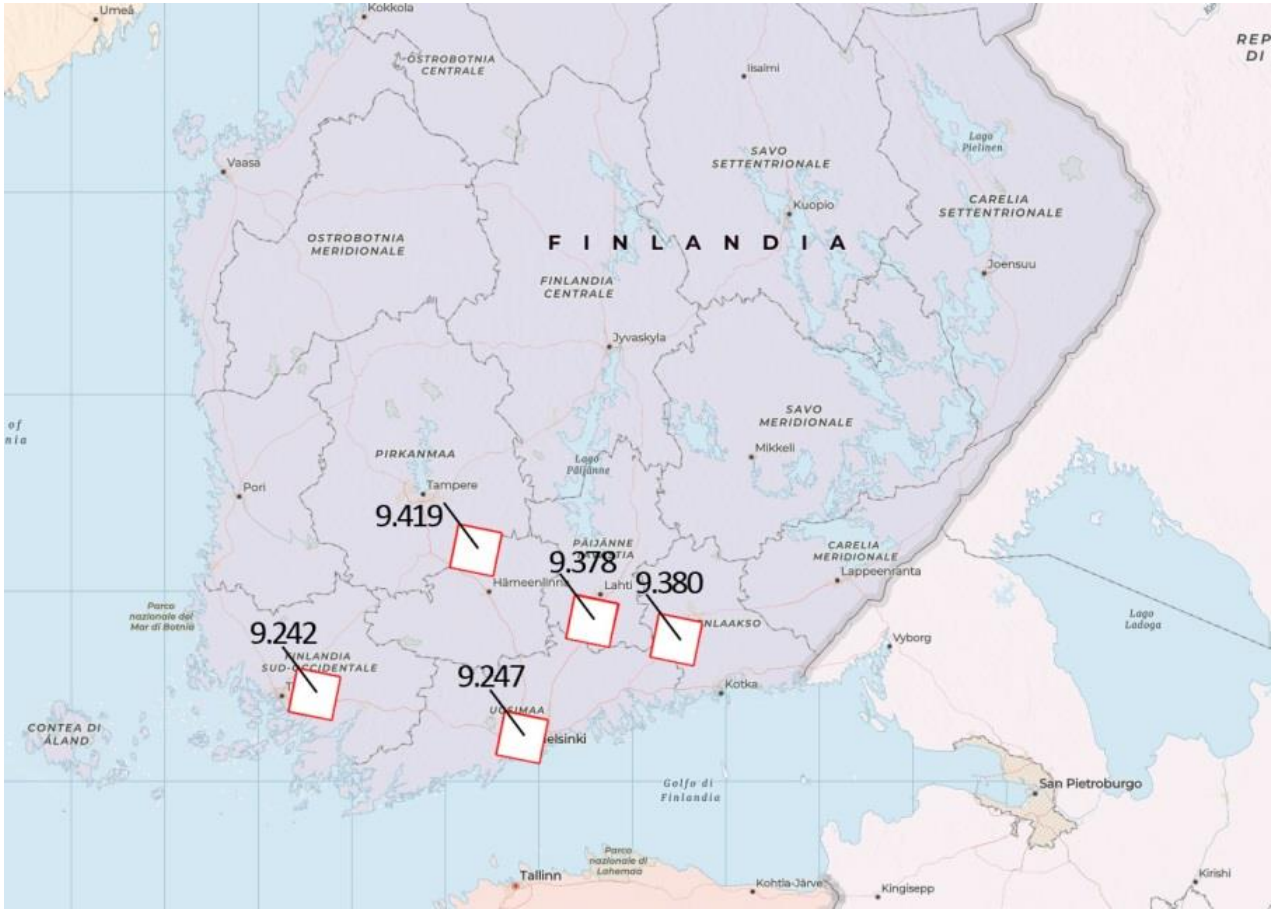


Figure 12. Location of sites of interest for inclusion in the European network (white squares). In the map cells have been magnified to make the image more readable.

Germany

Contact: Imke Thormann from Federal Office for Agriculture and Food

Main characteristics of the 5 sites initially identified for Germany.

ID Cell	Number of records	Number of crop species	Records/ species	Country	Biogeographic area	Natura 2K site
7162	15	6	2.5	DE	Continental	yes
7014	26	5	5.2	DE	Continental	no
6788	13	4	3.3	DE	Continental	no
6924	19	4	4.8	DE	Atlantic	no
7161	14	4	3.5	DE	Continental	no

Geographical distribution of the identified sites is reported in Figure 12.



Figure 13. Location of sites of interest for inclusion in the European network (white squares). In the map cells have been magnified to make the image more readable.

Greece

Contact: Parthenopi Ralli from Institute of Plant Breeding and Genetic Resources, Hellenic Agricultural Organization-DEMETER

Main characteristics of the 45 sites identified for Greece.

#	ID Cell	Number of records	Number of crop species	Records/species	Country	Biogeographic area	Rank, number of crop species	Rank, number records	Natura 2K site
2	1774	72	26	2.8	EL	Alpine	13	32	no
3	1902	48	22	2.2	EL	Alpine	28	67	yes
4	2321	53	21	2.5	EL	Alpine	38	58	no
5	2324	65	24	2.7	EL	Alpine	18	45	no
18	2325	28	14	2.0	EL	Continental	86	98	no
19	2326	38	20	1.9	EL	Continental	43	77	no
20	2470	123	17	7.2	EL	Continental	61	14	yes
21	2763	28	13	2.2	EL	Continental	97	96	yes
26	70	35	19	1.8	EL	Mediterranean	52	81	no
27	81	30	17	1.8	EL	Mediterranean	63	94	yes
28	83	58	24	2.4	EL	Mediterranean	19	51	no
29	84	78	32	2.4	EL	Mediterranean	6	29	yes
30	86	35	22	1.6	EL	Mediterranean	31	82	no
31	239	32	15	2.1	EL	Mediterranean	76	89	no
32	245	71	28	2.5	EL	Mediterranean	10	33	yes
33	257	54	29	1.9	EL	Mediterranean	9	55	yes
34	316	45	24	1.9	EL	Mediterranean	20	71	yes
35	373	148	35	4.2	EL	Mediterranean	2	9	no
36	427	34	23	1.5	EL	Mediterranean	26	85	yes
37	438	50	22	2.3	EL	Mediterranean	30	62	yes
38	443	34	20	1.7	EL	Mediterranean	46	83	no
39	598	58	25	2.3	EL	Mediterranean	17	52	yes
40	599	47	19	2.5	EL	Mediterranean	51	69	yes
41	600	28	19	1.5	EL	Mediterranean	54	100	yes
42	690	124	35	3.5	EL	Mediterranean	3	12	yes
43	972	30	16	1.9	EL	Mediterranean	71	92	yes
44	1177	229	42	5.5	EL	Mediterranean	1	7	yes
45	1178	94	25	3.8	EL	Mediterranean	16	17	yes
46	1179	30	19	1.6	EL	Mediterranean	53	95	yes
47	1183	35	16	2.2	EL	Mediterranean	69	80	yes
48	1188	33	16	2.1	EL	Mediterranean	70	88	no
49	1290	66	29	2.3	EL	Mediterranean	8	41	yes
50	1291	65	19	3.4	EL	Mediterranean	50	44	yes
51	1299	83	26	3.2	EL	Mediterranean	14	22	yes
52	1300	79	33	2.4	EL	Mediterranean	5	27	yes

53	1410	69	29	2.4	EL	Mediterranean	7	35	no
54	1419	42	20	2.1	EL	Mediterranean	44	75	yes
55	1529	78	16	4.9	EL	Mediterranean	68	28	yes
56	1654	50	28	1.8	EL	Mediterranean	12	63	yes
57	1775	30	17	1.8	EL	Mediterranean	64	93	yes
58	1781	57	22	2.6	EL	Mediterranean	29	54	yes
59	1782	85	34	2.5	EL	Mediterranean	4	20	yes
60	2180	66	21	3.1	EL	Mediterranean	40	39	yes
61	2181	34	20	1.7	EL	Mediterranean	45	84	no
62	2323	66	28	2.4	EL	Mediterranean	11	40	yes

Geographical distribution of the identified sites is reported in Figure 14.

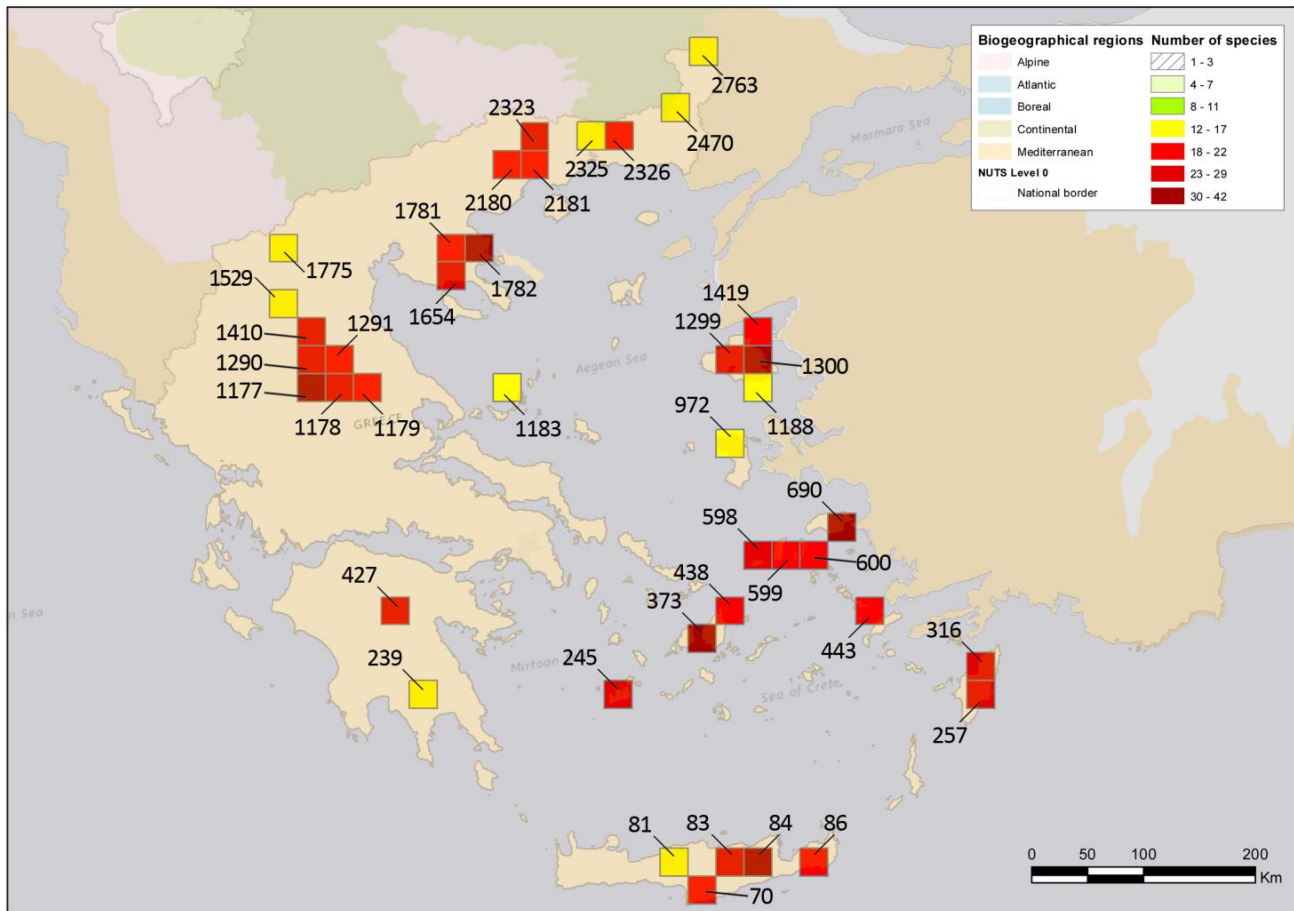


Figure 14. Location of sites proposed for Greece.

Italy

Contact: Valeria Negri and Lorenzo Raggi (University of Perugia); Claudio Buscaroli (Centro Ricerche Produzioni Vegetali); Isabella dalla Ragione (Fondazione Archeologia Arborea)

Main characteristics of the 16 sites initially identified for Italy.

#	ID Cell	Number of records	Number of crop species	Records/ species	Country	Biogeographic area	Rank, number of crop species	Rank, number records	Natura 2K site
6	2155	52	13	4.0	IT	Alpine	93	60	yes
7	4416	82	14	5.9	IT	Alpine	82	23	no
8	4417	57	13	4.4	IT	Alpine	92	53	no
22	2581	66	18	3.7	IT	Continental	57	38	yes
23	2727	74	17	4.4	IT	Continental	62	30	no
24	2877	48	19	2.5	IT	Continental	49	66	yes
25	2878	53	21	2.5	IT	Continental	39	57	yes
64	1055	235	22	10.7	IT	Mediterranean	32	6	yes
65	1056	48	13	3.7	IT	Mediterranean	99	65	yes
66	1164	257	24	10.7	IT	Mediterranean	22	4	yes
67	1165	301	24	12.5	IT	Mediterranean	21	3	yes
68	1168	37	15	2.5	IT	Mediterranean	78	78	no
69	1281	33	13	2.5	IT	Mediterranean	100	86	no
70	1760	33	14	2.4	IT	Mediterranean	87	87	yes
71	2015	49	16	3.1	IT	Mediterranean	72	64	no
72	2293	111	13	8.5	IT	Mediterranean	98	15	no

All the sites proposed have been confirmed of interest by the concerned Project Partners (Figure 15).

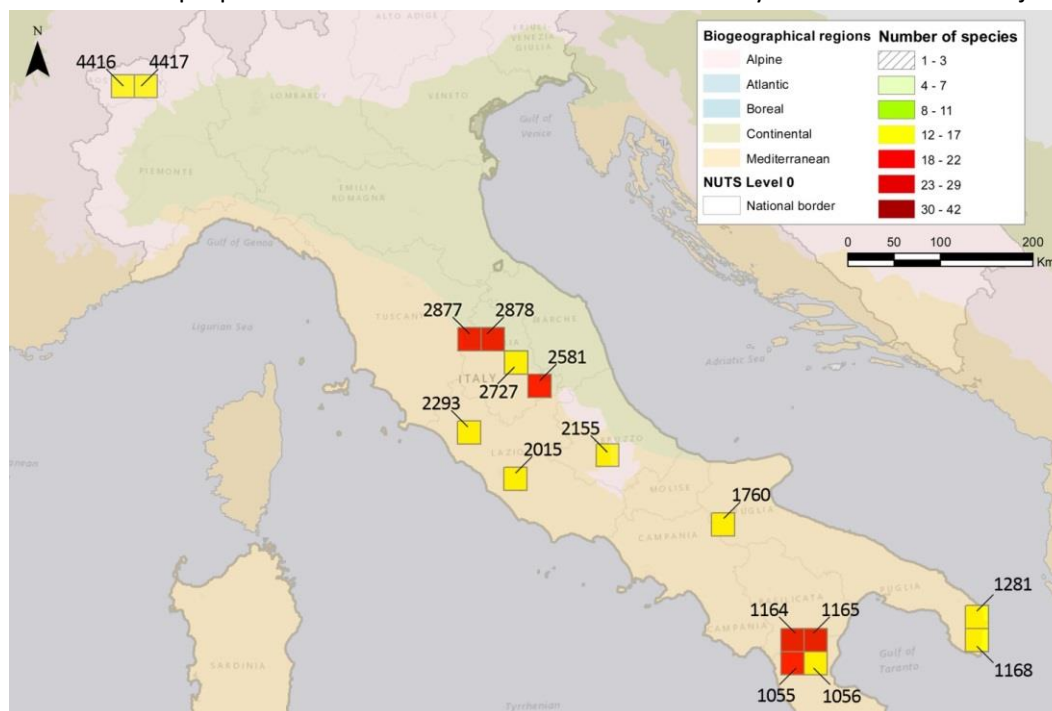


Figure 15. Location of landrace diversity hotspots in Italy.

Portugal

Contact: Ana Barata (Instituto Nacional de Investigação Agrária e Veterinária, Braga), Miguel Pinheiro De Carvalho (Universidade da Madeira, Funchal)

Main characteristics of the 16 sites identified in Portugal.

#	ID Cell	Number of crop records	Number of species	Records/species	Country	Biogeographic area	Rank, number of crop species	Rank, number records	Natura 2K site
9	2826	44	13	3.4	PT	Atlantic	94	72	no
73	1232	28	14	2.0	PT	Mediterranean	90	97	no
74	1344	36	15	2.4	PT	Mediterranean	81	79	no
75	1463	72	24	3.0	PT	Mediterranean	24	31	no
76	1466	42	17	2.5	PT	Mediterranean	66	74	yes
77	1586	138	24	5.8	PT	Mediterranean	23	11	yes
78	1587	39	15	2.6	PT	Mediterranean	80	76	no
79	1588	63	20	3.2	PT	Mediterranean	47	46	no
80	1589	82	26	3.2	PT	Mediterranean	15	24	no
81	1590	68	24	2.8	PT	Mediterranean	25	36	yes
82	1712	43	21	2.0	PT	Mediterranean	42	73	no
83	1713	50	22	2.3	PT	Mediterranean	37	61	no
84	1714	58	22	2.6	PT	Mediterranean	36	50	no
85	1971	69	19	3.6	PT	Mediterranean	55	34	yes
86	1973	59	22	2.7	PT	Mediterranean	35	48	no
87	1974	58	15	3.9	PT	Mediterranean	79	49	yes
88	2103	46	20	2.3	PT	Mediterranean	48	70	no
89	2104	59	19	3.1	PT	Mediterranean	56	47	no
90	2105	47	18	2.6	PT	Mediterranean	59	68	no
91	2106	53	16	3.3	PT	Mediterranean	73	56	yes
92	2108	28	16	1.8	PT	Mediterranean	74	99	no
93	2243	65	17	3.8	PT	Mediterranean	65	42	yes
94	2244	142	21	6.8	PT	Mediterranean	41	10	no
95	2245	67	14	4.8	PT	Mediterranean	88	37	no
96	2385	65	18	3.6	PT	Mediterranean	58	43	yes
97	2533	30	14	2.1	PT	Mediterranean	89	90	no
98	2535	84	22	3.8	PT	Mediterranean	33	21	no
99	2536	79	22	3.6	PT	Mediterranean	34	26	no
100	2680	53	23	2.3	PT	Mediterranean	27	59	yes

Three additional sites on Madeira island have been proposed:

- Porto Santo Island;
- Madeira island South Coast;
- Madeira island north Coast.

Details on the three additional sites are reported in Table 19.

Main characteristics of the 3 additional sites proposed for Portugal.

Site ID	Number of records	Number of crop species	Records/ species	Country	Biogeographic area	Rank, number of crop species	Rank, number records	Natura 2K site
Porto Santo (PS)	383	27	14.2	PT	macaronesian			yes/no
Madeira South (MS)	1491	49	30.4	PT	macaronesian			no
Madeira North (MN)	1046	37	28.3	PT	macaronesian			yes/no

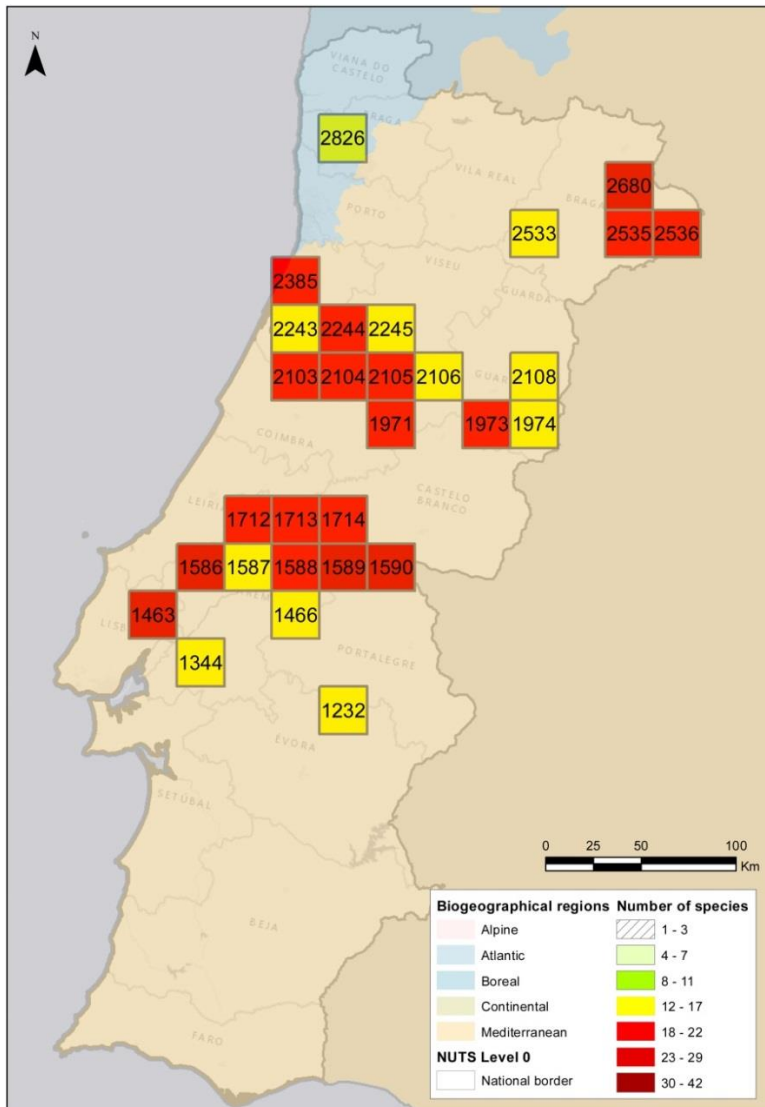


Figure 16. Location of sites proposed for Portugal.

Romania

Contact: Silvia Stajeru (Banca de Resurse Genetice Vegetale „Mihai Cristea” Suceava)

Main characteristics of the 5 sites identified for Romania.

ID Cell	Number of records	Number of crop species	Records/species	Country	Biogeographic area	Natura 2K site
6083	26	10	2.6	RO	continental	no
5907	19	9	2.1	RO	continental	yes
5506	18	5	3.6	RO	continental	no
6084	11	4	2.8	RO	continental	yes
5411	6	4	1.5	RO	continental	no

All the identified sites have been confirmed of interest by the concerned Project Partners (Figure 17).

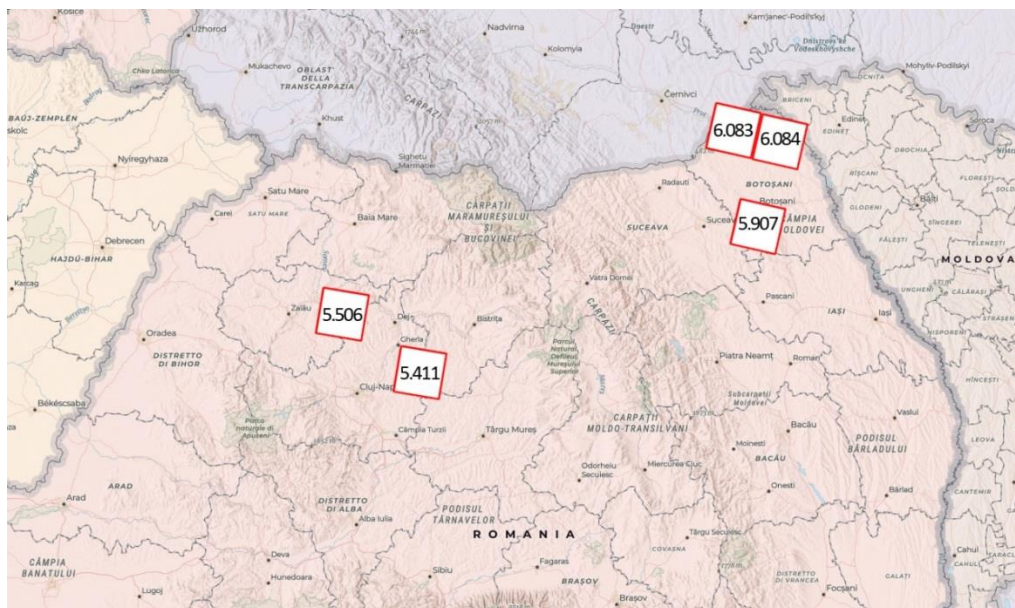


Figure 17. Location of sites of interest for inclusion in the European network (white squares). In the map cells have been magnified to make the image more readable.

In addition to those mentioned above, other 47 sites of interest for on-farm conservation of landraces diversity have been suggested; 34 of these sites are included in Natura 2000.

Main characteristics of the other sites of interest in Romania proposed by the concerned Project Partner.

Other sites of interest	Number of records	Number of crop species	Records/species	Country	Biogeographic area	Natura 2K site
Bistrita Nasaud, Bistrita Bargaului	28	13	2.15	RO	continental	No
Bistrita Nasaud, Rebrisoara, Gersa II	25	10	2.5	RO	continental	Yes
Bistrita Nasaud, Rebrisoara, Poderei	19	10	1.9	RO	continental	Yes
Bistrita Nasaud, Rusu Bargaului	10	8	1.25	RO	continental	No
Bistrita Nasaud, Lunca Ilvei	25	6	4.16	RO	continental	Yes
Bistrita Nasaud, Magura Ilvei	33	6	5.5	RO	continental	No
Bistrita Nasaud, Zagra	18	5	3.6	RO	continental	Yes
Maramures, Bogdan Voda	21	9	2.3	RO	continental	Yes

Maramures, Botiza	59	11	5.36	RO	continental	Yes
Maramures, Budesti	35	12	2.92	RO	continental	Yes
Maramures, Calinesti	28	11	2.54	RO	continental	Yes
Maramures, Cernesti	12	9	1.33	RO	continental	No
Maramures, Cupseni	26	8	3.25	RO	continental	No
Maramures, Fanate	19	11	1.7	RO	continental	No
Maramures, Peteritea	14	8	1.75	RO	continental	No
Maramures, Poienile de sub Munte	17	7	2.42	RO	continental	Yes
Maramures, Poienile Izei	14	8	1.75	RO	continental	Yes
Maramures, Repedea	14	7	2	RO	continental	Yes
Maramures, Remeti	18	7	2.57	RO	continental	Yes
Maramures, Ruscova	26	5	5.2	RO	continental	Yes
Maramures, Sacel	33	9	3.66	RO	continental	Yes
Maramures, Salistea de Sus	21	9	2.33	RO	continental	Yes
Maramures, Sapanta	25	7	3.57	RO	continental	Yes
Maramures, Sarasau	20	9	2.22	RO	continental	Yes
Maramures, Stramtura	12	8	1.5	RO	continental	Yes
Maramures, Slatioara	19	9	2.11	RO	continental	No
Maramures, Suciu de Jos	24	8	3	RO	continental	No
Maramures, Ungureni	14	8	1.75	RO	continental	No
Maramures, Vadu Izei	15	7	2.14	RO	continental	Yes
Maramures, Vima Mare	26	8	3.25	RO	continental	No
Satu Mare, Turt	17	7	2.43	RO	continental	Yes
Suceava, Bilca	13	7	1.86	RO	continental	Yes
Suceava, Bivolaria	27	8	3.37	RO	continental	No
Suceava, Breaza	20	8	2.5	RO	continental	Yes
Suceava, Brodina	46	6	7.66	RO	continental	Yes
Suceava, Frumosu	122	5	24.4	RO	continental	Yes
Suceava, Pojorata	33	4	8.25	RO	continental	Yes
Suceava, Radauti	21	6	3.5	RO	continental	Yes
Suceava, Straja	57	5	11.4	RO	continental	No
Suceava, Stulpicani	60	5	12	RO	continental	Yes
Suceava, Suceava	57	12	4.75	RO	continental	Yes
Suceava, Vama	132	7	18.86	RO	continental	Yes
Suceava, Vatra Moldovitei	91	6	15.16	RO	continental	Yes
Suceava, Vicovu de Jos	58	4	14.5	RO	continental	Yes
Alba, Almasu de Mijloc	13	2	6.5	RO	continental	Yes
Alba, Almasu Mare	56	16	3.5	RO	continental	Yes
Neamt, Pipirig	22	7	3.14	RO	continental	Yes

Spain

Contact: Josè Maria Iriondo from Universidad Rey Juan Carlos, Móstoles, Madrid and Jaime Prohens from Institute for the Conservation and Improvement of Valencian Agro-diversity, Universitat Politècnica de Valencia

Main characteristics of the single hotspot located in Spain.

#	ID Cell	Number of records	Number of crop species	Records/ species	Country	Biogeographic area	Rank, number of crop species	Rank, number records	Natura 2K site
63	397	30	15	2.0	ES	Mediterranean	77	91	no

Main characteristics of the 5 other sites of interest.

ID Cell	Number of records	Number of crop species	Records/ species	Country	Biogeographic area	Natura 2K site
339	21	12	1.8	ES	Mediterranean	yes
265	19	11	1.7	ES	Mediterranean	no
400	15	10	1.5	ES	Mediterranean	no
1038	11	10	1.1	ES	Mediterranean	no
268	28	9	3.1	ES	Mediterranean	no

All the identified sites have been confirmed of interest by the concerned Project Partner (Figure 18) with the only exception of the site in Marchena (Sevilla) since is no longer being cultivated due to present crisis.

It has been also pointed out that:

- the different sites provide complementary genetic diversity;
- was not possible to create a complete inventory of sites where landraces are grown in Spain mainly due to the difficulty of obtaining information from some regions (e.g. from the Center and North of Spain). Some additional sites could be identified in the future as knowledge concerning the cultivation of landraces is increased and improved.

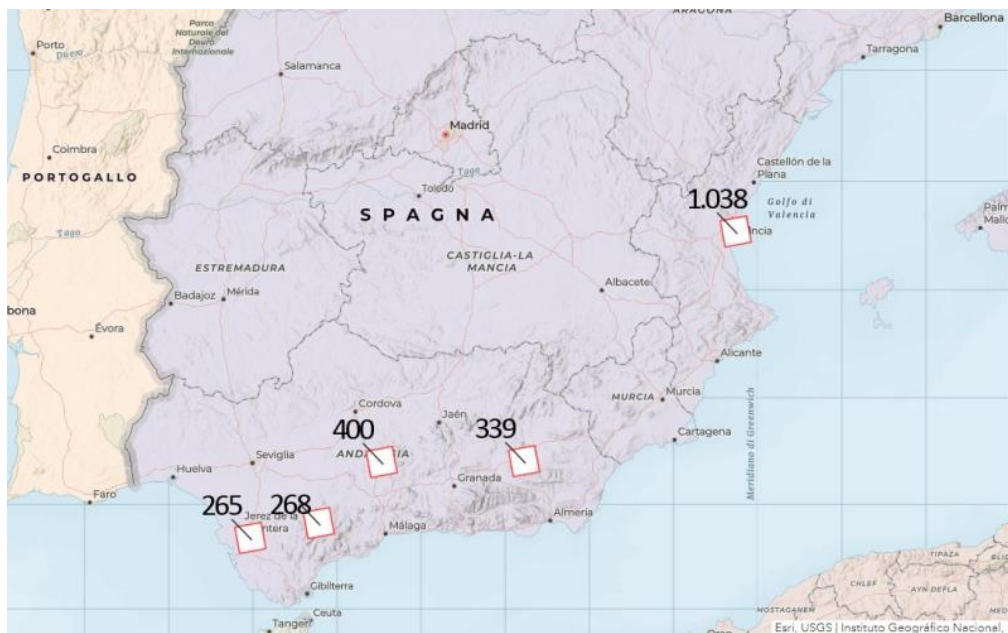


Figure 18. Location of sites of interest for inclusion in the European network (white squares). In the map cells have been magnified to make the image more readable.

Sweden

Contact: Jens Weibull (Swedish Board of Agriculture, Plant Regulations Division, Alnarp)

Main characteristics of the 5 sites identified in Sweden.

ID Cell	Number of records	Number of crop species	Records/ species	Country	Biogeographic area	Natura 2K site
8252	6	3	2	SE	boreal	no
8353	4	3	1.3	SE	boreal	partly
8611	5	3	1.7	SE	boreal	partly
9858	5	3	1.7	SE	boreal	no
8210	5	3	7	SE	boreal	no

All the sites have been confirmed of interest by the concerned Project Partners. In addition the two regions Dalarna (C Sweden) and Gotland (island in Baltic Sea) have been brought to attention; in these areas where several landraces were collected in the past (Figure 19, red-shaded areas).



Figure 19. Location of sites of interest for inclusion in the European network (white squares). In the map cells have been magnified to make the image more readable.

Switzerland

Contact: Bèla Bartha (Pro Specie Rara, Switzerland)

Main characteristics of sites identified in Switzerland.

First Administration	Second Administration	Number of records	Number of species	Records/species	Country	Biogeographic area	Natura 2000 site
GE	Genève	34	14	2.4	CHE	-	-
VS	Erschmatt	39	19	2.1	CHE	-	-
BL	Liestal	16	5	3.2	CHE	-	-
SO	Solothurn	42	22	1.9	CHE	-	-
AG	Hottwil	242	43	5.6	CHE	-	-
AG	Niederrohrdorf	60	22	2.7	CHE	-	-
LU	Ruswil	244	50	4.9	CHE	-	-
TI	Minusio	111	3	37.0	CHE	-	-
GR	Thusis	13	11	1.2	CHE	-	-
GR	Filisur	35	2	17.5	CHE	-	-
SH	Beggingen	57	24	2.4	CHE	-	-
SZ	Gross	13	3	4.3	CHE	-	-
ZH	Hedingen	52	6	8.7	CHE	-	-
TG	Neukirch a.d. Thur	273	5	54.6	CHE	-	-
AR	Heiden	75	64	1.2	CHE	-	-

United Kingdom

Contact: Nigel Maxted and Shelagh Kell (University of Birmingham); Maria Sholten (Independent researcher)

Main characteristics of the single hotspot located in United Kingdom.

Cell number	Number of records	Number of crop species	Records/species	Country	Biogeographic area	Rank, by number of crop species	Rank, by number of records	Natura 2K site
6983	92	16	5.8	UK	Atlantic	67	19	no

Main characteristics of the 5 other sites of interest located in United Kingdom.

ID Cell	Number of records	Number of crop species	Records/species	Country	Biogeographic area	Natura 2K site
7119	7	7	1.0	UK	Atlantic	no
7597	10	7	1.4	UK	Atlantic	no
7354	8	6	1.3	UK	Atlantic	no
8634	17	4	4.3	UK	Atlantic	yes
7777	6	4	1.5	UK	Atlantic	no

Results are based on surveys undertaken by Scholten et al. (2004), Kell et al. (2009) and Shoemark et al. (2018), not on a complete national inventory—therefore, the data analysed are partial and incomplete.

The European hotspot is attributed to E.W King & Co., a wholesale seed company based in Essex, and one of the UK's most prominent maintainers of traditional vegetable varieties (Kell et al., 2009). Although most seed production is contracted out to overseas companies, stock seed is maintained in the UK in small plots, so selection is still carried out in the UK with mother seed sent to growers overseas for regeneration (P. Miller, E.W. King & Co. Ltd., pers. comm., 2009; Kell et al., 2009).

Other sites of interest include Geirinis township on the Isle of South Uist, Castlebay on the Isle of Barra, and Grenitote on the Isle of North Uist, where local varieties of barley, black oat, cabbage and rye are maintained by crofters; and W. Robinson & Son (Seeds & Plants) Ltd., a family run business that has been maintaining many heritage vegetable varieties in the same location for over 160 years, including seed regeneration for sale (M. Robinson, W. Robinson & Son Ltd., pers. comm., 2009; Kell et al., 2009).

Also included as other sites of interest are two home gardens and one allotment. These are of course only a few of the hundreds of home gardens and allotments in which landraces in the broad sense are cultivated, and are included in the analysis because the maintainers responded to the survey undertaken by Kell et al. (2009).

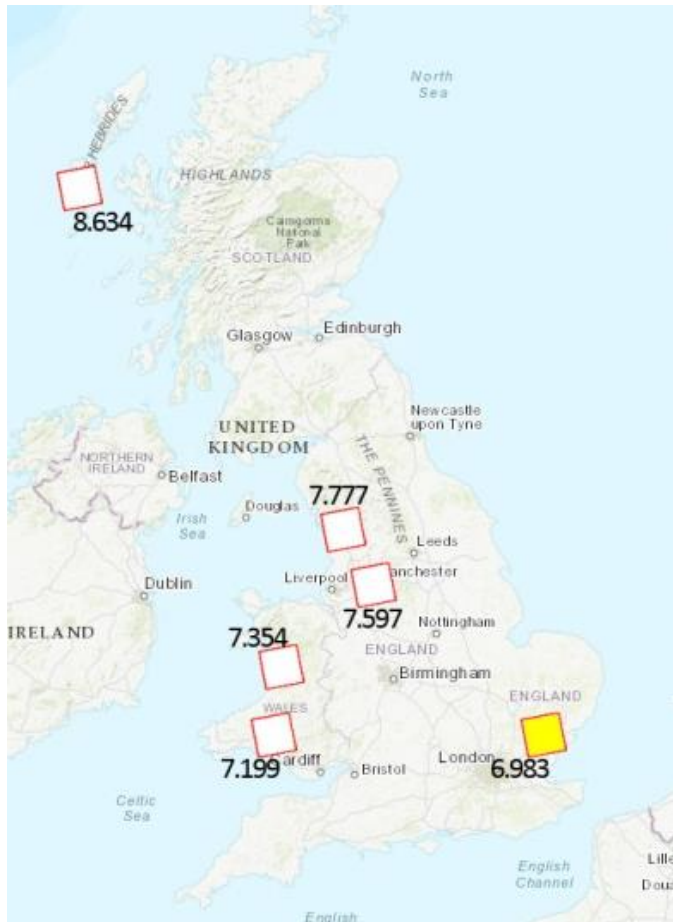


Figure 20. Location of landrace diversity hotspots (yellow) and other sites of interest in United Kingdom (white squares). In the map cells have been magnified to make the image more readable.

Discussion

To manage, coordinate and enhance *in situ* conservation of plant genetic resources (PGR), the European Union financed the Farmer's Pride project, which aims to establish a network that effectively coordinates conservation actions to safeguard the wealth of Europe's *in situ* conserved PGR and integrates the user community to maximize their sustainable use.

There are numerous types of networks that already exist in Europe, including those for seed exchange, traditional or organic farmers and protected area managers. However, in this project we aim at the establishment of a network of sites and populations and their custodians that is designed to optimize both CWR and LR genetic diversity maintenance and use. As the process – that starts from the conceptualization up to the establishment of such a network – is rather complex, during the development of the project, and specifically for landraces, the following aspects were explored:

- The breadth of stakeholders involved in *in situ* conservation of PGRFA in Europe (Raggi *et al.*, 2018).
- Structure and governance of existing formal and informal European stakeholder networks involved in *in situ* conservation.
- Criteria for the evaluation of the efficiency of collaboration platforms for *in situ* conservation of landraces (Negri and Raggi, 2020).

- Methods and practices for maintenance and propagation of landraces *in situ* according on their use, type, mating systems and applied propagation strategies (Caproni *et al.*, 2020).
- Minimum criteria for the inclusion of a resource in a European Network for PGR *in situ* conservation and use (Negri *et al.*, 2019).
- Nomination process of a resources for inclusion in the European Network for PGR *in situ* conservation and use (Negri *et al.*, 2019).
- Distribution of landrace cultivation sites in different European countries (Raggi *et al.*, 2018).
- Distribution of *in situ* landrace diversity hotspots in different European countries (Raggi *et al.*, 2020b).

A first comprehensive document on the establishment of a European network for *in situ* conservation and sustainable use of plant genetic resources was also produced (Farmer's Pride 2019).

From the data reported in the present document, it is evident that landraces, obsolete cultivars and other heterogeneous materials (i.e. landraces in a broad sense, ECPGR 2017) are still grown in many European countries and Biogeographic Regions. Reasons behind this fact can be rather different and complex and are mainly related to cultural habits, adaptation of these materials to specific environments, their agronomic value together with other elements that kept a tight connection between landraces and local communities. Landrace *in situ* conservation involves not only those farmers interested in cultivation of traditional varieties but also many private citizens that still use landrace in home gardeners, mainly for home consumption, and other private and public stakeholders (e.g. NGOs, research bodies).

The number and distribution of landrace cultivation sites (Raggi *et al.*, 2020a) and of diversity hotspots and other sites of interest (Raggi *et al.*, 2020b) – knowledge of which is a precursor for rational implementation of the network – showed that relevant differences existing among European countries regarding number of conserved landraces and landrace's species richness. Hotspots distribution, as well as differences in both number of landrace records and of cultivated species, is probably influenced by the different level of knowledge and data available in the different countries but are also certainly related to real differences on on-farm maintained materials. It is also probable that the reported numbers are an underestimation of real ones with the image resulting in this document possible unbalanced regarding conservation activities between different regions of the same country (e.g. for Spain, Iriondo Alegria J.M., personal communication). Unfortunately, it was also not possible to collect data on landrace cultivation sites from all regions of Europe; filling this gap is certainly desirable, especially to get information from countries with a strong agricultural vocation and where local varieties are certainly still grown.

Nevertheless, identified sites are certainly relevant for the choice of landrace diversity to be part of the network due to their high specific diversity. Indeed, sites to be included in the Network should often be selected pragmatically to contain multiple CWR or LR populations and, therefore, designated sites will be selected partially on the basis of PGR diversity hotspots (Farmer's Pride 2019).

In addition to here presented sites, a list of more than 100 landraces cultivated in different European countries has been developed under Work Package 2 (Caproni *et al.*, 2020). Being most of these landraces already well characterized (mainly for morpho-phenological traits) and of interest due to peculiar diversity and/or agronomic and economical relevant traits, such resources could be also usefully proposed for inclusion in the Network potentially contributing to increase its value. All data regarding this landrace collection are

publically available in a database hosted by *The European Cooperative Programme for Plant Genetic Resources (ECPGR)* web site. Noteworthy, precise information on access to reproductive material are also available for these landraces. This is a particularly relevant aspect since *in situ* materials access facilitation is one of the specific aims of the Project. Indeed, facilitate access to different stakeholder (e.g. breeders, *ex situ* managers and farmers interested in starting landraces cultivation), and promoting awareness of the value of landraces diversity for food and economic security, are two critical aspects to ensure the long-term success of the Network.

Here proposed sites of interest cover all the different main European biogeographical regions and the Mediterranean in particular. Even if a limited number of hotspots were observed in some other biogeographical areas (i.e. Alpine, Continental and Atlantic) landraces cultivated in those sites are, anyway, of great interest potentially holding unique traits: i) involved in local adaptation processes and/or ii) specific of certain peculiar pedoclimatic conditions. It has already proposed that, to form a coherent, integrated network, also sites containing a single or few populations could be considered in order to ensure the full breadth of PGR diversity is included. Even if it regards CWR, an archetypal example are the sites holding the *Beta vulgaris* subsp. *maritima* populations from the Kalundborg Fjord area, Denmark, which contain resistance to beet necrotic yellow vein virus (Farmer's Pride Consortium 2019).

Since the putative Network will include both CWR and LR, we also considered the occurrence of landraces diversity hotspots in protected areas of the Natura 2000 network. In fact, as already argued by Maxted et al. (2008), the Natura 2000 network holds a great potential in supporting the European network for *in situ* conservation and sustainable use of PGR and interesting synergies can be found by considering together the wild and cultivated components of PGRFA. Indeed, the high percentage of here presented landrace diversity hotspots located in Natura 2000 sites seems to confirm this intuition: originally aimed at protecting the wild part of nature, the European Union policies that allowed the creation of Natura 2000 network also had a great impact in protecting landraces. In fact, organic or low input agricultural techniques are encouraged in protected areas and landraces are the best material to be cultivated in such conditions (Raggi et al., 2017; Caproni et al., 2018; Ciancaleoni and Negri, 2020 and references therein).

Considering the knowledge of Project Partners on materials and *in situ* conservation processes occurring in their respective countries and starting from sites proposed in D1.4 (Raggi et al., 2020b), Partners are currently involved in the process of: i) gathering expressions of interest in joining the Network by concerned stakeholders and ii) of nominating sites (a process that is anticipated will occur only in a second phase). Indeed, according to received comments it looks that the method applied for the identification of landrace diversity hotspots was very successful; in most of the cases the concerned Partners confirmed the suitability of the identified sites for inclusion in the network with few changes. In some cases additional sites were also proposed. At this regard, it should be considered that Maxted *et al.* (2015) proposed that systematic and effective *in situ* conservation of PGR diversity can only be achieved via three interrelated geographic, or more precisely, geopolitical levels (national, regional, and integrated), each level including nationally and regionally identified/nominated sites/populations. In this scheme, although the identification of crop wild relatives and landrace sites/populations can result from national, regional or even global research initiatives, all are necessarily managed at national level because the sites/populations are in a specific location within a country and post-CBD countries have national sovereignty over their biological resources CBD (1992).

Therefore, national coordinators/agencies will retain oversight of national PGR resources and their continuing support will be essential to the success of the European Network. Taking these fundamental aspects into mind, the process proposed for the inclusion of sites/resources in the Network should be as follows:

- Application of conservation science to data gathered during the project for the identification of sites of particular interest in different European countries due to the high level of specific diversity, their position in different European biogeographical areas and possible inclusion in Natura 2000 protected areas (Raggi *et al.*, 2020b).
- Involvement of Project Partners and National Coordinators, that are mainly the persons who have the best knowledge of the sites and respective conserved resources (those who provided the raw data in many cases) for comments on the opportunity, or not, to consider stakeholders, sites and resources of a certain area for inclusion in the network.
- Involvement of Project Partners and National Coordinators in contacting farmers (mainly), others stakeholders working in the selected sites or other designed nominees (a subject that, according to national legislation, have the right to nominate a site/resource for inclusion in the network) inviting them to express their general interest in joining the network by filling up an *ad hoc* developed template available in the project website: [Register your interest in joining a network for future food security](#).

Once the network is established national partners will be invited to propose their resources for inclusion in the network itself (what foreseen is a network of sites, stakeholders and resources). It is also worthy to say that it is envisaged that the process will be iterative, meaning that it will be always possible to nominate new sites for inclusion in the network in future years.

A concise description of the possible benefits of membership – together with some details about the rationale for the establishment of the network, its aim and objectives, possibly involved stakeholders and how the Network will operate – are available in the document *European network for in situ conservation and sustainable use of plant genetic resources—in cultivation and in the wild* available in the [Project web site](#). Information provided by the document are though to help target stakeholder in understanding the key role that the Network can play in safeguarding *in situ* diversity in Europe and how they can take actively part to this process.

Conclusions

There are numerous types of networks that already exist in Europe including those for seed exchange, traditional or organic farming, and protected area managers. With this project, we aim at the establishment of a network of sites and populations, of both landraces and crop wild relatives with their respective custodians, that optimizes genetic diversity maintenance and increases access to and use of such materials. This document presents the results of a first attempt to systematically analyse European *in situ* landrace diversity. Although further data are needed for a more comprehensive analysis, the data gathered during the project, and the analyses carried out, allowed the identification of a set of sites and resources that represent an optimal starting point for the process of network establishment. Interesting synergies appear when the occurrence of landraces and crop wild relatives are considered together in protected areas (Natura 2000 network) across Europe. Such

synergies should be properly exploited for the establishment of a network that coordinates actors involved in the *in situ* conservation of these two key components of PGRFA and that contributes to protect the full breadth of European PGRFA diversity.

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