

Preserving diversity: a concept for *in situ* conservation of crop wild relatives in Europe: version 2



Nigel Maxted, Alvina Avagyan, Lothar Frese, José Iriondo,
Joana Magos Brehm, Alon Singer and Shelagh Kell

Preserving diversity: a concept for *in situ* conservation of crop wild relatives in Europe: version 2

Nigel Maxted, Alvina Avagyan, Lothar Frese, José Iriondo, Joana Magos Brehm, Alon Singer and Shelagh Kell¹

Citation: Maxted, N., Avagyan, A. Frese, L., Iriondo, J.M., Magos Brehm, J., Singer, A. and Kell, S.P. (2013). Preserving diversity: a concept for *in situ* conservation of crop wild relatives in Europe: Version 2. Rome, Italy: *In Situ* and On-farm Conservation Network, European Cooperative Programme for Plant Genetic Resources.

Front cover page (clockwise from top left):

Allium atropurpureum (Pavol Hauptvogel)

Asparagus officinalis (Nigel Maxted)

Vavilovia formosa (Ivan Gabrielyan)

Fragaria viridis (Juozas Labokas)

¹ Shelagh Kell's contribution to this document in part overlaps with her PhD research and its inclusion here does not infringe her right to include the research in her PhD or in associated publications.

Contents

Contents	iii
Acknowledgements	iii
Executive summary	iv
Acronyms and abbreviations	v
Definitions of terms	v
1.0 Introduction	8
1.1 Why develop a concept for <i>in situ</i> CWR conservation in Europe?	8
1.2 The policy context for CWR conservation and use	8
1.3 The ECPGR context	10
1.4 Preparation of the draft concept	10
2.0 The Concept	11
2.1 Key elements of the Concept	11
2.2 Unique and important CWR populations for <i>in situ</i> conservation	13
2.3 Two core levels of conservation strategy planning	13
2.3.1 National CWR conservation strategy planning	14
2.3.2 Regional (European) CWR conservation strategy planning	14
2.4 An integrated CWR conservation strategy for Europe	14
2.4.1 Establishment and operation of the integrated strategy	14
2.4.2 Identifying important CWR diversity and hot-spots	16
2.5 A new policy paradigm for CWR conservation in Europe	17
2.6 Enhancing the utilization of conserved CWR resources in Europe	18
2.6.1 Improving the conservation–utilization link	18
2.6.2 Strengthening the interface between <i>in situ</i> and <i>ex situ</i> CWR conservation	18
2.6.3 Integrate ECPGR <i>In Situ</i> and On-farm Conservation Network with Crop WGs	19
2.7 Options to promote awareness and raise additional funding	19
2.8 Conclusions	20
Annex 1. ECPGR terms of reference	21
Annex 2. Recommendations	22
Annex 3. Summary of minimum quality standards for CWR genetic reserve conservation.	24

Acknowledgements

This document was prepared by the seven members of the *In Situ* Conservation of Crop Wild Relatives in Europe Task Force but they wish to acknowledge the support and endorsement of the full membership of the ECPGR *In Situ* and On-farm Conservation Network for the Concept proposed.

Executive summary

There is an imperative to develop and implement a comprehensive strategy for *in situ* conservation of the valuable crop wild relative (CWR) genetic resources native to Europe because historically these taxa have fallen between the conservation priorities of both the agricultural and conservation communities. These wild plant resources, which are related to the many socio-economically important crops cultivated in the region (food, forage, fodder, beverage, food additive, oil, medicinal, ornamental and forestry crops), contain a wide pool of genetic diversity that is of value for crop improvement. CWR are therefore an important resource for the maintenance of food security and for safeguarding the substantial economic gains to Europe through crop production in the region. However, despite their recognized value, the conservation of CWR has been largely neglected, in part due to the disconnection between the agencies responsible for the conservation of plant genetic resources for food and agriculture and those responsible for the conservation of wild plant populations in general or the habitats in which they grow.

Recent advances in our understanding of CWR diversity in the region, as well as in planning for their complementary conservation (i.e., both *in situ* and *ex situ*), provides a solid foundation for the development of a strategic approach to their conservation in Europe based on a range of commonly agreed and widely tested scientific concepts and techniques. However, achieving effective conservation and utilization of European CWR diversity as a means to promote food and economic security in the region will require a coherent, regionally coordinated policy and the appropriate resources to fund their conservation, characterization and evaluation. To achieve sustainable conservation of CWR and maximise their sustainable exploitation in Europe, there is an imperative to develop an EU-led policy to harmonize their conservation, characterization, evaluation and use with existing biodiversity conservation and agricultural initiatives, and to develop new initiatives where necessary.

In this document, we present a concept for *in situ* conservation of CWR (the Concept) to guide EU and national policy development which can be used as a blueprint to drive concerted actions throughout the region. The Concept was developed by the *In situ* conservation of CWR in Europe Task Force which was established under the guidance of members of the ECPGR *In Situ* and On-farm Conservation Working Group and the ECPGR Secretariat in response to a mandate provided by the ECPGR Steering Committee. The objective is to agree and adopt the Concept with a view to offering it to the European Commission for its consideration when formulating future European policy on *in situ* conservation of CWR diversity. This policy would substantially aid and secure the implementation of the wider EU strategy for the conservation of genetic resources in food, agriculture and forestry in Europe.

The Concept is presented in seven sections: (1) an outline of the Concept and its key elements; (2) a proposal for the designation of Most Appropriate Wild Populations—a new paradigm for CWR conservation; (3) a description of the two core levels of CWR conservation strategy planning needed for the development of a comprehensive pan-European conservation strategy; (4) a vision of how an integrated CWR conservation strategy for Europe can be established and administered; (5) rationale for new policy required to establish and support the ongoing operation of the integrated strategy; (6) proposals for enhancing the utilization of conserved CWR resources in Europe; and (7) options to promote awareness and raise additional funding for *in situ* CWR conservation with complementary management of *ex situ* germplasm samples. Specific recommendations for taking forward the *in situ* conservation strategy for CWR in Europe are also included. The Concept has been endorsed by the members of the ECPGR *In Situ* and On-farm Conservation Network and represents the Network's vision of how *in situ* conservation of CWR diversity can be achieved in Europe, as well as forming the basis of an action plan for the Network's activities on CWR conservation over the next ten years.

Acronyms and abbreviations

AEGIS	A European Genebank Integrated System
CBD	UN Convention on Biological Diversity
CWR	Crop wild relative(s) (see definitions of terms)
EC	European Commission
ECCDB	European Central Crop Databases
ECPGR	European Cooperative Programme for Plant Genetic Resources
EEA	European Environment Agency
EU	European Union
EUCARPIA	European Association for Research on Plant Breeding
EURISCO	European Genebank Search Catalogue
GEF	Global Environment Facility
GEN RES	European Council regulation 1467/1994 (EC, 1994) or 870/2004 (EC, 2004)
GPA	FAO Global Plan of Action for plant genetic resources for food and agriculture
ICWRA	Important Crop Wild Relative Areas
ITPGRFA	International Treaty on Plant Genetic Resources for Food and Agriculture
IUCN	International Union for the Conservation of Nature
MAWP	Most Appropriate crop Wild relative Population
PAs	Protected areas
PGR	Plant genetic resources
PGRFA	Plant genetic resources for food and agriculture (see definitions of terms)
WG	ECPGR Working Group

Definitions of terms

Accessions	Distinct, uniquely identified samples of seeds, plants, or other germplasm materials that are maintained as an integral part of a germplasm collection.
Action plan	See ‘Conservation action plan’.
Agrobiodiversity	Elements of biodiversity—including plants, animals and micro-organisms—that benefit people. Encompasses the variety and variability of animals, plants and micro-organisms which are necessary to sustain key functions of the agroecosystem, its structure and processes for, and in support of, food production and food security. Comprises genetic, population, species, community, ecosystem, and landscape components and human interactions with all these.
Annotated CWR checklist	A list of all CWR found in a certain geographic area, but here additional information has been added to the list of taxon names and authorities.

Biodiversity	The variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part, this includes diversity within species, between species and of ecosystems (CBD 1992, Article 2).
Climate change	A change in climate that can be directly or indirectly attributed to human activity and that is in addition to natural climate variability over comparable time periods.
Complete CWR checklist	A list of all CWR taxa found in a certain geographic area comprising a list of taxon names and authorities.
Complementary conservation	The application of both <i>in situ</i> and <i>ex situ</i> techniques to maximize genetic diversity conservation of a single taxon or group of taxa, one conservation technique acting as a backup for the other.
Concept	Within the context of this document ‘concept’ means the proposed process for planning and implementing <i>in situ</i> conservation of crop wild relatives in Europe.
Conservation action plan	A statement of the specific <i>in situ</i> and <i>ex situ</i> conservation actions that are required for a taxon, group of taxa or geographic location.
Conservation strategy	An overview of the diversity, current conservation / threatened status and including a conservation action plan for a taxon, group of taxa or geographic location.
Crop wild relative (CWR)	A wild plant taxon that has an indirect use derived from its relatively close genetic relationship to a crop; this relationship is defined in terms of the CWR belonging to gene pools 1 or 2, or taxon groups 1 to 4 of the crop. CWR include crop progenitors and can broadly be described as any taxon in the same genus (or closely related genera) as a crop.
CWR checklist	A list of taxon names and authorities of all CWR taxa found in a certain geographic area.
Ecosystem	Dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit.
Ecosystem services	The direct and indirect contributions of ecosystems to human wellbeing categorized in four main types: provisioning services (e.g. food, water, fuel); regulating services (e.g. flood and disease control); supporting/habitat services (e.g. nutrient cycling); and cultural services (e.g. recreation).
<i>Ex situ</i> conservation	Conservation of components of biological diversity outside their natural habitats.
Gap analysis	A conservation planning technique that identifies <i>in situ</i> and <i>ex situ</i> conservation actions that are required for a taxon, group of taxa or geographic location.
Gene bank	A facility where crop diversity is stored in the form of seeds, pollen, <i>in vitro</i> culture or DNA or in the case of a field gene bank as plants growing in the field.
Genetic diversity	Genetic variation present in a population or species.

Genetic erosion	The loss over time of genetic diversity caused by either natural or man-made processes.
Gene pool	Total genetic diversity of a population, species or group of species, commonly used in the context of defining a crop together with its related species.
Genetic reserve	Site for the management and monitoring of genetic diversity of natural wild populations within defined areas designated for active, long-term conservation.
Genetic resources	Genetic diversity of plants, animals and other organisms that is of value for present and future generations of people.
Germplasm	Sexual or vegetative propagating materials of plants.
Global Environment Facility	Joint programme between the United Nations Development Programme, the World Bank and the United Nations Environment Programme, established in 1991 to provide funds for environmental problems.
<i>In situ</i> conservation	Conservation of ecosystems and natural habitats and the maintenance and recovery of viable populations of species in their natural surroundings and, in the case of domesticates or cultivated species, in the surroundings where they have developed their distinctive properties.
Integrated CWR conservation strategy	An overview of the diversity, current conservation / threatened status and action plan for CWR diversity conservation that incorporates information from different geographic levels, e.g. national (bottom up) and regional (top down), into one holistic strategy.
Landrace	<ol style="list-style-type: none"> 1. A landrace of a seed-propagated crop is a variable population, which is identifiable and usually has a local name. It lacks “formal” crop improvement, is characterized by a specific adaptation to the environmental conditions of the area of cultivation (tolerant to the biotic and abiotic stresses of that area) and is closely associated with the traditional uses, knowledge, habits, dialects, and celebrations of the people who developed and continue to grow it. 2. A landrace is a dynamic population(s) of a cultivated plant that has historical origin, distinct identity and lacks formal crop improvement, as well as often being genetically diverse, locally adapted and associated with traditional farming and cultural systems.
National CWR conservation strategy	An overview of the diversity, current conservation / threatened status with an action plan for CWR diversity conservation within a nation.
On-farm conservation	Sustainable management of genetic diversity of locally developed traditional animal breeds or crop varieties by farmers within traditional agricultural, horticultural or agri-silvicultural cultivation systems.
Population	All individuals of the same taxonomic group present in the same geographical area and capable of interbreeding.
Regional CWR conservation strategy	An overview of the diversity, current conservation / threatened status and including a conservation action plan for CWR diversity conservation within a region.
Taxon (plural: taxa)	Group or category at any level in a system for classifying plants, animals or other organisms.

1.0 Introduction²

1.1 Why develop a concept for *in situ* CWR conservation in Europe?

The considerable value of crop wild relatives (CWR) as gene donors for crop improvement is well known and their potential to contribute to food and economic security is universally recognized. Europe has significant native CWR diversity of potential value for improving a range of food, forage and fodder crops, as well as beverage, food additive, oil, medicinal, ornamental and forestry crops. However, until the beginning of the 21st century, relatively little effort had been made in Europe, or indeed elsewhere, to systematically study and conserve these resources, either *in situ* or *ex situ*. The imperative for *in situ* CWR conservation is clear: to capture the diversity of wild populations that may be of use for crop improvement, these populations need to continue to thrive in their natural habitats and adapt to changing environmental conditions. *Ex situ* CWR conservation alone will not capture or maintain this diversity. While most of the world's national parks and other protected areas (PAs) contain CWR populations, they were established to conserve particular habitats or charismatic species; thus, CWR are only conserved passively and individual CWR populations could decline or go extinct without specific monitoring and management interventions.

In the past decade, knowledge of European CWR diversity has significantly increased, primarily through activities undertaken within the context of three sequential EC-funded projects initiated by and involving members of the ECPGR *In Situ* and On-farm Conservation Network³. Fundamental to this increase in knowledge has been the development of an agreed definition of a CWR⁴ which has enabled the identification of the breadth of taxonomic CWR diversity in the region, as well as providing the foundation for prioritizing CWR taxa for conservation action. A joint EC/IUCN initiative to publish a European Red List provided a unique opportunity to assess the threatened status of wild relatives of some of the most socio-economically important crops in the region. The main pressures threatening CWR populations and the threatened status of a significant number of priority species are now known. Techniques for identifying diversity within taxa and within and between populations, as well as for conservation gap analysis, have diversified and been enhanced through targeted research on CWR and have greatly facilitated the production of national CWR and crop gene pool conservation strategies.

These recent advances have provided a solid foundation for the development of a strategic approach to CWR conservation planning based on a range of commonly agreed and widely tested scientific concepts and techniques. Significant progress has been made in national and regional CWR conservation planning in Europe, but these activities have depended on resources provided via specific short-term EC-funded projects. Achieving effective conservation and utilization of European CWR diversity as a means to promote food and economic security in the region will require a coherent policy and substantial resources over the next ten to twenty years to fund actions on CWR conservation, characterization and evaluation. To achieve sustainable conservation of CWR in Europe, there is an imperative to develop EU-led policy to harmonize CWR with existing biodiversity conservation and agricultural initiatives where possible, and to develop new solutions where necessary. Therefore, while the scientific basis for *in situ* CWR conservation is well-developed, a clear concept for a European CWR conservation strategy is needed to guide EU and national policy development to drive concerted actions throughout the region.

1.2 The policy context for CWR conservation and use

Although CWR have been used by plant breeders to broaden crop breeding pools since the early 20th century, the conservation of CWR was addressed by policy makers only recently. At the global level, the value of CWR and the requirement for more effective CWR conservation is recognized in a number of policy instruments. The rolling Global Plan of Action for the conservation and sustainable utilization of plant genetic resources for food and agriculture (GPA) includes conservation of CWR as a priority area,

² The Background Document is available to download at www.pgrsecure.org/documents/Background_document.pdf

³ PGR Forum (www.pgrforum.org), AEGRO (<http://aegro.jki.bund.de/aegro/>) and PGR Secure (www.pgrsecure.org).

⁴ 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: 2673–2685.

and Article 5 of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) also promotes *in situ* conservation of CWR, including in protected areas. The FAO Commission on Genetic Resources for Food and Agriculture (CGRFA) recently held a Technical Workshop to debate the establishment of a global network for *in situ* PGRFA conservation⁵ and recommended the establishment of a network to provide the necessary platform to raise awareness of the social and economic value of *in situ* conservation (and on-farm management) in partnerships with national and regional level activities. The Conference of the Parties to the CBD (COP) underlined the importance of CWR in Target 13 of the CBD Strategic Plan⁶ which states that “by 2020 the status of crop and livestock genetic diversity in agricultural ecosystems and of wild relatives has been improved” and that “*in situ* conservation of wild relatives of crop plants could be improved inside and outside protected areas”, as well as in the CBD Global Strategy for Plant Conservation 2011–2020⁷ in which Target 9 is “70 per cent of the genetic diversity of crops including their wild relatives and other socio-economically valuable plant species conserved”. These explicit goals can be achieved through the identification of gaps in current *in* and *ex situ* CWR conservation combined with improved recognition of CWR in national and regional policy, ultimately leading to systematic CWR diversity conservation.

At the pan-European level, the policy lead has been taken by the European Strategy for Plant Conservation 2008–2014⁸ (Council of Europe, 2008), which includes CWR related targets to be achieved by 2014, including:

- Target 7.1 60% of species of European conservation priority⁹ 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 diversity¹⁰
- Target 13.1 Projects in place in four European subregions demonstrating sustainable methods of conserving plant resources (crop wild relatives, landraces, medicinal plants) whilst supporting European livelihoods

The rise of Environmental Stewardship schemes further provides an opportunity for those interested in agrobiodiversity conservation; their aim is to promote: biodiversity conserve, maintain and

⁵ FAO, (2013). Towards the establishment of a global network for *in situ* conservation and on-farm management of PGRFA. Report of Technical Workshop held in Rome, Italy 13th November, 2012. Food and Agriculture Organization of the UN, Rome Italy. Available at: <http://www.fao.org/agriculture/crops/core-themes/theme/seeds-pgr/itwg/6th/technical-workshop/en/> (accessed on 05.04.2013).

⁶ CBD (2010a) Strategic Plan for Biodiversity 2011-2020. Secretariat of the Convention on Biological Diversity, Montreal.

⁷ CBD (2010b) Global Strategy for Plant Conservation. Secretariat of the Convention on Biological Diversity, Montreal.

⁸ Council of Europe (2008) European Strategy for Plant Conservation (2008-2014): A Sustainable Future for Europe. T-PVS/Inf(2008)14, Council of Europe, http://www.bgci.org/files/Plants2020/national_responses/new_european_strategy_for_plant_conservation_20082014.pdf.

⁹ Prioritised according to their inclusion in regional and national legislation, including the EC Habitats and Species Directive, the Bern Convention and IPA programmes, and with reference to European Red Lists for all taxonomic groups as they are developed.

¹⁰ Including: Action 1 Establish baseline of genetic diversity for priority crop complexes of European socio-economically important wild species to assist conservation prioritization and as a means for assessing genetic erosion; Action 2 Assess genetic diversity against time for all European socio-economically important wild species; Action 3 Develop a preliminary list of crop wild relative hotspots of species and genetic diversity at national and European levels; Action 4 Prepare a gap analysis review of *ex situ* holdings of European crop wild relative species; Action 5 Prepare a European inventory of traditional, local crop landrace varieties; Action 6 Prepare a priority list of European crop wild relatives; Action 7 Promote the Crop Wild Relative Information System.

enhance the landscape, protect historic environments, promote public access and understanding of the countryside, protect natural resources, prevent soil erosion and water pollution and support environmental management. Objectives that are clearly relevant to agrobiodiversity conservation. Future reform of the Common Agricultural Policy is also likely to offer further opportunities for integrating CWR conservation as part of the revised policy¹¹. Within the EU-28 itself, in line with the results of the 10th Conference of the Parties (COP) of the CBD, a new EU biodiversity strategy—*Our life insurance, our natural capital: an EU biodiversity strategy to 2020*—was adopted by the European Commission (EC) in May 2011. This provided a framework for the EU to meet its own biodiversity objectives and its global commitments as a party to the CBD. The Strategy set out a long-term vision to be achieved by 2050, such as: By 2050, European Union biodiversity and the ecosystem services it provides—its natural capital—are protected, valued and appropriately restored for biodiversity’s intrinsic value and for their essential contribution to human wellbeing and economic prosperity, and so that catastrophic changes caused by the loss of biodiversity are avoided¹². The European Parliament stressed “*the need for more effective cooperation at European level in the field of scientific and applied research regarding the diversity of animal and plant genetic resources in order to ensure their conservation, improve their ability to adapt to climate change, and promote their effective take-up in genetic improvement programmes*”¹³.

1.3 The ECPGR context

At the twelfth ECPGR Steering Committee (SC) Meeting, 14-16 December 2010, Bratislava, Slovakia, it was agreed that the ECPGR Task Force on EU matters would prepare a strategy paper that outlines gaps and required actions to improve the relationship between ECPGR and the European Union (EU) and European Commission (EC). The Task Force, composed of Jan Engels, Paul Freudenthaler, Lars Landbo and Fernando Latorre, with assistance from Frank Begemann and Mathias Ziegler, proposed that the ECPGR *In Situ* and On-farm Conservation Network should, via two Task Forces, develop and present draft concepts for *in situ* conservation of (a) crop wild relatives (CWR) and (b) landraces to the SC for consideration and adoption. Once adopted, the SC would offer the concepts to the EC as an aid to developing European policy on *in situ* conservation of CWR and landraces in the context of implementing the wider EU strategy for the conservation of genetic resources in food, agriculture and forestry.

In February 2013, the Chair of the SC invited the *In Situ* and On-farm Conservation Network to establish two Task Forces to prepare the draft concepts, and provided Terms of Reference (ToR) for this purpose (Annex 1). Members of the Task Forces were elected by the Coordinating Group of the *In Situ* and On-farm Conservation Network or selected by the ECPGR SC, with additional expertise added where it was particularly important for the development of the draft concepts. The Task Force comprises five members of the Wild Species Conservation in Genetic Reserves Working Group of the *In Situ* and On-farm Conservation Network and two non-ECPGR members who are experts on CWR conservation. The Task Force began deliberation on the preparation of the draft concept in June 2013.

1.4 Preparation of the draft concept

A Background Document was initially prepared (see Maxted *et al.*, 2013) which details the proposed elements of a CWR conservation strategy for Europe, including a framework for developing national CWR conservation strategies, a regional (European) approach to CWR conservation strategy planning and an

¹¹ EC, (2010). The CAP towards 2020: Meeting the food, natural resources and territorial challenges of the future. COM (2010) 672. European Commission, Brussels. Available at: <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2010:0672:FIN:en:PDF> (accessed on 05.04.2013).

¹² EC, (2011). Our life insurance, our natural capital: an EU biodiversity strategy to 2020. Communication from the Commission to the European Parliament, the Council, the Economic and Social Committee and the Committee of the Regions. COM (2011) 244 final.

¹³ EP, (2012). Our life insurance, our natural capital: an EU biodiversity strategy to 2020. European Parliament resolution of 20 April 2012 on our life insurance, our natural capital: an EU biodiversity strategy to 2020 (2011/2307(INI)).

integrated European strategy combining the national and regional approaches. The Background Document addresses both the technical and policy aspects of the implementation of the European CWR conservation strategy, the specific topics specified in the ToR provided by the Chair of the ECPGR SC, as well as providing a set of recommendations for the way forward (Annex 2). The document builds on the experience gained in the context of past and ongoing initiatives on conservation of CWR diversity in Europe and their associated publications. In particular, the framework for developing national CWR conservation strategies, which is integral to the overall European CWR conservation strategy, was agreed and adopted by 33 members (or their representatives) of the Wild Species Conservation in Genetic Reserves Working Group at the joint PGR Secure/ECPGR workshop, 'Conservation strategies for European crop wild relative and landrace diversity', convened in Palanga, Lithuania, 7-9 September 2011 (see www.pgrsecure.org/palanga_workshop).

The key elements of the Background Document are summarized here in the draft concept for *in situ* conservation of CWR (the Concept). The Background Document and Concept have been endorsed by the members of the *In Situ* and On-farm Conservation Network and represent the Network's vision of how *in situ* conservation of CWR diversity can be achieved in Europe. The Background Document and Concept also form the basis of an action plan for the Network's activities on CWR conservation over the next ten years and could act as an aid for the EC in formulating policy on *in situ* conservation of CWR diversity in Europe.

2.0 The Concept

2.1 Key elements of the Concept

The concept for *in situ* conservation of CWR in Europe is encapsulated in Figure 1. In essence, achieving effective and systematic *in situ* conservation of CWR diversity in Europe centres on two core levels of conservation strategy planning: (i) national (Fig. 1 in green) and (ii) regional (European) (Fig. 1 in blue). At each level, priority CWR populations (Most Appropriate Wild Populations – see section 2.2) are designated for inclusion in an *in situ* management network of national and regional MAWPs as part of an integrated CWR conservation strategy for Europe (Fig. 1 in orange) (section 2.4). The integrated strategy therefore combines complementary national (bottom-up) and regional (top-down) approaches to conservation planning (see section 2.3), although all management actions are necessarily implemented at national level. The integrated CWR conservation strategy for Europe will contain an action plan that will act as the blueprint for management of the *in situ* network of national and regional MAWPs. The action plan will include specific management guidelines, quality standards and reporting requirements, and will entail periodic review based on a set of monitoring indicators.

The integrated CWR conservation strategy for Europe will be driven by EU and national policy on conservation and utilization of plant genetic resources for food and agriculture (PGRFA) (Fig. 1 in red) and implemented at national level (Fig. 1 in green) (see section 2.5). The purpose of the integrated strategy is to preserve CWR genetic resources for use in crop improvement—in particular, to provide a wide pool of diversity as insurance against the negative impacts of climate change on crop production. Therefore, a fundamental element of the Concept is making conserved CWR germplasm available to the user community (Fig. 1 in purple) and to achieve this, the interface between *in situ*, *ex situ* and use of CWR conservation needs to be strengthened (section 2.6). As indicated in by the cyclical flow of the related elements in Figure 1, planning and implementing *in situ* conservation of CWR in Europe is an iterative process requiring periodic review and updating as CWR conservation and utilization policy, science and practice develops. Promoting awareness of the value of CWR to food and economic security as well as raising additional funding, will be critical to support this process and ensure long-term *in situ* CWR conservation in Europe (section 2.7).

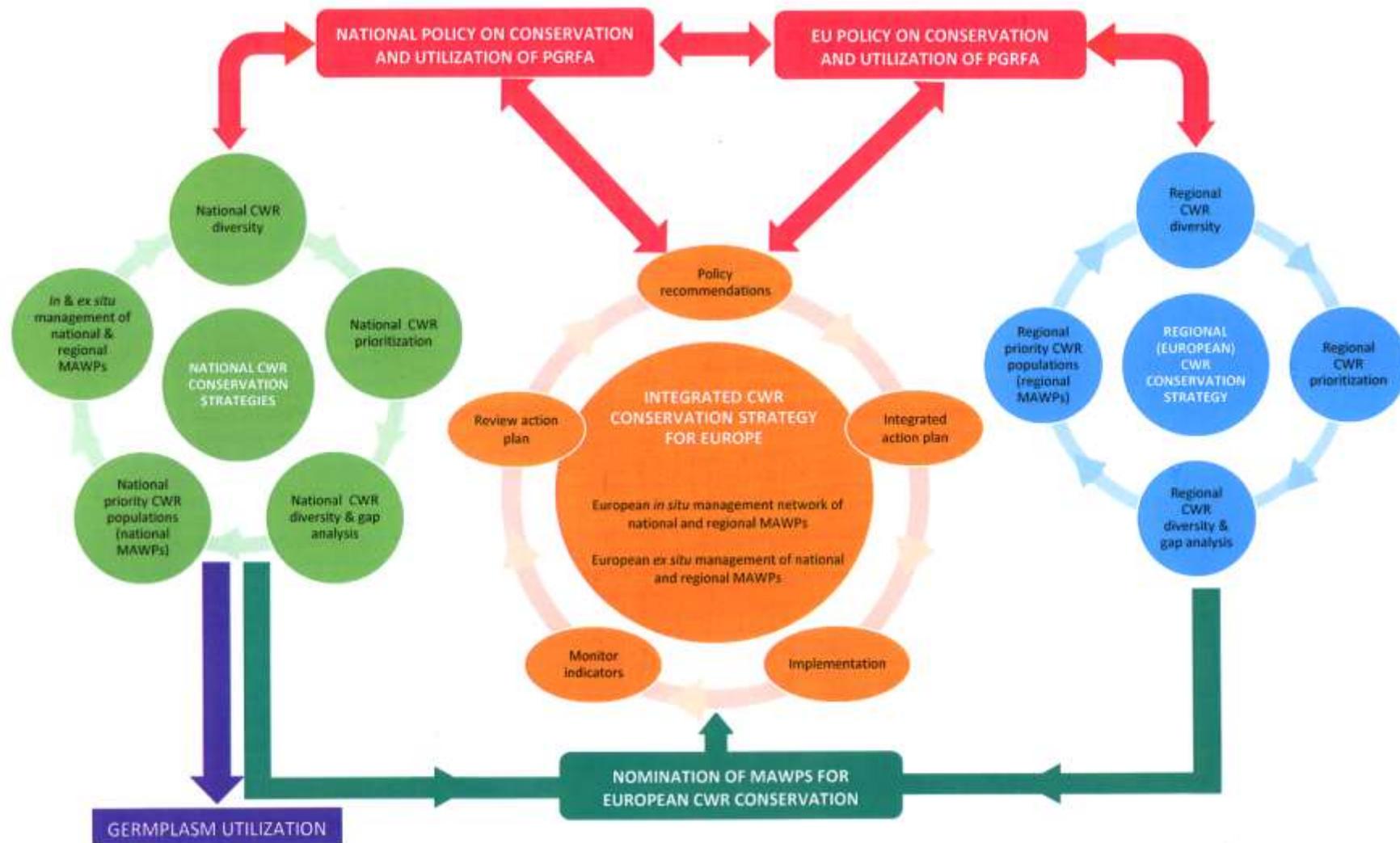


Figure 1. Schematic representation of the concept for *in situ* conservation of CWR in Europe¹⁴.

¹⁴ Kell, S., Maxted, N., Ford-Lloyd, B.V. *et al.* (in prep.). A methodological approach to complementary conservation of priority European CWR.

2.2 Unique and important CWR populations for *in situ* conservation

Central to the Concept is the identification of Most Appropriate Wild Populations (MAWP). Although all CWR taxa and populations are of actual or potential value, there is a need to prioritize which populations are of most value to target limited conservation resources. In the *ex situ* context of AEGIS, participating countries nominate Most Appropriate Accessions (MAA) for inclusion in the AEGIS system (www.ecpgr.cgiar.org/AEGIS/AEGIS), these accessions being effectively conserved samples of agrobiodiversity managed in *ex situ* conservation facilities. The *in situ* equivalent of a MAA is an actively conserved *in situ* CWR population, but a MAWP should not be seen as a mere safety duplicate of a MAA, it has its own rationale for selection and does not necessarily have any relationship to MAA of the same taxon (although all MAWP should themselves have an *ex situ* safety duplicate). Another important distinction between a MAWP and a MAA is that a MAWP is dynamic and will evolve over time whereas a MAA is static and is genetically fixed. In order for a MAWP to be included in the integrated CWR conservation strategy for Europe, the population needs to meet a number of criteria:

- The population is native or if introduced has existed at that location for at least ten generations.
- The population contains distinct or complementary genetic diversity¹⁵ or specific traits of interest¹⁶.
- The population must be actively and sustainably managed as a long-term *in situ* conservation resource according to the minimum quality standards for genetic reserve conservation of CWR¹⁷.
- The population itself should not be specifically threatened so there is a good chance of long term survival (normally thought to mean 100 years) and so relative threats from development or climate change will need to have been assessed and found negligible.
- The nomination of a population as a MAWP should be made through an appropriate national agency and samples must be available in the public domain and available on request, possibly using a specified *ex situ* facility included within the AEGIS system as an intermediary.

Individual MAWP will pragmatically often contain multiple priority species selected using gap analysis techniques and so often found in CWR hotspots, but they will also need to be complementary and in certain cases contain single CWR populations to ensure the breadth of CWR diversity coverage. MAWPs will be formally nominated by the ECPGR national coordinator following discussion with national representatives and the associated ECPGR Crop and Wild Species Conservation in Genetic Reserves WGs. Ideally, MAWPs would occur within formally designated PAs but many CWR populations of value occur outside PAs, so a MAWP may occur within or outside a PA. However, in both cases, active and sustained *in situ* CWR conservation management commitment is pivotal to the long-term success of the European network of priority *in situ* CWR populations.

2.3 Two core levels of conservation strategy planning

The two core levels of conservation strategy planning that combine to form the integrated CWR conservation strategy for Europe are summarized in Figure 2. The processes of designing national strategies (the bottom-up approach) and the regional strategy (the top-down approach) are similar in that each follows a clear set of steps that are fundamental in CWR conservation strategy planning: (i) create a CWR checklist, (ii) identify priority crops, (iii) determine priority CWR, (iv) undertake diversity and gap analysis to designate priority CWR populations (MAWPs), and (v) design the *in situ* management network of MAWPs and specify *ex situ* management needs. Although both conservation strategy planning approaches share the same basic steps, the precise methods and criteria used are likely to vary according to national and regional (European) priorities and geographic scale.

¹⁵ Ecogeographic diversity may be used as a proxy for genetic diversity when identifying MAWPs.

¹⁶ An example of high importance to the CWR user community is beet necrotic yellow vein virus (BNYVV) resistance in *Beta vulgaris* subsp. *maritima* populations from the Kalundborg Fjord area, Denmark.

¹⁷ Iriondo, J.M., Maxted, N., Kell, S.P., Ford-Lloyd, B.V., Lara-Romero, C., Labokas, J. and Magos Brehm, J. (2012) Quality standards for genetic reserve conservation of crop wild relatives. In: Maxted, N., Dulloo, M.E., Ford-Lloyd, B.V., Frese, L., Iriondo, J.M., Pinheiro de Carvalho, M.A. (eds.), *Agrobiodiversity Conservation: Securing the Diversity of Crop Wild Relatives and Landraces*. Pp. 72–77. CAB International, Wallingford. *Note a summary of the Minimum Quality Standard is provided in Annex 3*

2.3.1 National CWR conservation strategy planning

National CWR conservation strategies are central to *in situ* conservation of European CWR diversity because all *in situ* conservation actions are necessarily implemented at national level. The simplified conceptual framework for national conservation strategy planning shown in Figure 2 (in green) provides nations with a logical model applicable for all European (EU and non-EU) countries¹⁸ but is not prescriptive and therefore respects the sovereignty each country has over its own genetic resources. However, the clear structure of the model provides a solid foundation for integration into a future European strategy for the conservation of genetic resources in food, agriculture and forestry. This structured but flexible approach will be critical to the success of a coherent CWR conservation strategy for Europe. To ensure smooth implementation of each National CWR conservation strategy it is recommended that establishing a Memorandum of Understanding or some such agreement between implementing parties that outlines agreed tasks, responsibilities and resourcing would be beneficial.

2.3.2 Regional (European) CWR conservation strategy planning

A national approach to CWR conservation strategy planning is essential because nations have sovereignty over the genetic resources within their jurisdiction and the responsibility to conserve them. However, national priorities vary between nations and may not take into account broader regional priorities. Therefore, a Europe-wide CWR conservation strategy is also needed to ensure that regionally important CWR resources are targeted for conservation action across their full range and to provide a framework for directing European policy on the conservation of regionally important PGRFA.

A simplified conceptual framework for regional conservation strategy planning is shown in Figure 2 (in blue). Results of conservation planning at regional level will inform the development of a regional CWR conservation strategy comprising details of a proposed *in situ* network of regional priority CWR populations (regional MAWPs) and complementary germplasm collection and *ex situ* conservation needs. The proposed criteria and process of selecting priority CWR taxa and MAWPs at regional level is detailed in the Concept Background Document. It is anticipated that 300–400 regional priority CWR species will be identified in the initial planning phase, followed by diversity and gap analysis to designate regional priority CWR populations (MAWPs) for *in situ* management and *ex situ* collection and storage¹⁹.

2.4 An integrated CWR conservation strategy for Europe

2.4.1 Establishment and operation of the integrated strategy

The integrated CWR conservation strategy for Europe (Figures 1 and 2) brings together regional and nationally nominated MAWPs to form a network of *in situ* conserved priority European CWR diversity with complementary *ex situ* conservation. The national and regional approaches to conservation strategy planning are therefore complementary and interdependent—they form a holistic matrix to conserve overall CWR diversity and make it available for use. The proposed approach to establishment and operation of the integrated CWR conservation strategy for Europe is outlined in Box 1. We anticipate that the majority of regional priority CWR taxa will also be identified by national agencies responsible for CWR conservation strategy planning because the prioritization criteria for selecting target CWR taxa at national level are likely to overlap with the regional criteria. However, proposals for the inclusion of regional priority taxa not already included in the national CWR conservation strategies of the countries in which they occur will be made via EU policy based on recommendations of the European authority responsible for planning the regional CWR conservation strategy. It may also be possible that some MAWPs identified at regional level may not be concurrent with nationally identified MAWPs for the same taxa. In these cases, discussion may be needed between the relevant national agencies and the authority responsible for planning and overseeing the regional CWR conservation strategy in order to reach agreement, while noting that national agencies will have priority in deciding which MAWPs are included in the European network from their country. A further consideration is that because regional MAWPs are selected without respect to political boundaries, there may be a need to engender cross-border collaboration in cases where individual MAWPs occur in two or more countries.

¹⁸This conceptual framework has already been widely adopted by the international PGRFA community as the standard for national CWR conservation strategy planning and has been successfully applied in a number of European and non-European countries.

¹⁹Kell, S., Maxted, N., Ford-Lloyd, B.V. *et al.* (in prep.) A methodological approach to complementary conservation of priority European CWR.

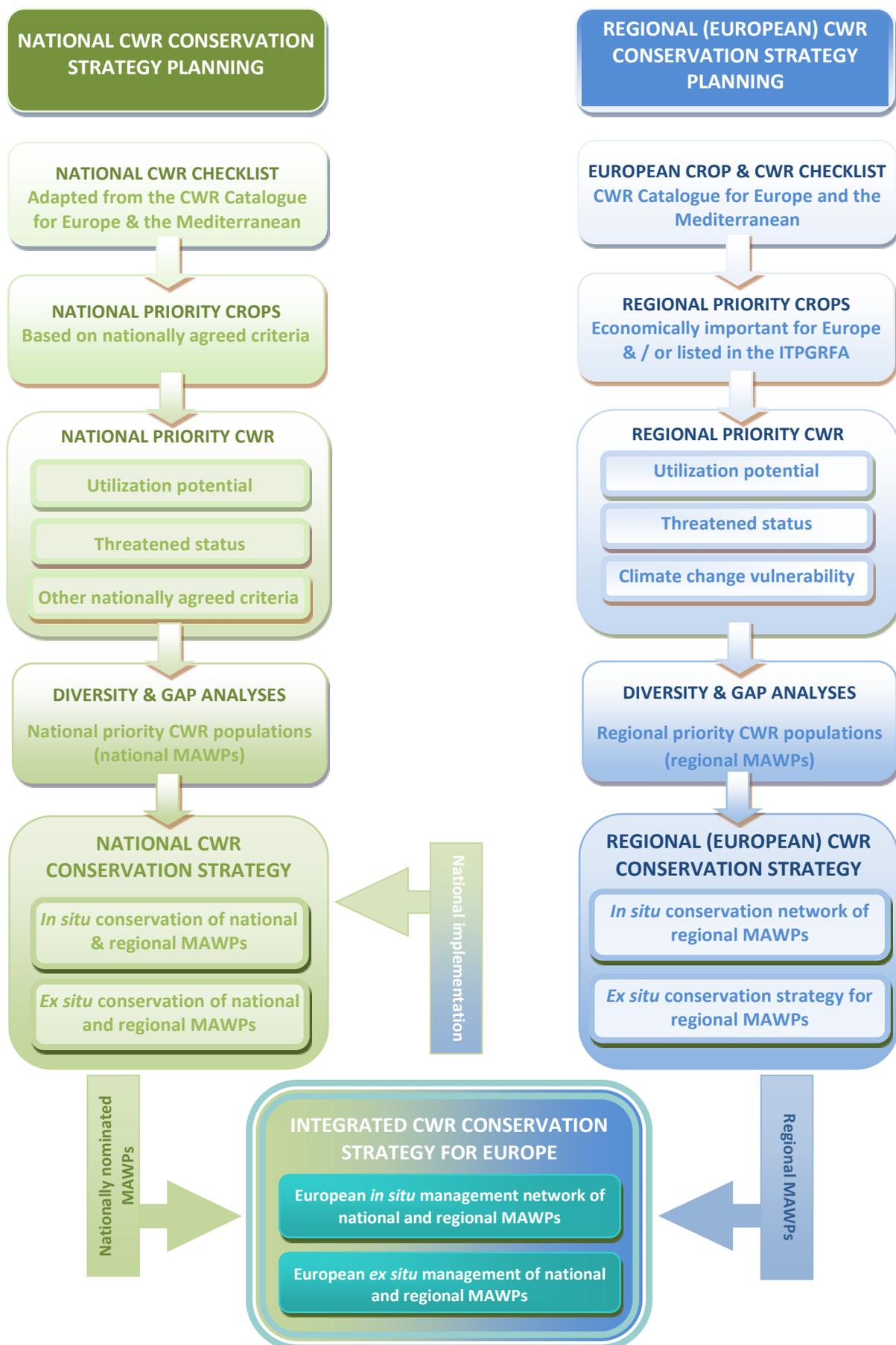


Figure 2. Two levels of conservation strategy planning are combined to achieve *in situ* conservation of CWR diversity in Europe (Kell *et al.*, in prep. a)²⁰.

²⁰ Kell, S., Maxted, N., Ford-Lloyd, B.V. *et al.* (in prep.) A methodological approach to complementary conservation of priority European CWR.

Box 1. Concept for establishment and operation of the integrated CWR conservation strategy for Europe

- **National CWR conservation strategies** – each country in Europe develops a national CWR conservation strategy which is implemented through complementary *in situ* and *ex situ* activities undertaken by national agencies. Nationally nominated MAWPs will be proposed by the ECPGR national PGR coordinator, after discussion with national and regional stakeholders.
- **Regional (European) CWR conservation strategy** – the regional strategy comprises an *in situ* network of CWR conservation populations (MAWPs) backed up by germplasm collection and *ex situ* management. Regionally nominated MAWPs will be proposed by the ECPGR *In situ* and On-farm Conservation Network.
- **Integrated CWR conservation strategy for Europe** – the two national and regional strategies are integrated as follows:
 - a. Bottom-up integration** – Priority national CWR populations (national MAWPs) are nominated by the national PGR coordinator for formal recognition as part of the European network of priority *in situ* CWR populations.
 - b. Top-down integration** – Priority regional CWR populations (regional MAWPs) identified in the regional (European) CWR conservation strategy are included in the European management network of national and regional MAWPs and, if supported by the appropriate national agencies, integrated into the relevant national CWR conservation strategies.

National agencies in the relevant countries are responsible for the implementation of conservation actions for regional MAWPs with oversight and support provided by national and regional PA and PGRFA stakeholders.

2.4.2 Identifying important CWR diversity and hot-spots

A fundamental step in the CWR conservation strategy planning process is undertaking diversity and gap analyses for priority taxa. The results of these analyses serve to identify MAWPs and *in situ* and *ex situ* conservation gaps. A range of diversity analyses may be carried out, but the most commonly used approaches in CWR conservation planning are complementarity analysis, genetic diversity analysis and ecogeographic diversity analysis (for details see section 2.2.4 of the Background Document). These analyses may be applied at both national and regional levels and a combination of the approaches may be used, depending on a number of factors. These include: (a) the number of target taxa in the conservation strategy, (b) the likelihood of particular groups of taxa occurring at the same sites, and (c) the availability of data of sufficient quality to base sound conservation recommendations upon.

At both national and regional levels, particular hot-spots of CWR are likely to be identified and these will be highlighted as part of the integrated CWR conservation strategy. CWR hot-spots may be selected for their richness, uniqueness or utility of CWR diversity and may be designated as Important CWR Areas (ICWRA). ICWRA could be considered comparable with Important Plant Areas²¹, Key Biodiversity Areas²²,

²¹ Anderson S., Kusík T. and Radford E. (Eds) (2005) *Important Plant Areas in Central and Eastern Europe*. Plantlife International.; Plantlife (2008) *Important Plant Areas*. www.plantlife.org.uk/international/wild_plants/IPA/

²² Edgar, G.J. Langhammer, P. F., Allen, G., Brooks, T.M., Brodie, J., Crosse, W., De Silva, N., Fishpool, L.D.C., Foster, M.N., Knox, D.H., Mccosker, J.E., McManus, R., Millar, A.J.K. and Mugo, R. (2008) Key biodiversity areas as globally significant target sites for the conservation of marine biological diversity. *Aquatic Conservation: Marine and Freshwater Ecosystems* 18(6): 969–983.; IUCN (2013) *Key Biodiversity Areas*. IUCN, Gland, Switzerland. www.iucn.org/about/union/secretariat/offices/iucnmed/iucn_med_programme/species/key_biodiversity_areas/.

World Heritage Sites²³ and Globally Important Agricultural Heritage Systems²⁴. Once identified, European ICWRA will serve to draw attention to key areas for CWR conservation in the region and act as flagship locations to raise awareness of the important role of CWR in the European economy and for food security. In addition, the European network of MAWPs may also contribute to the proposed global network of CWR genetic reserves²⁵ if they contain CWR of global importance. Conversely, it is logical that each MAWP included in the regional or global network is also nominated as part of a country's national CWR management network provided there is national support.

2.5 A new policy paradigm for CWR conservation in Europe

A critical aspect of the strategy is the implementation of conservation actions for regionally important CWR taxa and MAWPs at national level, specifically called for in the CBD Strategic Plan and the ITPGRFA, the latter being a legally binding instrument that requests the contracting parties to undertake these conservation measures. This approach will require a regional authoritative body to oversee its implementation; therefore, the practicalities of implementing this integration need to be addressed and incorporated into European policy on agrobiodiversity conservation. As no European legislation with a focus on CWR conservation currently exists, there is at present no means of requiring EU member states or European countries outside the EU to meet this obligation. Emphasis therefore needs to be placed on the development of a clear regional policy on CWR conservation with buy-in from national PGR programmes throughout the region. For the regionally important CWR species that are included in Annex I of the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA), the Treaty may be used as leverage for obligating European nation states to actively conserve CWR genetic resources within their jurisdiction. However, the Treaty does not cover all European priority crop gene pools; therefore, EU legislation with a specific focus on CWR requires development. To achieve this, a specific EU Directive on PGRFA could be enacted that would contemplate the protection of MAWPs in a coordinated way within the already existing European level biodiversity protection infrastructures. The inclusion of priority CWR (if not already included) in the EU Habitats Directive would place an obligation on EU member states to conserve populations of the species within their jurisdiction. However, since the species for inclusion in the Habitats Directive have to be proposed by nation states, buy-in on regional policy with respect to CWR conservation is needed from the onset of discussions in this area. A possible complication in terms of changes to the Habitats Directive is that it falls under the remit of EC Directorate-General (DG) for Environment while PGRFA issues fall under the EC DG for Agriculture and Rural Development. However, it is worth noting that some taxa already listed in the Annexes of the Habitats Directive are CWR, though they were not listed with their role as CWR in mind—rather, they are likely nationally rare or threatened taxa that are coincidentally CWR.

Other policy-related aspects of the integrated European CWR conservation strategy that will need to be considered are how to ensure the success of conservation actions that depend on cross-border cooperation and the need for a central coordinating body to collect reports on the conservation of priority CWR resources. ECPGR needs to discuss these policy-related issues with the relevant players (e.g., the EC, EEA and EUCARPIA) and policy changes instigated to promote CWR *in situ* conservation.

Further at the implementation level the adoption of what is proposed will require national establishment of nationally and regionally important *in situ* genetic reserves to conserve CWR diversity. Feedback from members of the ECPGR *In Situ* and On-farm Conservation Network indicates this itself may prove problematic. The reason being that although most European countries have a comprehensive system of national parks, protected landscape regions and national protected areas / reserves, many of which fall within the Natura 2000 network, these sites are managed by staff / agencies associated with the Ministry of Environment who often work independently from the national Gene Bank which reports to the Ministry of Agriculture. Even though the Ministry of Agriculture may wish to declare genetic reserve sites they neither have the power to do so or the resources to manage them once established. Therefore it is imperative that in the future there is closer cooperation between each countries Ministries of

²³ UNESCO (2013) *World Heritage Sites*. UNESCO, Paris, France. <http://whc.unesco.org>

²⁴ Koohafkan, P. and Altieri, M. (2011) A methodological framework for the dynamic conservation of agricultural heritage systems. Food and Agriculture Organization of the United Nations, Rome, Italy. FAO (2013) *Globally Important Agricultural Heritage Systems*. Food and Agriculture Organization of the United Nations, Rome, Italy. www.giahs.org/

²⁵ FAO (2013) *Towards the Establishment of a Global Network for In Situ Conservation and On-farm Management of PGRFA. Report of Technical Workshop held in Rome, Italy 13th November, 2012*. Food and Agriculture Organization of the UN, Rome, Italy. www.fao.org/agriculture/crops/core-themes/theme/seeds-pgr/itwg/6th/technical-workshop/en/

Agriculture and Environment. In some countries, like the Norway and the UK the national Gene Bank team have actively engaged in a dialogue with the Ministry of Environment and this collaboration have proven productive in getting genetic reserves established. However, another perhaps more successful model would be to encourage cooperation at the European regional level and then could filter down into national application, perhaps starting with the recognition of the value of CWR conservation within the Natura 2000 network.

2.6 Enhancing the utilization of conserved CWR resources in Europe

2.6.1 Improving the conservation–utilization link

The perceived value and impact of the integrated CWR conservation strategy for Europe ultimately depends on successfully channelling conserved germplasm from *in situ* and *ex situ* conservation facilities to the user community for crop improvement. The strategy needs to meet the interests of public and private plant breeding research institutes, breeding companies, plant genebanks and agro-NGOs. End user including farmers, farming NGOs, private breeders and breeding researchers should be involved in priority setting to ensure the user's demand is fully met. Therefore, parallel concerted actions to enhance the utilization of conserved plant germplasm by the conservation and user communities are required. The four main aspects of this challenge that need to be addressed are: (a) strengthening the interface between *in situ* and *ex situ* conservation, (b) increasing efforts to characterize and evaluate conserved germplasm, (c) improving the availability of conservation, characterization and evaluation data to end users, and (d) addressing issues of access by the user community to *in situ* and *ex situ* conserved germplasm although even for *in situ* conserved material the normal access route is likely to remain via national gene banks using standard SMTAs. Promoting the route of access to germplasm for the user *via ex situ* collection which involves the use of an SMTA would in the short term alleviate the need for genetic reserve managers becoming involved in ABS issues. However, in the longer term, particularly with the growing use of predictive characterisation techniques users are likely to require access to the full range of potential CWR diversity available in nature rather than just the sampled held *ex situ* in which case there will need to be solutions found to allow full implementation of the Nagoya Protocol in the *in situ* context. Further in the longer term to provision of user's access to *in situ* diversity may provide a tool to incentivize further *in situ* conservation.

Progress towards improving the CWR conservation use interface has already been made to achieving these goals. First, they were key foci of the EC-funded FP7 project, PGR Secure (www.pgrsecure.org) which has developed novel approaches to the characterization of CWR diversity, improved the availability of conservation, characterization and evaluation data, and facilitated greater engagement of the stakeholder community in the use of conserved CWR genetic diversity. Second the ECPGR Documentation and Information Working Group held a meeting in May 2014 in Prague where these issues were further discussed²⁶, where the decision was made to include characterization and evaluation data and *in situ* conservation data in EURISCO. Therefore, concerted action has already begun to address these issues.

2.6.2 Strengthening the interface between *in situ* and *ex situ* CWR conservation

Improving the interface between *in situ* and *ex situ* conservation is a complex issue that needs to be addressed in order to develop a coherent and effective CWR conservation strategy for Europe and ensure that CWR genetic resources are available for utilization. A critical issue that needs to be addressed is the division between the agencies responsible for *in situ* and *ex situ* CWR conservation which are almost always located under the administration of different government ministries. The success of a comprehensive and efficient complementary conservation strategy for European CWR will depend on the collection and *ex situ* management of germplasm samples of national and regional MAWPs. One option is for the national agencies responsible for *in situ* conservation of MAWPs to designate an associated gene bank (on the grounds of geographic proximity or crop/crop group specialization) where representative germplasm accessions would be conserved. It would be the responsibility of the genetic reserve manager to periodically sample the *in situ* population and forward it to the designated *ex situ*

²⁶ Maggioni, L., van Hintum T. and Lipman, E., (2014). Tailoring the Documentation of Plant Genetic Resources in Europe to the Needs of the User. Workshop of the ECPGR Documentation and Information Working Group, 20-22 May 2014, Prague, Czech Republic. Available online: <http://www.ecpgr.cgiar.org/resources/publications/publication/tailoring-the-documentation-of-plant-genetic-resources-in-europe-to-the-needs-of-the-user-2014/> (Accessed on 20 January 2015).

facilities to ensure safety duplication and to make the sample available via SMTA to the user community – it is not foreseen that *in situ* samples would be routinely made available to the user community directly from the genetic reserve. As with other *ex situ* stored samples, the gene bank would be responsible for adequately *ex situ* duplicated and to regenerate stored samples as necessary. In order to achieve this, it is essential to obtain buy-in of the two conservation sectors in the integrated CWR conservation strategy for Europe and to ensure that there is full collaboration between them. EU-led legislation that promotes the integration of *in situ* CWR conservation with the conservation of other wild plant diversity (e.g., rare or threatened species or habitats, or unique habitats) could invigorate cooperation and coordination between the diverse agrobiodiversity and biodiversity conservation stakeholders. An example of how complementary conservation measures can be integrated is demonstrated by the ‘Gene Bank for Wild Plant Species for Food and Agriculture’ located at Osnabrück, Germany and its network partners²⁷. Here the *ex situ* holding institute functions as a conduit between *in situ* conserved populations at the original location and the availability of *ex situ* conserved samples through collection and re-collection of specific provenances inside and outside PAs.

An additional option for improving the *in situ*–*ex situ* conservation interface is to focus complementary conservation actions on an individual crop gene pool basis. The logical unit for crop gene pool conservation and utilization activities in Europe is the ECPGR Crop WGs with EURISCO or the respective ECCDB as coordination and management instruments. Bringing together crop, *ex situ* and *in situ* expertise with the ECPGR framework is likely to have significant benefits but the WGs would need to be adequately funded to achieve this goal.

2.6.3 Integrate ECPGR *In Situ* and On-farm Conservation Network with Crop WGs

Greater collaboration between the Crop WGs and the Wild Species Conservation in Genetic Reserves WG would help to ensure that recommendations and action plans developed by *in situ* conservation experts are appropriate in terms of targets and scale, that they complement or enhance *ex situ* conservation actions, and that they address the overall goal of promoting CWR genetic diversity utilisation by the user communities. To improve this collaboration would we feel require a further restructuring of ECPGR to a more fully integrated Crop and Thematic network. Greater integration of the Thematic and Crop WGs in one system would greatly improve the interface between *in situ* and *ex situ* conservation and further promote the link between conservation and utilization. For further details of this proposed re-structuring and the potential benefits, see section 3.6 of the Background Document.

2.7 Options to promote awareness and raise additional funding

Significant progress has been made in promoting awareness of the value of CWR and the need for their conservation within the European PGR conservation community, for example, through the three sequential ECPGR *In Situ* and On-Farm Conservation Network-led EC-funded projects, PGR Forum (www.pgrforum.org), AEGRO (aegro.jki.bund.de/aegro) and currently PGR Secure (www.pgrsecure.org/). CWR have also been placed firmly on the global conservation agenda, as reflected by specific references in a number of global and regional policy instruments (see section 1.6 of the Background Document), as well as the establishment of the CWR Specialist Group of the IUCN Species Survival Commission (www.cwrsg.org), the implementation of a UNEP/GEF-funded CWR project (www.cropwildrelatives.org) and the Global Crop Diversity Trust CWR project (www.cwrdiversity.org/). Four major text books addressing CWR conservation²⁸ and the newsletter *Crop wild relative* (www.pgrsecure.org/) have also been published in association with these initiatives. However, CWR genetic resources are not yet exploited to their full potential, which, in addition to the reasons stated in section 2.6, is in part due to the fact that their value is not fully appreciated by the potential user

²⁷Anonymous, (2013). Genbank Wildpflanzen für Ernährung und Landwirtschaft. Available online: www.biologie.uni-osnabrueck.de/genbank-wel/Einfuehrung/ (Accessed on 5 June 2013).

²⁸Hunter, D. and Heywood, V.H. (eds.) (2011). *Crop Wild relatives. A Manual of In Situ Conservation*. Earthscan, London, Washington DC.

Iriondo, J.M., Dulloo E, Maxted N (Eds) (2008) *Conserving plant genetic diversity in protected areas: population management of crop wild relatives*. CAB International Publishing, Wallingford.

Maxted, N., Dulloo, M.E., Ford-Lloyd, B.V., Frese, L., Iriondo, J.M. and Pinheiro de Carvalho, M.A.A. (eds.), (2012e). *Agrobiodiversity Conservation: Securing the Diversity of Crop Wild Relatives and Landraces*. CAB International, Wallingford.

Maxted, N., Ford-Lloyd BV, Kell SP, Iriondo J, Dulloo E, Turok J (eds.). (2008e) *Crop Wild Relative Conservation and Use*. CAB International, Wallingford, UK.

communities. There is therefore a pressing need for ongoing concerted actions to promote the importance of CWR for food and economic security in tandem with the implementation of the integrated CWR conservation strategy for Europe.

In terms of promotion of CWR value among the public this could be improved by (a) the publication of popular articles; (b) incorporating CWR and agrobiodiversity knowledge in school and higher educational curricula; (c) promoting the direct link between food provisioning ecosystem services and CWR conservation and use, both for the general public and policy-makers; and (d) assisting in the production of applications that can identify plant species using pictures taken by mobile phones in the field and collate population level information (e.g. www.ispot.org.uk). The data gathering potential of such techniques could be as significant as the genomic sequencing revolution and would clearly help involve the general public.

Opportunities for funding the establishment and ongoing management of the European *in situ* network of national and regional MAWPs, as well as adequate back-up in *ex situ* collections, will need to be driven by the EU but with the onus for securing sufficient resources for the implementation of national CWR conservation strategies (including the management of national and regional MAWPs) on the relevant national agencies with support from government. Where possible, the integration of CWR conservation in existing national *in situ* conservation actions (e.g., adaptation of PA management plans) will be vital to make effective use of limited conservation resources.

Ensuring awareness of funding opportunities among ECPGR WGs should be a key activity of the ECPGR Secretariat because ECPGR itself does not have sufficient funding to maintain an active European PGR network itself. In the past, funding for larger scale WG activities has been *ad hoc* and dependent on the initiative of the WGs themselves. It would be beneficial for the ECPGR network as a whole if the ECPGR Secretariat led the lobbying and funding awareness by developing the necessary expertise and assisting all ECPGR WGs. However, in general though, the options for raising funds for *in situ* CWR conservation in Europe are primarily associated with the EC (Research framework programmes, DG Agriculture and Rural Development, DG Environment) and national government. Private sources should also be investigated, such as foundations and plant breeding companies.

2.8 Conclusions

Increased global awareness of the value of CWR for crop improvement, particularly due to the projected impact of climate change on crop production and the need for insurance against food insecurity, has highlighted the imperative for greater targeted CWR conservation and utilization efforts. Substantial progress has been made in Europe in increasing knowledge on CWR diversity and in methods of CWR conservation planning and management. A step change is now needed to develop and implement a comprehensive and coherent European strategy for CWR conservation, which is led by policy at the EU level.

Due to the large number of CWR taxa containing potentially useful diversity and the changing demands of the crop improvement community, *ex situ* conservation as the sole option for maintaining CWR diversity is not viable. The primary means of conserving CWR diversity is *in situ* in actively managed genetic reserves (either within existing PAs, in newly designated PAs or outside PAs in less formally protected sites) with complementary conservation management of samples in *ex situ* facilities that will at least in the short term be the usual mode of access for germplasm users.

Scientific knowledge and expertise is available in Europe to plan for and implement *in situ* conservation management of CWR diversity across the region. This concept document proposes a way of achieving this goal. The concept combines scientific knowledge with appropriate policy and financial resourcing, concerted actions to enhance the utilization of CWR resources, improved awareness of the value of CWR diversity, as well as a more effective role for the ECPGR WGs in European CWR conservation. Specific recommendations are made to help ensure the concept is realized and Europe maximizes the potential benefits from this valuable natural resource.

Annex 1. ECPGR terms of reference

In situ conservation of crop wild relatives

Background: The activities will address the ECPGR outcome 3: *In situ* and on-farm conservation and management concepts are agreed. http://www.ecpgr.cgiar.org/about_ecpgr/objectives.html

1. Two Task Forces will be established to develop two concepts:
 - a. *In situ* conservation of crop wild relatives in Europe
 - b. On-farm management and conservation of landraces in Europe
2. The draft concepts should be based upon the “Strategy Paper on the ECPGR Relationship with the European Union/European Commission” (see document no. 11: http://www.ecpgr.cgiar.org/steering_committee/13th_sc_meeting/background_documents.html)
3. The draft concepts should be applicable to all the European countries (EU member states and Non-EU countries) but not prescriptive and be respectful of the sovereignty each country has on its own genetic resources. However, they should be developed in such a way that they could also become part of a future EU *strategy for the conservation of genetic resources in food, agriculture and forestry*.
4. The Task Forces should use the internationally agreed definitions and concepts of *in situ* and on-farm conservation (CBD, EC, GPA) where such definitions are available.
5. The draft concepts should be developed by the two Task Forces in close collaboration with the *In situ* and on-farm Network and the draft concept for on-farm management and conservation should also be developed in close collaboration with the Documentation and Information Network.
6. The draft concepts should describe the interface between *in situ* conservation, on-farm management and conservation and *ex situ* conservation of PGRFA.
7. The draft concept for *In situ* conservation of crop wild relatives in Europe should give special attention to locations of high diversity (hot spots) and if they fall inside (specific genetic reserve management) or outside protected areas (complementary conservation measures).
8. The draft concept for On-farm management and conservation of landraces in Europe should give special attention to the development of national inventories of landraces maintained on farm as defined by the respective national focal points as *plant genetic resources naturally adapted to the local and regional conditions and under threat of genetic erosion*.
9. The draft concepts should investigate options to improve the complementarity of *ex situ* and *in situ* crop wild relatives and landraces conservation in Europe through better integration of the initiatives of the *In situ* and on-farm Network and those of the crop-based Working Groups.
10. The draft concepts must explore the approach of unique and important accessions for *in situ* conservation (like in AEGIS).
11. The draft concepts should investigate options to promote awareness and raise additional funding for *in situ* crop wild relatives and landraces conservation in Europe.
12. The draft concepts should not exceed 10 pages each.
13. The draft concepts should be sent to the SC by the end of September 2013.
14. The SC members (National Coordinators) will be invited to undertake a national consultation and provide amendments and corrections to the draft concepts.
15. The SC will seek to finalize the two concepts by the end of 2013 and will offer them to the European Commission for its consideration when developing a future EU *strategy for the conservation of genetic resources in food, agriculture and forestry*. The concepts will also be the basis for the conservation strategy of ECPGR for *in situ* conservation and on-farm management and will be offered to the European countries if they wish to use them for their relevant national strategies.

Annex 2. Recommendations

Recommendation 1: European countries should nominate national Most Appropriate Wild Populations – Following national research, the ECPGR National Coordinators for each European country should nominate national MAWPs to the ECPGR *In Situ* and On-farm Conservation Network for inclusion in the European Integrated *In situ* CWR Network.

Recommendation 2: The ECPGR In Situ and On-farm Conservation Network should nominate European Most Appropriate Wild Populations – The ECPGR *In Situ* and On-farm Conservation Network should research, identify and nominate regional MAWPs for inclusion in the European Integrated *In situ* CWR Network. However, the final decision for inclusion of MAWPs in the European Integrated *In situ* CWR Network will always rest with the appropriate national agencies.

Recommendation 3: Include in situ populations as well as ex situ accessions in the AEGIS project – Parallel to Most Appropriate *ex situ* Accessions in the ‘A European Genebank Integrated System’ (AEGIS) project, priority CWR populations (Most Appropriate Wild Populations – MAWPs) should be nominated and included on an equal footing with *ex situ* accessions within AEGIS.

Recommendation 4: Carry out IUCN Red List assessments of priority CWR taxa – Part of preparing the concept involves CWR prioritization; there is a need for IUCN Red List assessments of priority CWR taxa not already assessed at European and national levels.

Recommendation 5: Promote improved integration of CWR conservation with other biodiversity conservation activities in Europe – There is a need to mainstream CWR into European nature conservation. Inclusion of CWR conservation within the remit of the European Environment Agency could have a significant impact on the required integration and working alongside ECPGR would engender more cross sectorial approach to CWR diversity conservation. This may also have the additional benefit of opening up access for EU Rural Development support (both agri-environment and other rural development ones) for CWR conservation measures.

Recommendation 6: Integrate CWR conservation into in situ conservation activities – There is a need for practical integration of CWR conservation into non-PGRFA *in situ* activities, both within existing PAS and unprotected areas such as roadsides and field margins. An obvious step would be to integrate CWR conservation with the existing Natura 2000 network, a suggestion not currently supported by the network but active promotion of CWR conservation within these protected areas would enhance their value.

Recommendation 7: Undertake systematic and effective complementary CWR conservation at European and national levels – Systematic, effective and integrated CWR complementary conservation of national and regional (European) CWR diversity should be planned and implemented. It is recognised that this will require in many countries active collaboration between respective Ministries of Agriculture and Environment and their staff, this is also likely to engender integration of agrobiodiversity with other elements of biodiversity in a more coherent manner.

Recommendation 8: Engender greater collaboration and coordination among national and European efforts to promote CWR conservation and use and their integration with allied networks – To effectively conserve CWR diversity *in situ*, a coordinated effort at national and European levels is required, with appropriate links to other European and global networks. Establishing *de novo* a network of genetic reserves for *in situ* conservation of CWR diversity is impractical and unnecessary, however closer collaboration between the conservation activities of the Ministries of Agriculture and

Environment is required; this is likely to include the active *in situ* conservation of CWR diversity within the existing Natura 2000 network.

Recommendation 9: Establish the evidence research base to underpin CWR conservation and utilization – Lobby for greater prominence in the EC Horizon 2020 programme for research on CWR involving all scientific disciplines, and stimulate improved use of scientific evidence. For example, there is a need for a systematic assessment of climate change impacts on CWR conservation and utilization.

Recommendation 10: Establish a policy context for CWR diversity conservation in Europe – European nations should be obliged to monitor/conservate populations of CWR species, whether nationally threatened or not. Emphasis therefore needs to be placed on the development of a clear regional policy on CWR conservation, with buy-in from national PGR programmes throughout the region. There is a clear EU level responsibility to provide the required legislative framework.

Recommendation 11: Create mechanisms to enhance the utilization of conserved CWR diversity in crop improvement programmes – There is a pressing need for greater efforts to undertake actual or predictive characterization and evaluation of conserved CWR. Further, issues of access to this information, as well as to the germplasm itself need to be addressed.

Recommendation 12: Promote access to in situ conserved CWR diversity – In the short term the normal route for a user to access to germplasm conserved *in situ* is likely to be *via ex situ* collection which avoids the necessity for genetic reserve managers to become involved in issuing SMTAs and ABS issues. However, in the longer term to allow full implementation of the Nagoya Protocol access should be provided direct from *in situ* genetic reserve, direct use may then act as a tool to incentivize further *in situ* conservation.

Recommendation 13: Promote complementary conservation actions that incorporate in situ and ex situ action for CWR diversity – There is a need for greater integration of *in situ* and *ex situ* action for CWR diversity, practically this may be achieved by taking a holistic approach to conservation planning, ensuring that seed is collected and stored *ex situ* from nationally MAWPs and where possible the same people are responsible for implementing both *in situ* and *ex situ* conservation actions.

Recommendation 14: Restructure Thematic WGs membership to enhance greater Crop WG and Thematic WG integration – The current membership of the Thematic WGs is not as efficient as it might be in encouraging collaboration and it would be beneficial to look at greater integration, possibly through having Crop WG members included in the Thematic WGs to represent the Crop WG goals.

Recommendation 15: Promote awareness of the value of CWR diversity – It is vital that the general public understand the link between PGRFA conservation and human well-being.

Recommendation 16: ECPGR should lobby the EC for greater in situ CWR conservation and broader PGRFA funding in Horizon 2020 – Although there has been significant funding of networking and research in PGRFA conservation and use, this needs to be maintained within Horizon 2020 and extended to cover the full range of CWR related conservation and use activities, particularly those that integrate CWR conservation and use as through use comes conservation sustainability. It is desirability that a specific EU Directive targets European PGR conservation and use, and within that that CWR conservation and use is given priority.

Annex 3. Summary of minimum quality standards for CWR genetic reserve conservation²⁹.

Location

1. Located at sites that have been identified through a rigorous scientific process involving prioritization and careful site selection.
2. Located in a protected area network according to European, national or regional environmental law (e.g. Natura 2000 network or National Parks network).

Spatial structure

1. The polygon of the GR should be clearly defined and geo-referenced.
2. Sufficient extent to conserve the populations of the target taxon and its natural habitat and to maintain natural processes.

Target taxa

1. The limits of the GR within the protected area are traced, taking into account as primary consideration the needs of target CWR populations.
2. GRs are designed to capture as much genetic diversity of each target taxon as possible, conserving at least the alleles that are common, widespread and localized *sensu* Marshal and Brown (1975).
3. A full survey that provides a demographic characterization of target CWR taxa has been made.

Populations

1. Population sizes are large enough to sustain long-term population viability and maintain evolutionary potential. Therefore, population sizes are larger than the demographic and genetic minimum viable population (MVP) estimates available for the target taxon.

Management

1. The GR is recognized as such by the appropriate national environmental and/or agriculture agency.
2. Clearly defined, detailed, achievable and evaluable conservation objectives, including preservation of evolutionary potential of target species, are formulated.
3. It is verified that there are no contradictions or incompatibilities between the objectives of the GR and the objectives of management plans of the protected area of superior rank. If such conflicts arise then there are appropriate, pragmatic means of mitigating the contradictions or incompatibilities.
4. A management plan using participatory and evidence-based criteria is designed and implemented in which: (i) the target CWR taxa are clearly identified and located; (ii) a diagnostic of the conservation status of target CWR taxa based on demographic and genetic structure is made; (iii) problems, opportunities and trends are defined; (iv) social and ecological conditioning factors are identified; and (v) a detailed action plan that defines a baseline for time-series analysis is prepared and implemented.
5. Monitoring plans are designed and implemented. Demographic and genetic diversity indicators to evaluate the expected results of the actions are identified. A protocol to obtain the indicators is prepared and implemented at appropriate intervals to obtain a time-series analysis.
6. A framework for evaluating and reporting GR management effectiveness is established.
7. Necessary financial, technical and human resources are available to meet the start-up and ongoing costs to effectively implement management plans for target taxa or habitat restoration.
8. Institutional backing (local, national, regional) for this initiative is obtained through agreements, letters of support, etc.

²⁹ Adapted from Iriondo, J.M., Maxted, N., Kell, S.P., Ford-Lloyd, B.V., Lara-Romero, C., Labokas, J. and Magos Brehm, J. (2012) Quality standards for genetic reserve conservation of crop wild relatives. In: Maxted, N., Dulloo, M.E., Ford-Lloyd, B.V., Frese, L., Iriondo, J.M., Pinheiro de Carvalho, M.A. (eds.), *Agrobiodiversity Conservation: Securing the Diversity of Crop Wild Relatives and Landraces*. Pp. 72–77. CAB International, Wallingford.

9. Local social actors that have a direct or indirect relationship with the GR are identified. A strategy for involvement of the local community in GR conservation activities is formulated ensuring that both local people and other public stakeholders benefit from the establishment of the GR.

10. A clearly defined procedure to ensure and regulate the use of the genetic resources by breeders, researchers and other user communities is defined. Accessibility to scientists for monitoring and collection of germplasm for research is explicitly stated.

For protected areas in which genetic reserves is to be established

1. The protected area has a legal foundation that underpins long-term site stability with clearly defined conservation and protection objectives.

2. The governance of the protected area assumes a continuing commitment to the *in situ* conservation of target CWR taxa in the GR.

3. The management plan of the protected area acknowledges the existence of the GR and includes its maintenance among its objectives. Objectives and management of the GR are integrated with the mid- and long-term general management plans of the protected area.

4. An inventory of all CWR present in the protected area has been made.