A review of

European progress towards the Global Strategy for Plant Conservation

2011-2020

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A review of European progress towards the Global Strategy for Plant Conservation 2011-2020

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Front Cover Image: Species rich meadow with *Papaver paucifoliatum*, Armenia, Anna Asatryan.

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Acronyms

ISO	International Standards Organisation
ITPGRFA	International Treaty on Plant Genetic Resources for Food and Agriculture
IUCN	International Union for Conservation of Nature and Natural Resources
IUCN SSC	IUCN Species Survival Commission
IWT	Illegal Wildlife Trade
LAAAF	Law for the Future of Agriculture, Food and Forestry (France)
LR	Landraces
MAPs	Medicinal and Aromatic Plants
AEGIS	A European Genebank Integrated System
ASC	Aquaculture Stewardship Council
ASSI	Areas of Special Scientific Interest (ASSIs)
BGCI	Botanic Gardens Conservation International
BSBI	The Botanical Society of Britain and Ireland
CBD	Convention on Biological Diversity
CBN	Conservatoire botanique national (France)
CGIAR	Formerly the Consultative Group on International Agricultural Research
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
COP	Conference of the Parties
CWR	Crop Wild Relatives
DAFM	Department of Agriculture, Food and the Marine (Ireland)
EASIN	The European Alien Species Information Network
EBGC	European Botanic Gardens Consortium
ECCB	European Committee for the Conservation of Bryophytes
ECPGR	European Cooperative Programme for Plant Genetic Resources
ELC	Ecogeographic Land Characterization
EMA	European Medicines Agency
EPCS	European Plant Conservation Strategy 2002-2007
EPPO	European and Mediterranean Plant Protection Organization
EPSO	European Plant Science Organisation
ERA	Ecological Restoration Alliance of Botanic Gardens
EPCS	European Plant Conservation Strategy 2008 – 2014
EUNIS	European Nature Information System
EURISCO	European Search Catalogue for Plant Genetic Resources
EUTR	European Union Timber Regulation
FAO	United Nations Food and Agriculture Organization
FESPB	Federation of European Societies of Plant Biology
FLEGT	Forest Law Enforcement, Governance and Trade (EU)
FSC	Forest Stewardship Council
GBIF	Global Biodiversity Information Facility
GxMxE	Genotype x Management x Environment
GPPC	Global Partnership for Plant Conservation
GSPC	Global Strategy for Plant Conservation
HMPC	Committee for Herbal Medicinal Products (EU)
HNV	High Nature Value (farmland)

IAS	Invasive Alien Species
IASEG	The Invasive Alien Species Expert Group
IDMP	Identification of Medicinal Products standard
INERA	Institut National des Etudes et Recherches Agronomique (Yangambi, DRC)
INRAE	Institut National de Recherche pour l'Agriculture, l'Alimentation et l'Environnement (France)
IPA	Important Plant Area
IPBES	Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services
IPCC	Intergovernmental Panel on Climate Change
IPLCs	Indigenous Peoples and Local Communities
IPSN	International Plant Sentinel Network
ISO	International Standards Organisation
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LAAAF	Law for the Future of Agriculture, Food and Forestry (France)
LR	Landraces
MAPs	Medicinal and Aromatic Plants
MSB	Millennium Seed Bank
MNHN	Muséum National d'Histoire Naturelle (France)
MPNS	Medicinal Plant Names Services
MSC	Marine Stewardship Council
NBDC	National Biodiversity Data Centre (Ireland)
NDFs	Non-detriment Findings (under CITES)
NEM	Network Ecological Monitoring (The Netherlands)
NDFF	National Database Flora and Fauna (The Netherlands)
NNSS	Non-Native Species Secretariat (GB)
OFB	Office Français de la Biodiversité
PEBLDS	Pan European Biological and Landscape Diversity Strategy
PEEN	Pan-European Ecological Network
PEFC	Programme for the Endorsement of Forest Certification
PGRFA	Plant Genetic Resources for Food and Agriculture
PGRS	Plant Genetic Resources Secure
PMR	Plant Micro-Reserves
RBGE	Royal Botanic Garden Edinburgh
SAC	Special Area of Conservation
SDGs	Sustainable Development Goals
SEBiCoP	Spanish Society for Plant Conservation Biology
SSSI	Site of Special Scientific Interest (UK)
SLOSS	Single Large or Several Small (as applied to nature reserves)
TEN-G.	Trans-European Network for Green Infrastructure in Europe
TENs	Taxonomic Expert Networks
TVB	Trame Verte et Bleue (The Green and Blue Framework – France)
UAA	Utilised Agricultural Area
UEBT	Union for Ethical Biotrade
UNECE	United Nations Economic Commission for Europe
WDPA	World Database of Protected Areas

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Forewords

The conservation of plant species is an essential requisite for maintaining life on Earth as we know it. Plants are not only essential for providing us with fundamental eco-system services such as food, clean air, medicine, clothing and fuel, but they equally serve the more unnoticed function of balancing the fragile ecosystems of the planet, allowing millions of species of fellow plants and animals to survive, and thrive. Simply put, without them, there is no living planet.

The Convention of the Council of Europe on the Conservation of European Wildlife and Natural Habitats (Bern Convention) has, since its creation in 1979, sought to monitor the multitude of flora species across Europe and promote their critical function in the balance of our eco-systems. The Bern Convention's role of raising awareness and calling for action applies to all stakeholders: the local, regional, national and international governing authorities, the private sector, civil society and the citizens of our Continent.

The Bern Convention, in the 40 years of its existence, has worked on the issue of plant species through the establishing of a Group of Experts on Plant Conservation in 1990, the forming of guidelines and codes of conduct, action plans and recommendations. This culminated in the launching of the European Strategy on Plant Conservation in collaboration with Planta Europa and Plantlife UK in 2001, as a regional response to the Global Strategy for Plant Conservation.

Recommendation No. 87 (2001) on the European Plant Conservation Strategy adopted by the Standing Committee of the Bern Convention called on its Contracting Parties for coordinated action and implementation of the Strategy at national and European level to stop any further loss of plant diversity in Europe. The Strategy was revised in 2008 and has undergone regular reviews. The end of the decade and reflections for the post-2020 Strategic Plan of the Convention on Biological Diversity implied an up-to-date review of what has been done in Europe for Plant Conservation and what remains to be done, which brings us to this review.

While the data and statistics increasingly point to worryingly negative trends in the diversity of plant life in Europe, such as the mammoth loss of wetlands and other habitats, and extinction threats from climate change, invasive alien species and human activity, we can and should also highlight and learn from the positive actions and success stories in plant conservation, in order to be inspired and remain motivated. In particular, it is worth mentioning the significant development of the Emerald Network of Areas of Special Conservation Interest under the Bern Convention over the last decade which has strongly contributed to plant species conservation at pan-European level as more and more Contracting Parties have joined the network.

The Bern Convention is proud to be a key partner in this work, and to further the long-term collaboration with Planta Europa whose work is vital both for the direct conservation of plant species in Europe, and for providing best practice examples on a global scale. We hope to continue working together toward a new European Strategy on Plant Conservation for the post-2020 global biodiversity framework.

Jana Durkošová
Chair of the Bern Convention Standing Committee

Biodiversity has been experiencing significant declines at all levels, from genes and species, to ecosystems. The pressures on biodiversity and the underlying causes of biodiversity loss, such as climate change and land-use change, affect plants as much as other components of biodiversity.

Faced with global challenges of unprecedented magnitudes, threats to plants and biodiversity are accelerating and trends continue to decline.

However, evidence has shown that actions to address the biodiversity crisis have had a meaningful impact and that policy measures, when implemented properly, do work.

The Global Strategy for Plant Conservation (GSPC), and its 2010 update to support the Strategic Plan for Biodiversity 2011-2020, provide clear long-term goals for plant conservation that have been adopted at global, national and local levels, by a wide range of stakeholders across sectors.

The European Plant Conservation Strategy, one of the regional responses to the GSPC, has set an example for similar coordinated efforts in other regions.

The present review, being an assessment of progress in Europe under the second European Plant Conservation Strategy (2008-2014, extended to 2020), including challenges and successes, provides critical information for the way forward, especially in the context of the development of the post-2020 global biodiversity framework.

The continued delivery of the multiple ecosystem services provided by plants, from food to medicine, is even more critical now if we want to achieve sustainable development. We must think of more ambitious and innovative ideas for plant conservation. This will include wider integration across sectors and involvement of all segments of society, including businesses.

I congratulate and thank everyone involved in the preparation of the present report, in particular Plantlife and Planta Europea, and the Bern Convention at the Council of Europe for supporting this work.

I encourage Parties to the Convention on Biological Diversity, relevant organizations and stakeholders, to support future work related to the European Plant Conservation Strategy and to pursue efforts towards better integration of its objectives into policies.

Elizabeth Maruma Mrema
Executive Secretary of the Convention on Biological Diversity

In 2002, the Council of Europe and PLANTA EUROPA jointly launched the first European Plant Conservation Strategy. This Strategy was reviewed in 2007 leading to a revised Strategy for the 2008-2014 period, and extended until 2020 to meet the deadline of the 2011-2020 Strategic Plant for Biodiversity of the Convention on Biological Diversity.

Officially welcomed by the CBD, the European Plant Conservation Strategy offers a regional response to the Global Strategy for Plant Conservation (GSPC) and is also recognized as the most developed response to the GSPC by the Global Partnership for Plant Conservation.

2020 is a turning-point for most of the international, regional and national agendas for biodiversity and consequently, for the PLANTA EUROPA network, this is our responsibility to report on progress against the Global Strategy for Plant Conservation targets. This review aims at providing a trustworthy overview of the progress made to reach the 16 targets of the Strategy as well as highlighting the gaps and indicating the way forward for the upcoming decades. This review brings together relevant knowledge that will also feed the discussions of the next PLANTA EUROPA Conference which is to be held in Paris, FRANCE at the National Museum of Natural History in September 2021, providing thus guidance for a new PLANTA EUROPA network action plan.

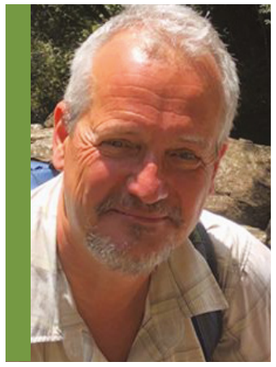
This review together with the CBD National Reports for European countries showcase the outstanding array of initiatives that are deployed for each target throughout Europe. The authors of this review have aimed at presenting at both the European and the national levels the more relevant contributions providing basic information on the extent that the targets have been reached.

Armed with these progress assessments, the PLANTA EUROPA network emphasizes that international, regional and national agendas are core contributions to plant and habitat conservation and urges governments - as well as international and national bodies - to strengthen their human and financial support and to move towards the development of more integrative policies for plant and habitat preservation.

At the time of writing these words, mankind is discovering with dismay the role that human habits could play in the occurrence of global epidemics and that must contribute, in addition to the substantial evidence of the effects of global changes on biodiversity, to question our certainties on the sustainability of the development model we have been promoting for so many years.

I warmly acknowledge all organizations and people who have made this review possible and wish you a pleasant and enlightening reading.

Philippe Bardin
PLANTA EUROPA Chair



Plant diversity is a fundamental element of all biodiversity. It provides natural solutions to the challenges of climate change; supports food and health resilience; is the life support of nearly all other wildlife, and enhances wellbeing at a time of societal stress. The solace of nature is built upon plant diversity. My foreword is therefore also a call to arms.

I write at a time of extraordinary challenge for humanity amidst a global pandemic. In responding to an invisible and asymptotic virus we have seen the very best of human endeavour and a coalition of minds, effort, finances, nations and all sectors of society to address what, was until December 2019, an unknown threat.

Yet, the greater and multi-generational challenge of humans' negative impact on the natural world has been unable to galvanise an equal coalescence in how to tackle it. The Global Strategy for Plant Conservation takes on even greater significance in this context. We have made progress over the last decade, but too little. We have a greater understanding of what we know and don't know, but the gaps remain huge. We have been able to engage more people in the debate but populations, policy makers and opinion formers largely remain 'plant blind'. We cannot therefore be satisfied, notwithstanding the huge effort applied by all those involved. For those, I also express my heartfelt thanks as I know it can feel like 'pushing water uphill' at times.

Our targets must be to make plant diversity a central issue in all international biodiversity considerations. We need to enable global communities to work together on plants and plant conservation. At Plantlife, we call for plant diversity and its conservation to be explicitly embedded in all major post-2020 biodiversity and climate agreements.

Much has been achieved so far but the journey is only just beginning. The Global Strategy for Plant Conservation has been empowering for nations across Europe, it provides a focus to report progress alongside failings and gives us all a vehicle to make recommendations. So, great foundations laid, wonderfully capable people committed and engaged and we know much more than we did.

Let's now build on these foundations using GSPC as the foundation for a biodiverse and climate secure future.

Ian Dunn
Plantlife Chief Executive

It gives me great pleasure to write this foreword for Planta Europa's Review of European progress towards the Global Strategy for Plant Conservation (GSPC) 2011-2020. The GSPC was the first target-driven initiative of the Convention on Biological Diversity, and one of its strengths compared to other CBD work programmes is that it is a framework against which progress can be measured relatively easily. This may also be one of the reasons why reporting against the GSPC is not obligatory for parties to the Convention – because it has the potential to expose poor performance as well as highlight good progress. In my mind, this makes the GSPC, and this Review, particularly useful. It is essential for us to know how well we are doing in our efforts to prevent the loss of biodiversity and to ensure that the benefits we derive from biodiversity are sustainable into the future.

In this context, this report makes sobering reading. As the authors say themselves 'the biodiversity of Europe and Central Asia is in continuous strong decline.' This Review charts this decline in impressive detail but also sets out clearly where failings have taken place. The main drivers of plant species extinction continue to be habitat loss, invasive species, over-exploitation and climate change, and the Review covers these and other, emerging threats in some detail.

The heart of this review, however, is a target by target assessment of progress towards the GSPC. Depending on whether your cup is half full or half empty, we can either celebrate the progress we have made against most of the targets or we can lament our failures. This Review tries to take a balanced and honest view, and identifies issues to consider related to each of the targets, and ways in which we might make better progress. I think the botanical community can be proud of what it has achieved – often in the face of indifference or competition from more 'charismatic' elements of biodiversity. However, what is clear, regardless of your disposition, is that we have not done enough. The Review looks at the main reasons for this, including inadequate policy frameworks and instruments, data gaps and lack of resourcing. More encouraging, are the opportunities that have arisen, including the role of civil society, volunteers and new technologies.

For me, the key message is that we need transformational change – a complete paradigm shift – in which we are serious about tackling the drivers of biodiversity loss but also about repairing and restoring the biodiversity that we have damaged so badly. For this to happen, we need public support for the idea that people cannot always come first. If we want to enjoy the benefits of biodiversity, then we need to make room for it, celebrate it and support it.

I hope you find this Review as informative and inspiring as I do.

Dr Paul Smith
Secretary General BGCI

1. Executive summary

Anemone sylvestris - *Philippe Bardin*

The Global Strategy for Plant Conservation (GSPC) has provided unity and focus for a broad global community of organisations and individuals committed to plant conservation, and has helped contribute to the delivery of plant conservation targets (Appendix 1) that themselves contribute to broader biodiversity and sustainability targets. This focus has stimulated considerable activity and resulted in greater knowledge and understanding of the world's plants, their status, and the roles that they play, both in the broader environment and in supporting human society. The GSPC has also enabled the identification of key knowledge gaps, and ways in which plant conservation could be improved. It has stimulated the production of national plant conservation strategies across the world; and Europe has its own regional strategy.

The targets have provided both a focus for action and a framework for measuring progress. Much of the policy and practice for plant conservation over the last ten years has been driven by the GSPC, and is unlikely to have been as effectively formulated or implemented in its absence.

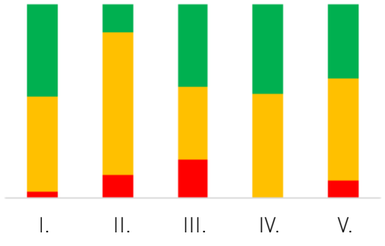
However, despite the progress made under this important strategy, European countries are not on track to meet, or have not met, most targets. This is not unique to plants. We have reached a point of biodiversity and climate crisis, and current European policies and actions have not been sufficient to tackle either. This failure is partly due to inadequate compliance with and implementation of policies, and to lack of sectoral integration. In order to conserve the diversity of plants and other taxa transformational change is needed, requiring effective sectoral integration, adequate resourcing and substantial public support.

The following summary of the GSPC Objectives and Targets highlights various areas of progress, inadequacy, and future needs to enable effective plant conservation. Plants form a vital cornerstone of a healthy and functioning environment, human society, and planet – their conservation is not optional.

Progress towards GSPC objectives (Box 1.1 - averaged across all targets under each objective taking account of numbers of countries that scored targets) and targets (Box 1.2).

'Green' denotes being on track to achieve targets at national levels, 'Amber' denotes progress being made towards targets at national levels but at an insufficient rate, and 'Red' denotes a lack of progress towards achieving targets at national levels. These charts are not necessarily representative of all countries as only about a quarter of European countries (10-13) reported on GSPC targets (see Appendix 1 for target details) and scored progress. However, the relative levels of progress with delivering the GSPC objectives and targets is generally borne out by other sources of information as described in the text (Section 5).

Box 1.1 Progress towards GSPC Objectives I-V



Objective I: Plant diversity is well understood, documented and recognized (Targets 1-3)

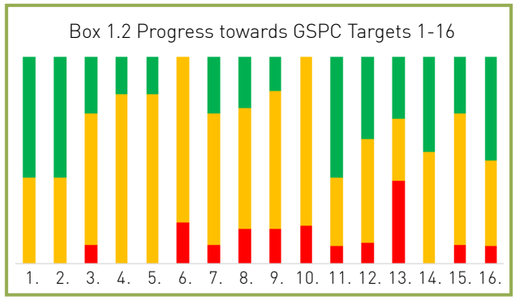
Considerable effort has gone into the targets under this objective. While an online flora database exists, effort to populate this is needed from regions with sparse data and research needs remain for taxonomically difficult plant species. The conservation status of most of Europe's plants has not been assessed, although it has for all trees, bryophytes and probably for a disproportionate number of threatened plants, such as those listed in policy instruments.

A key research need involves ensuring that the role individual plant species and plant communities play in ecosystem services are evidenced, to ensure plant diversity is properly integrated INTO policies such as agri-environmental SCHEMES, and site and landscape conservation approaches.

Diphelypaea tournefortii - *Anna Asatryan*

Objective II: Plant diversity is urgently and effectively conserved (Targets 4-10)

Box 1.2 Progress towards GSPC Targets 1-16



While good mechanisms exist for site designation, data issues exist regarding site identification. Where threatened plant species are present within protected areas, only a limited number of management/action plans have been produced, even though active conservation measures are frequently necessary. Ecological condition, representativeness and connectedness of the network, especially with respect to future impacts of climate change, including interactions with invasive species, are significant issues. The management of the matrix between protected areas needs to be sustainable to enable plant dispersal, and this is not generally the case. Within the EU, the post 2020 Common Agricultural Policy needs to be fully aligned with the Sustainable Development Goals and the EU must have clearly defined 2030 targets for the contributions of agriculture and forestry to sustainability and biodiversity conservation.

Analysis of the Important Plant Areas (IPA) programme in 11 countries across Europe found that poor forestry practices (intensified forest management, deforestation and afforestation) was the single most widespread threat to IPAs, affecting 47% of sites. Old growth or 'virgin' forests are particularly important for plant, fungi, lichen and bryophyte conservation but they form a tiny proportion of overall forest cover in Europe. These remaining areas need to be targeted urgently for increased protection. Afforestation of other habitats, such as grassland and heath, is also a key threat which looks set to increase if climate change targets are applied without thought to wider biodiversity concerns.

Botanic gardens already play an important role in ex situ *conservation but have considerable potential to aid* in situ *conservation. However, currently only a small proportion of their capacity is devoted to* in situ *conservation of threatened species and to collaborating in* in situ *restoration programmes. Increasing the representation of threatened species, and associated genetic diversity with multiple accessions across the network of botanic gardens and seed banks, would be a first enabling step towards delivering* in situ *conservation outcomes for threatened species, followed by involvement in* in situ *conservation on the ground and public awareness. The role of botanic gardens in* ex situ *conservation of plant material from other global regions was apparent. The need for better integration between conservation and agricultural sectors would help enable the conservation of Crop Wild Relatives.*

Objective III: Plant diversity is used in a sustainable and equitable manner (Targets 11-13)

CITES is key to ensuring that trade does not endanger threatened plant species but stronger governance is needed to improve listing response times and ensure accountability and enforcement in cases of noncompliance. Risks to valuable plants (especially forests) are compounded by serious risks to the safety of people that protect them.

In Europe, sustainable management of forests and other wild plants currently depends upon voluntary certification schemes. Although these are not perfect, they are currently one of the few tools available to help ensure sustainable management and product traceability. An expansion of the area of forest, and the species of non-forest plants, covered by certification would be beneficial, as would an exploration of whether the interactions between governments, private companies and NGOs in sustainability standards could be adjusted to increase the coverage of and compliance with sustainable management techniques.

In addition, the entry into force of the Protocol of Nagoya ensures the equitable sharing of benefits generated by the use of plant genetic resources, when their natural products or genetic information can generate new products. In addition, the protocol aims at protecting the important contribution of communities to the traditional knowledge, especially rich in Europe.

Objective IV: Education and awareness about plant diversity, its role in sustainable livelihoods and importance to all life on earth is promoted (Target 14)

The ability of plants to deliver natural solutions to sustainability problems, for example through green infrastructure and agro-ecology, is a growing and important area, and better integration and communication across sectors (engineering, agriculture, environment, development etc.) would be beneficial. The apparent 'plant blindness' in the international wildlife trade area merits additional effort in communication and awareness.The development of measures that enable the effectiveness of education and communication channels at delivering conservation outcomes would be valuable.

Objective V: The capacities and public engagement necessary to implement the Strategy have been developed (Targets 15 and 16)

In many countries professional capacity to tackle plant conservation has been eroded, largely due to lack of financial resources. This is of particular concern given the scale of the problems that plant conservation faces. In parallel, opportunities for citizens to understand and contribute to plant conservation have increased. While it is important that professional capacity be maintained and enhanced, other capacity building avenues merit consideration.

Many networks for plant conservation exist, facilitated by digital technology, but there are few inter-sectoral strategic networks for plant conservation. Such networks could potentially contribute to the delivery of many GSPC objectives and aid in the development of sustainable financing models.

Human and financial resources are currently inadequate to deliver plant conservation objectives and sustainable models need to be developed for both. We live in challenging times, but it would be a false economy not to invest in plant conservation due to our dependence upon plants for our well-being and survival and the many opportunities they provide for mitigating and helping us adapt to the negative effects caused by unsustainable human exploitation of the environment.

Postcards to raise awareness on plants - Anna Asatryan

2. Background

Glaucium flavum – *Erika Penzesné Kónya*

In recent decades, governments across the world have recognised the developing biodiversity crisis and committed through the targets on the Convention on Biological Diversity (CBD) to conserve biodiversity and ensure that development is sustainable. So far, delivery of these commitments has failed. While important positive steps have undoubtedly been taken, some of these successfully, the overall picture remains one of biodiversity loss, and this includes plants (Box 2.1). While many *in situ* plant conservation actions taken at site level, along with supportive *ex situ* actions, have seen positive outcomes, the drivers of plant loss have not been adequately addressed, and overall trends have been unremittingly negative. The CBD and the incorporated Global Strategy for Plant Conservation (GSPC) Targets continue to be missed, even in more developed parts of the world, like Europe, that potentially have more resources to enable conservation and sustainable management. Of great concern is the fact that some of the threats facing plants and other biodiversity have accelerated, and continue to do so. Climate change is arguably the most obvious and pressing of these, affecting plants directly but also interacting with many other drivers of plant decline, including the major driver of habitat loss, degradation and fragmentation. Additional risks include those associated with the resource demands of a growing population and the impacts of globalisation. It is of considerable concern that we have failed to meet previous targets, even when the challenges of meeting them appeared less demanding than today.

Box 2.1. The biodiversity of Europe and Central Asia is in continuous strong decline.

"The extent of natural ecosystems has declined, e.g., wetland extent has declined by 50 per cent since 1970 and natural and semi-natural grasslands, peatlands and coastal marine habitats have been degraded. Ecosystems have considerably declined in terms of species diversity. Of the assessed species living exclusively in Europe and Central Asia, 28 per cent are threatened. Among all the assessed groups of species living in the region, particularly threatened are mosses and liverworts (22.5 per cent of European bryophytes[1]), freshwater fish (37 per cent), freshwater snails (45 per cent), vascular plants (33 per cent) and amphibians (23 per cent). Landscapes and seascapes have become more uniform in their species composition and thus their diversity has declined."

Source: IPBES 2018[2]

1 https://portals.iucn.org/library/sites/library/files/documents/RL-4-027-En.pdf
2 https://ipbes.net/assessment-reports/eca; https://ipbes.net/sites/default/files/spm_2b_eca_digital_0.pdf

The conservation of plants and biodiversity and the sustainable use of the planet's natural resources will require a step change in management of the natural world. This will not be easy, it will involve governments making difficult and uncomfortable decisions in the long-term interest of the planet and societal well-being, and society accepting these changes. Such long-term thinking is not always evident from governments elected for short-term periods, especially when long-term benefits are associated with short term costs. However, such planning is both possible and essential. Within nations, decisions on issues of national interest have been, and will increasingly need to be, made across political divides. Multilateral agreements will continue to be an important driver of national decision making, and must be creative, robust and outcome driven to enable the transformational changes required.

The scale and urgency of the climate and biodiversity crises emphasise the need, more than ever, for nations to unite with the common purpose of conservation and sustainable management of the planet's resources to ensure that species are not lost, ecological support systems are maintained and restored, and human livelihoods are sustainable. The formulation of new GSPC targets, learning from the successes and failures of previous targets, should play an important role in the process. Regional responses, like the European Strategy for Plant Conservation (ESPC), will further facilitate implementation. Yet more important will be ensuring that the mechanisms and resources are in place to enable new targets to be met – and ensuring that they are met. There may not be many more opportunities to do so.

3. The status of the world's plants and threats to them

Vavilovia formosa – *Anna Asatryan*

Oudemansiella mucida – *Sébastien Filoche*

The plant kingdom (Plantae) can broadly be divided into vascular plants (trachyophytes) and non-vascular (lower) plants (bryophytes). Vascular plants belong to the phylum Tracheophyta. Bryophytes include mosses (phylum: Bryophyta), liverworts (phylum: Marchantiophyta) and hornworts (phylum: Anthoceratophyta). Other lower plants are algae (phyla: Rhodophyta – red algae, Charophyta – freshwater green algae, Chlorophyta – green algae). While not true plants, fungi are also sometimes considered as lower plants, although they have their own kingdom (Fungi). Lichens comprise algae or cyanobacteria living among fungal filaments in a mutually beneficial relationship. Lichens are classifieds within fungi, as the fungal component of the relationship is dominant.

Globally, less is known about the ecology and status of lower plants than vascular plants. For example, the global conservation status has been assessed for only a small number of fungi (285 of >140,000 named and classified species – IUCN 2020, Willis 2018[3]) and about 1.4% of bryophytes, compared with over 10% of vascular plants[4]. (as of April 2020; IUCN 2020[5]). However, at a European level, the status has been assessed for all Bryophytes, and at the level of individual European nations, status assessments also exist for many fungi.

This report concentrates on vascular plants, as it is for this group that the majority of information is available. However, non-vascular plants, fungi and lichens are also covered where possible, and especially where information suggests that species or groups are particularly threatened, or where data are lacking and urgently needed.

3.1. The status of the world's plants

Life on earth as we currently know it could not be sustained in the absence of plants. Plants are the fundamental building blocks of food chains in practically all ecosystems. Through photosynthesis they harvest light energy converting it to chemical energy using water and carbon dioxide to form carbohydrates, such as sugars, used as fuel by themselves and the many animals that feed upon them. A waste product of most photosynthesis is oxygen, needed for respiration (breaking down food to get energy) by both plants and all aerobic animals. But plants provide far more. They have a key function in the water cycle, returning water from the ground though transpiration to the atmosphere, helping form clouds and rain that redistributes the water. They play a similarly key role in the carbon cycle removing carbon dioxide from the atmosphere during photosynthesis and storing it in their tissues as they grow. Plants provide us not only with food but also with fuel (firewood and fossil fuels), shelter and medicine. Many plants also play an important cultural role, both recreationally and spiritually. Plants have their own intrinsic, existence value. It is neither ethical nor wise to knowingly allow plant species to decline to the point of extinction. In addition to providing the services described, certain plant species have a disproportionate effect, relative to their abundance, on the ecological communities that they are part of. For example, some plants (e.g. fig trees) provide a temporally or nutritionally-specific key food resource that cannot readily be replaced for certain animals, others (e.g. mangrove trees) may physically stabilise their direct environment. In these ways some plants can be considered as 'keystone' species, a term coined by biologist Robert T Paine in the late 1960s. However, it is notable that many keystone species are not identified until they have started to decline and the impacts of their loss becomes apparent. People have explored the useful properties of only a tiny proportion of the world's plants, thus the human-caused loss of any plant species represents a lost opportunity as well as an ethical failure of society.

> ***"1 in 5 plants are estimated to be threatened with extinction"***
>
> RBG Kew 2016

Yet, plant populations and entire species are being lost at an alarming rate. Over 350,000 plant species are known to exist[6]. The International Union for Conservation of Nature and Natural Resources (IUCN) Red List (IUCN 2019[7]) indicated that the conservation status of 38,603 plant species (11% of all known plant species) had been assessed globally, and of these 40.8% (15,774) were in the top three categories at risk of extinction (Critically Endangered CR, Endangered EN or Vulnerable VU) – collectively described as 'threatened'. However, this analysis is for only a small subset of the world's plants and may be subject to bias and unrepresentative of plants in general. For example, there is, quite understandably, a tendency to assess the conservation status of those species believed most likely to be at risk of extinction, as their conservation needs are the most urgent. Published estimates of the proportion of plants threatened with extinction therefore vary considerably in relation to the groups assessed. RBG (Kew) in 2016 proposed a solution to this potential bias of analysing a large random selection of plant species and assessing their extinction risk. This representative view of extinction risk in plants indicated that one in five plant species are estimated to be threatened with extinction. The largest survey of plant extinctions so far found that, averaged across the period, almost three species a year of the world's seed-bearing plants have been lost since 1900. The estimated ongoing extinction rate was up to 500 times the background extinction rate for plants (Humphreys *et al*. 2019).

3 https://stateoftheworldsfungi.org/2018/reports/SOTWFungi_2018_Full_Report.pdf
4 See theplantlist for numbers of species http://www.theplantlist.org/
5 IUCN 2020 -The IUCN Red List of Threatened Species. Version 2020-1. https://www.iucnredlist.org

6 http://www.theplantlist.org/
7 IUCN Red Lists are continuously updated. This figure relates to Version 2019-3

3.2. Threatened Plants in Europe

Rosa pendulina – *Erika Penzesné Kónya*

An analysis of the conservation status of Europe's plants suffers from similar problems of bias as only a small proportion of them have been assessed, and these are more likely to be among the most threatened. This needs to be considered when interpreting the results of an analysis of the IUCN Red List data presented below. However, in Europe, certain taxa or subgroups of plants have been assessed in their entirety, and issues of bias do not exist in the same way for these groups. European native trees, lycopods and ferns, and bryophytes are examples (e.g. Boxes T2.1 and T2.2) of groups that have been assessed, regionally, in their entirety (see 5.2 T2 for other European Red Lists).

There are an estimated 20,000-30,000 vascular plant species in Europe[8]. The exact figure depends upon the countries that are included in Europe. Considering the 47 Member States[9] of the Council of Europe, the number of plants is closer to, and may be in excess of 30,000. Bilz *et al*. (2011) in the European Red List of Vascular Plants cites >20,000 species (from Euro+Med Plantbase 2006-2011) and Allen (2014) cites more than 30,000 vascular plant taxa in Europe (from Euro+Med Plantbase 2006-2014), with new species constantly being discovered, classified and added to the list. The Biodiversity Information System for Europe (BISE[10]) cites 20,000-25,000 but this does not include all Council of Europe Member States.

In 2011, the European Red List of Vascular Plants (Bilz *et al*. 2011) had assessed the conservation status at a regional level of 1,826 selected species native to Europe or naturalised before AD 1500, including:

- Plants listed under European or global policy instruments such as the Habitats Directive, Bern Convention, Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and the EU Wildlife Trade Regulation
- Crop wild relatives (CWR) of priority crops
- Aquatic plant species

Red List assessments were made at two regional levels: for geographical Europe, and for the 27 Member States of the European Union (at the time of assessment). Of the 1,826 species assessed at European level, 467 (25%) were identified as threatened with extinction. For species listed in policy instruments, at least 44.9% of species at European, and 47.3% at EU 27 level were threatened, the high proportion reflecting that these species had already been identified as of conservation concern. The Red List identified a number of urgent actions necessary to conserve Europe's vascular plants, and these are reflected in the GSPC and ESPC targets (Appendices 1 and 2).

8 There are also many bryophytes in Europe. Although their conservation status is less well known the European Committee for the Conservation of Bryophytes (ECCB) provides an index of checklists and Red Lists for this group: https://eccbryo.nhmus.hu/checklists_redlists
9 https://www.coe.int/en/web/about-us/our-member-states
10 https://biodiversity.europa.eu/topics/species/vascular-plants

The status of far more plants in Europe has been assessed over the last decade, both for global and regional conservation status. The following numbers of plants were assessed from the IUCN database (IUCN 2020 [11]).

To determine the proportion of plants assessed as globally (rather than regionally) threatened with extinction we used a definition of Europe that corresponds to that of the Council of Europe (Member States plus Belarus). This incorporated the IUCN regional categories of Europe plus North Asia (Belarus, Republic of Moldova, Russian Federation and Ukraine) plus Armenia, Azerbaijan, Cyprus, Georgia and Turkey from the West and Central Asian region. In this broader definition of Europe, 3,579 plant species were assessed, of which 1,133 (31.7%) were globally threatened (CR, EN, VU), 7% were Near Threatened (NT) and 11% were Data Deficient (DD). Relatively few fungi in Europe have been assessed for regional (European) or global conservation status.

For the IUCN European region, of 2,730 species of plants assessed for global conservation status, 780 (28.6%) were globally threatened. When the main threats are analysed for globally threatened plant species across Europe the loss and degradation of habitats significantly threatens plants. The main threats are agriculture (aquaculture presents only a small number of threats), natural systems modifications and invasive and other problematic species (Figure 3.2.1).

A regional threat assessment has been completed for the IUCN Red List European region, and this finds that of 4,624 plant species assessed, 1,086 (23.5%) were regionally threatened with extinction (CR, EN, VU), 7.8% were NT and 11.3% DD. The main threats to regionally threatened species are very similar to those that threaten globally threatened species across Europe, with a few small differences in the order of threats (Figure 3.2.2).

While fungi have long been neglected in the past, the recent contributions of many mycologists from throughout the world enable to assess up to 280 species. The largest number of species are from Europe thanks to the hard work of members of the European Council for Fungal Conservation[12].

Lactarius deliciosus, *Estonia, IUCN Least Concern – Erika Penzesné Kónya*

11 https://www.iucnredlist.org/resources/summary-statistics Version 2010-1.
12 http://iucn.ekoo.se/iucn/plans/

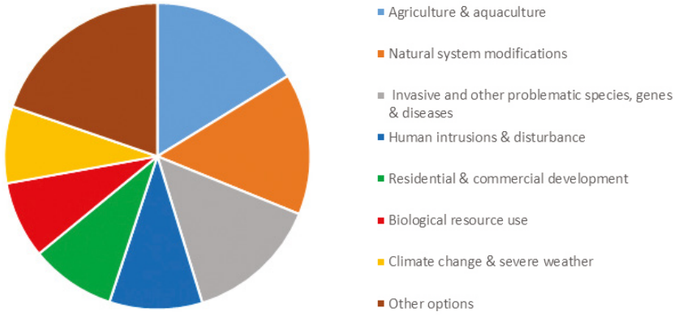


Figure 3.2.1 - Threats to globally threatened plant species in Europe

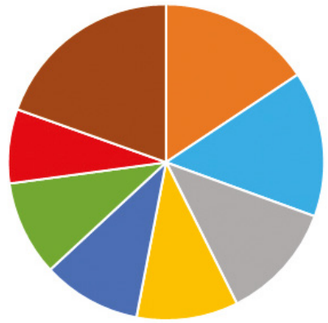


Figure 3.2.2 – Threats to regionally threatened plant species in Europe

Data for Figures 3.2.1 and 3.2.2 summarised and adapted from IUCN 2020 - Version 2020-1. Europe follows the IUCN definition. Other options include: Transportation & service corridors, pollution, energy production and mining, geological events, other threats.

3.3. Key threats to plants

Flavoparmelia caperata – *Sébastien Filoche*

A selection of the key threats to plants is included below, as highlighted in State of the World's Plants (SOTWP) (RBG Kew 2016 and Willis 2017) and an analysis of the IUCN Red Lists. These are broadly similar to threats to European macrofungi, although the main threats to macrofungi are considered to be unsuitable forest and farmland management and air pollution (Senn-Irlet *et al*. 2007).

Many of these threats interact with each other and climate change interacts with most or all of them, directly or indirectly. Additional threats, including trade, are covered in more detail in the reports on individual GSPC targets.

3.3.1. Habitat loss and degradation (agriculture, forestry, urbanisation, fragmentation)

Primary drivers of habitat loss and degradation include unsustainable agricultural and forestry practices and urban expansion, which are influenced by climate change.

Agricultural activities are key among these, as reflected in an analysis of threats to plant species that are threatened in European countries (Figure 3.2.2.). Among agricultural activities, livestock farming and annual and perennial non-timber crops are the most cited threats. The European Environment Agency State and Outlook Report (EEA 2019 – SOER 2020) highlights the multiple impacts that unsustainable agricultural activities have had on the environment, including from soil, water and air pollution, overexploitation of natural resources, biodiversity loss and ecosystem degradation. The pressures and threats that EU Member States most frequently report for all terrestrial species, habitats and ecosystems are associated with agriculture.

The multiple pressures from agriculture of particular consequence to wild plant populations, in addition to direct loss of land, include: excessive use of nitrogen-based fertilisers which can result in diffuse pollution of air, soil and water and eutrophication; pesticide use that can directly affect wild plant populations and also plant pollinators (Box 3.3.4.); ammonia (NH3) emissions; excessive use of water which can result in decreasing groundwater levels, salt water intrusion and loss of wetlands; soil compaction. Greenhouse gas (carbon dioxide CO2, methane CH4 and nitrous oxide N20) emissions that contribute to climate change result from fossil fuel use, soil management practices such as the addition of synthetic and organic fertilizer and certain cropping practices, the management of manure, burning of agricultural residues, and methane production by ruminants.

> *"Europe is experiencing a decline in biodiversity primarily due to the loss, fragmentation and degradation of natural and semi-natural ecosystems and agricultural intensification is one of the main causes"* EEA 2019

Many of the current threats from agriculture are associated with intensification. However, Europe has a long history of human land use, and across the centuries various landscapes have been managed for agricultural production in a low intensity fashion, and are of value culturally and for plants and other wildlife. Such land is described as 'High Nature Value'[13] (HNV) farmland. The maintenance of plant diversity on such land depends upon the continuation of more traditional low-intensity farming practices. EEA (2019) report that while the main trend has been towards the intensification of agricultural land, about 9% of agricultural land is part of Natura 2000 sites (protected under the EU Habitats Directive; Appendix V) and 30% was classified as HNV farmland (Paracchini *et al*. 2008 [14]). Organic agriculture has increased and comprised 7.5% of total EU agricultural land (utilised agricultural area -UAA) in 2018 (Eurostat 2020).

While the literature shows that agricultural intensification has caused substantial biodiversity loss in Europe, the abandonment of certain types of farmland also poses risks to plant diversity. For example HNV farmland under semi-natural grassland management is often valued for its botanical and other biodiversity interest, and abandonment can substantially reduce this. While abandonment is considered to be a key threat to HNV farmland, it has been suggested that a comprehensive analysis of the environmental risks and opportunities associated with any land abandonment requires both pre and post abandonment analyses, as they will be related to post abandonment land use (Queiroz *et al*. 2014). As lightly-grazed semi-natural grasslands of HNV tend to be low yielding, abandonment or intensification may result from them being uneconomic, even with subsidies. Preservation may nonetheless be important for both their ecological and cultural values, perhaps supported by agri-environmental or other subsidies, if they are not otherwise economically sustainable (e.g. see discussions of trade-offs between different types of farming systems for biodiversity in Phalan 2018).

Unsustainable **forestry practices** across Europe also result in habitat loss and degradation. Forests cover 40-45% of European land (EEA 39 region, EEA 2019; all Europe, Forest Europe[15]). Primary forests are very rare in Europe due to a long history of land use and the area they cover depends upon how they are defined. Using data from nearly 40 European countries, Forest Europe (2015)[16] classified

13 http://www.high-nature-value-farming.eu/
14 We could not find a more recent value
15 https://www.foresteurope.org/sites/default/files/EuropeanForestResourcesFINAL.pdf
16 https://www.foresteurope.org/docs/fullsoef2015.pdf

4% of the forest area as undisturbed by man. These undisturbed forests are those in which the natural forest development cycle has remained or been restored, and where there are no visible sign of human activity. Sabatini *et al.* (2018) mapped primary forests and found that known primary forests covered only 0.7% (1.4 million ha) of Europe's forest area in 32 countries. Most were protected but only a half of them strictly. Thirty million hectares of forests are protected within the Natura 2000 network, comprising almost half of all Natura 2000 protected areas, and their use for wood production is restricted. However, only about a third of the forest habitats listed under the EU Habitats Directive are in favourable conservation status (EEA 2019). Forests suffer from a range of threats including: fragmentation (which increased between 2009 and 2015 - EEA 2019); illegal logging; forest fires[17] (which may increase in some places as a result of climate change – Box 3.3.3.); infrastructure and tourism; invasive alien (non-native) species including pests and diseases (like ash die-back – Box 3.3.2.), whose distributions are also likely to be affected by climate change; intensive and unsustainable management of even aged plantations, including clear-cutting and the removal of deadwood. Other threats to trees and other plants associated with forests include air pollution, including sulphate deposition which can acidify forest soils, and nitrate deposition and cause eutrophication and acidification.

Centaurea caroli-henrici – *Anna Asatryan*

Land take for **urbanisation** is another cause of habitat loss and degradation that threatens plants, although this shows a slowing trend (EEA 2019). Land take for development has presented a substantial threat to plants in some areas, for example Mediterranean coastal areas, where development has been high. An analysis of those factors that threaten Important Plant Areas (IPAs) in Europe and the Mediterranean found that the greatest threat was from development and construction resulting from recreation and tourism – rather than urbanisation (Willis 2017 and Figure T5.2.). The other major threats to IPAs reflected the threats to plants described above; these are discussed in more detail later (Section 5.2 T5).

Habitat fragmentation can result from agriculture, forestry, urbanisation or other factors that make habitat unsuitable and represents a particular threat for plants that require external vectors, including water, wind, birds and mammals, to transport their pollen and/or seeds across landscapes. Fragmentation can affect cross-pollination, negatively impacting gene flow and reducing evolutionary potential. When the availability or abundance of an individual or suite of relevant vectors decrease, we might expect a related decrease in the dispersal and ultimately distribution and population of the associated plant species. Ozinga *et al.* (2009) found that losses in plant diversity in Northwest Europe in the 20th century could be partly explained by differences between species in their adaptations to various dispersal vectors, combined with changes in the availability of these vectors. These factors may have more influence over the loss of plant diversity than previously realised. To be effective, plant conservation measures need to consider ways of restoring dispersal ability, i.e. the 'dispersal infrastructure' across landscapes.

17 Although boreal forests may benefit from controlled fires, depending on forest management https://ec.europa.eu/environment/integration/research/newsalert/pdf/43si6_en.pdf

While species losses can be very rapid there can often be a time delay, which may be quite long, during which species persist close to or moving gradually towards their extinction thresholds. This delay in eventual losses of species in fragmented or degraded habitats is known as an 'extinction debt'. This was illustrated for long-lived vascular plants in a pan-European study of 147 fragmented grassland remnants where present-day species richness was better explained by past than current landscape patterns (Krauss *et al.* 2010). Such studies provide a good illustration of the insufficiency of simply maintaining existing fragmented habitats, as time delayed extinctions of species, and those that depend upon them, will result in further plant impoverishment.

Many of the threats mentioned in this section interact to influence habitat suitability for plants, including climate change which may cause bioclimatic shifts in the suitability of areas and also result in shifts in human land use patterns. Increasing the permeability of the wider landscape and the connectivity of key sites and plant populations is needed both to protect core areas of plant diversity and enable species dispersal. *In situ* conservation often supplemented by *ex situ* resources are important for site enlargement and restoration, the creation and management of effective corridors and broader enhancement of the wider landscape.

A key element of the pan European biological and landscape diversity strategy (PEBLS 1996), developed under the auspices of the Council of Europe, was the development of the Pan European Ecological Network (PEEN) to ensure coherence in biodiversity conservation. Jongman *et al.* (2011) highlighted some of the associated challenges. A main challenge is developing sufficient understanding of how a changing environment, especially with respect to climate change and other major changes, affects species and habitats in the wider environment. Especially important is knowledge of how to prevent irreversible damage to landscape permeability, and an identification of the essential measures that need to be taken to adapt to and mitigate changes that are happening in the wider environment. While the importance of networks that incorporate permeable landscapes have become increasingly acknowledged and are becoming integrated into policy initiatives, more work is needed on this complex issue. International coordination is critical to ensuring effective transboundary networks that facilitate movement and maintenance of plant species across borders. Existing examples include the European Greenbelt Initiative[18] and the EU Strategy on Green Infrastructure[19]. Other important networks including those that define specific protected sites (e.g. the Emerald Network, incorporating Natura 2000 – Box T7.1.) also call for broader landscape measures above and beyond site designation and management to improve network coherence (T4.1). These initiatives are described in Appendix V.

3.3.2. Invasive Alien Species

Non-native invasive animal and plant species (Invasive Alien Species - IAS) present a major threat to native plants and animals in Europe. It has been estimated that they cost the European economy at least 12.5 billion Euros per year, and probably over 20 billion Euros with costs resulting mainly from the damage they cause and control measures (Kettunen *et al.* 2008). Invasive alien plants are a major threat to the conservation of native plant diversity and affect the provision of a range of ecosystem services, especially the supply and quality of water. In addition to the impacts of IAS introduced accidentally or deliberately into the European environment, native species can become invasive as local conditions and environments change in association with, for example, climate change. However,

18 https://www.europeangreenbelt.org/
19 https://ec.europa.eu/environment/nature/ecosystems/strategy/index_en.htm

non-native species present particular risks and in January 2015 the Invasive Alien Species (IAS) Regulation (EU) 1143/2014[20] entered into force. This fulfils Action 16 of Target 5 of the EU 2020 Biodiversity Strategy, and contributes to Aichi Target 9 of the CBD Strategic Plan for Biodiversity 2011-2020 and Target 10 of the GSPC. An important measure preceding this key EU Regulation was the European Strategy on Invasive Alien Species adopted in 2003 by the Bern Convention (Appendix V). The IAS Regulation includes a list of Invasive Alien Species of Union concern, that is regularly updated to include more species, and provides for certain measures to be taken regarding species on the list, including measures to prevent their introduction, detect early their introduction and eradicate them, and manage those that are already established to minimise their impacts.

Many introduced invasive plants can have a wide range of effects on European native flora and fauna, through outcompeting native species, changing local conditions and otherwise affecting native habitats. For example, the introduced invasive Japanese knotweed *Fallopia japonica* often outcompetes native plant species, building up large, dense monodominant stands, shading out understorey plants, inhibiting woody seedling growth and producing allelochemicals that can negatively affect other plant species. Similarly, many non-native invasive animals affect native European plants (see EEA 2012 for examples of the impacts of certain invasive plants and animals).

However, the introduction of certain plant pests and diseases has had particularly devastating consequences for native European flora. The circulation of plant material around the world, for whatever purpose, brings attendant risks associated with the spread of plant pests and diseases. These risks have accelerated as a result of globalisation including increases in global trade and changes in agricultural production systems, and climate change may increase the favourability of new environments for some pathogens. This trend is having a substantial impact upon plants across Europe, including those in both more natural and managed environments. Consequently, EU Plant Health legislation was revised to adopt the 'Plant Health Law' (Regulation (EU) 2016/2031[21]), applicable from December 2019. As part of this legislation a list of the most dangerous, 'priority', pests[22] was established, including those non-native plant pests with the potential to have the most severe economic, environmental or social impacts across the EU (Appendix IV). EU Members States must act to protect the environment and agriculture from these pests by carrying out surveys, communicating with the public and adopting eradication plans for them if they are detected.

There have been several severe and large-scale outbreaks of new plant pests across Europe in recent decades and some have had dramatic impacts upon the environment, landscape and the economy. One example, is ash dieback, caused by the fungus *Hymenoscyphus fraxineus* (Box 3.3.2).

20 https://ec.europa.eu/environment/nature/invasivealien/index_en.htm
21 https://ec.europa.eu/food/plant/plant_health_biosecurity/legislation/new_eu_rules_en
22 https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1570789349853&uri=CELEX:32019R1702

Box 3.3.2.The devastating consequences of ash dieback in Europe

Fraxinus excelsior *trees affected by ash dieback, note the dead tree, dying tree and others showing crown dieback – Dave Lamacraft*

The fungus *Hymenoscyphus fraxineus* causes ash dieback (commonly known as Chalara ash dieback). While it does not cause significant damage to its host trees Manchurian ash *Fraxinus mandshurica* and Chinese ash *F. chinensis* in its native Asian range, it is having a devastating effects on European common ash *F. excelsior* trees and narrow-leaved ash *F. angustifolia* trees following its introduction to Europe in the early 1990s.

European ash trees evolved in the absence of this fungus and have no defence against it, and there appears to be little resistance, with <5% of trees appearing tolerant.

The fungus affects both young and old ash trees, and has moved west across Europe. It was identified in the UK in 2012, although was probably introduced in the 1990s, and has now spread across the country. Ascospores (produced and contained within the ascus of an Ascomycete fungi) are produced from fruit bodies formed on the stalks of leaves on the ground, shed from affected trees in the previous year. Ascospores can then travel in the wind and affect new trees, causing leaves to develop dark patches and discoloration in the summer, followed by wilt, necrosis, and lesions on the shoots and stems. Over time the disease causes dieback of the crown which extends, finally killing the tree. It is considered that 95% of all European ash trees may be infected and die from ash dieback. While spores can transmit the disease several tens of km, movement of infected trees is a key way of transmitting ash dieback to new areas.

It is estimated that ash dieback could cost £15 billion in Britain alone (Hill *et al.* 2019), including the loss of benefits the trees provide through water and air purification and carbon sequestration, and the costs of clearing up dead and dangerous trees.

European ash trees are also threatened by the Emerald ash borer beetle *Agrilus planipennis* from eastern Asia which was first found outside Asia in 2002 in North America where it has now killed tens of millions of ash trees, with associated lost ecosystem services causing estimated economic losses of hundreds of millions of dollars. Emerald ash borer was first confirmed in Europe in Moscow in 2003[23] and continues to move west.

Sources: The Woodland Trust[24] Forest Research[25]

23 https://www.cabi.org/ISC/abstract/20083294946
24 https://www.woodlandtrust.org.uk/trees-woods-and-wildlife/tree-pests-and-diseases/key-tree-pests-and-diseases/ash-dieback/
25 https://www.forestresearch.gov.uk/tools-and-resources/pest-and-disease-resources/ash-dieback-hymenoscyphus-fraxineus/

Good and coordinated regulatory action has already been taken across the EU, and some across Europe more broadly, to monitor and control the introduction, spread and impacts of invasive species. With globalisation and interacting threats, such as climate change, the risks are likely to increase. Effective implementation of existing mechanisms will be essential, as will comprehensive monitoring both of the introduction and spread of non-native species, and of control measures taken to limit or eradicate them. While this will require concerted effort and funding, the costs of inaction would be far higher to the European economy.

3.3.3. Climate Change

Regional variations in temperature and rainfall occur across Europe in both observed climate trends and future climate projections. Temperature increases are projected throughout Europe with increasing precipitation in Northern Europe and decreasing precipitation in Southern Europe. Coastal and river flood risk are projected to increase due to increases in extreme rainfall. High temperature extremes, meteorological droughts and heavy precipitation events are all projected to increase with variations across Europe. The frequency and intensity of heat waves is particularly likely to increase in Southern Europe, along with wildfire risk (Box 3.3.3.). Fires and fire suppression measures are one of the key 'natural systems modifications' considered to threaten plants in analysis of the IUCN European Red List (see Figures 3.2.1 and 3.2.2. above). Evidence suggests that climate change has already had a number of effects on plants (and other taxa) throughout Europe including on distribution, phenology, and abundance, also affecting crop yields and forestry in some places. Climate change is also affecting plant pests and diseases, and disease vectors and hosts. Both the introduction and expansion of non-European invasive species, especially those with high migration rates, is likely to increase.

Himantoglossum robertianum – *Debbie Pain*

Kovats *et al.* (2014) reported on these impacts, adaptation, and vulnerability to climate change in Europe, as a contribution to the IPCC 5th Assessment Report, with details and the confidence associated with various projections.

As a result of climate change impacts, some plants will either have to move or adapt. If they cannot do this quickly enough or face barriers to movement (like habitat fragmentation) or to adaptation (like insufficiently diverse genetic stock), they will go extinct. Plants in certain at risk habitats, like coastal lagoons and associated wetlands, are particularly vulnerable, as are plants in high mountain areas, due to lack of adaptation options. It is highly likely that climate change will continue to affect plants in a variety of ways, with species also moving to new areas. Some species will be more vulnerable than others to the changing temperature and rainfall patterns that result from climate change. Plant resilience is likely to be related to certain physical, physiological or life history characteristics, e.g. those with thicker leaves, deeper roots, higher wood density and efficient water-use strategies may be among the most resilient (Willis 2017).

Thuiller *et al.* (2015) used seven climate change scenarios to project late 21st century distributions for 1,350 European plant species. They found that more than half of these species could be vulnerable or threatened by 2080 and extinction risks could be large even under moderate climate change scenarios. Species from mountains appeared most sensitive to climate change (≈60% species loss). Areas of transition between the Mediterranean and Euro-Siberian regions are expected to experience the greatest changes. Even if society takes all possible actions to reduce greenhouse gas emissions and move to a carbon neutral economy, an action seen by most as imperative for the sustainable future of humankind and the planet, much of the built in effects of previous emissions will remain and adaption will be necessary. The ability to adapt will be greatly enhanced by an understanding of how different components of our ecosystem are likely to respond to a changed and changing climate. A synthesis of some of the information available on plant responses is presented in State of the World's Plants (Willis 2017).

Box 3.3.3. Climate Change, Fire and European Forests

Over a third of the land area of Europe is covered by forests (about 215 million ha) and other wooded lands (36 million ha) and substantial forest fires have repeatedly affected Mediterranean countries, and more recently boreal forests. In 2010 alone, wildfires damaged 0.5 million ha in the forests over the European continent. Many factors contribute to the occurrence of fires, including the moisture content of leaf litter and deeper layers of organic matter, and wind speed. Climate change will reduce fuel moisture levels around the Mediterranean, driving an increased danger of weather-driven forest fires, and areas at moderate danger from forest fires will move further north.

Preliminary observational evidence suggests that some specific areas protected for biodiversity conservation may be affected less by forest fires than unprotected areas, despite containing more combustible material. This could be related to the age, structure and typologies of forests and it is suggested that, as long as other strategies are considered in parallel, increasing the area of protected areas (such as Natura 2000 sites) of specific forest typologies may potentially be an adaptation option. This subject merits further investigation, as do the traits of plant species, and species mixes, that are likely to show the greatest resilience to fire under both current and future bioclimatic habitat patterns. A more in-depth understanding of species resistance, resilience and the habitat suitability of mixtures of forest tree species would improve understanding of how best to conserve forests, and would inform restoration projects.

Source: de Rigo *et al.* 2017.

There is a need to better chart and understand plant responses to climate change, in order to better predict threats and opportunities that result from these and develop appropriate conservation management plans. Some work in this area is already underway (e.g. as presented in SOTWP, Willis 2017). While climate change threatens many plant species, their ability, especially for groups like trees, to sequester carbon highlights the importance of habitat conservation and restoration. A North American study illustrated that adding plant species (increasing the number of plant species) increased the cumulative carbon storage in plant, soil, and ecosystem carbon pools thus highlighting the value of species-rich grassland (Hungate *et al.* 2017). Plants play a key role in both climate change adaptation and mitigation, key areas being carbon sequestration and reduced flood risk. It is important though that the right plant species are planted in the right places, to contribute both to carbon sequestration and biodiversity conservation. There is a continued need to raise awareness of the key role of plant conservation in providing sustainable solutions to the impacts of climate change, both in terms of adaptive management and mitigation.

Tulipa bakeri *on the Omalos plateau, Crete – Debbie Pain*

Future conservation strategies will need to consider, where possible, the complex interactions between climate change and other threats to plants and biodiversity, for example through its impacts on invasive species and plant health, constraints imposed on the types and locations of different types of land use and human population redistribution. It is very likely that in future climate change will cause changes in the populations and distributions of habitats and species, with both local extinctions and continental-scale shifts in species distributions.

Although this could influence the effectiveness of the network of European conservation areas, the extent to which this could happen is not currently known with any confidence. Nevertheless, protected areas are likely to remain key refuges for a wide range of species that have been lost from or severely affected by threats in the wider landscape. Increased habitat connectivity will be an essential response to the threats posed by climate change (and other factors), and specific conservation policies and support mechanisms will be needed to facilitate this.

3.3.4. Emerging threats

Box 3.3.4. Dramatic declines in pollinators

There has been considerable recent concern regarding the massive loss of insects across Europe and elsewhere across the world. A global review of 73 reports of insect species declines (Sánchez-Bayo & Wyckhuys 2019) concluded that the main drivers of decline appear to be habitat loss by conversion to intensive agriculture and urbanisation, followed by agro-chemical pollutants, invasive species and climate change. In Germany, a more than 75 percent decline over 27 years was found in total flying insect biomass in protected areas (Hallman *et al.* 2017). Insects play a key role in pollination, with an estimated almost 90% of wild plants depending upon them (Ollerton *et al.* 2011), along with the majority of leading food crops. In Great Britain the diversity of wild bees appears to have declined in recent decades, as does the abundance of butterflies and moths and the long-term trend of losses of wild plant diversity may indicate patterns of loss in pollinators (Vanbergen *et al.* 2014). However, while some studies have found greater range contractions and decreases in frequency (in field surveys) in plant species dependent on insect pollination relative to those dependent on other modes of pollination (e.g. wind), other studies have not. An additional concern is that at night artificial light can disrupt nocturnal pollination networks with negative consequences for plant reproductive success (Knop *et al.* 2017), although it is clear that much remains to be understood about the impacts of artificial light on pollinators (Bennie *et al.* 2016).

An understanding of the impacts of pollinator losses on plant populations is essential for both the conservation of wild and crop plants. Although it has been suggested that a number of plant communities may be able to function effectively in the absence of some of the pollinator species in an ecosystem, this has seldom been tested empirically in the field. However, one such field experiment in subalpine meadows in the Rock Mountains of Colorado, USA, tested the impacts of removing single pollinator Species, and found a significant decrease in seed production relative to the control site, when a single pollinator species was removed (Brosi & Briggs 2013).This suggests that ongoing pollinator declines could already be having negative effects on some plant populations, and more work is needed to understand the interactions between individual and communities of pollinators and plants. On 1 June 2018, the European Commission acknowledged the urgent need to address pollinator decline and adopted a Communication[26] on the first-ever EU initiative on pollinators. The initiative sets actions under three priority areas: improving knowledge of pollinator decline, its causes and consequences; tackling the causes of pollinator decline; and raising awareness, engaging society-at-large and promoting collaboration.

Echinops ritro *ssp.* ruthenicus *– Erika Penzesné Kónya*

Annual horizon scans of emerging issues likely to be of relevance for global conservation have been undertaken and published for over a decade. In their most recent analysis, Sutherland *et al.* (2020) include several issues that could substantially affect plant conservation. Two of these relate to the increasing demand for wood and wood products. There is a rapidly increasing global demand for nanocellulose, derived from trees, which can be used to produce a wide range of products including packaging and construction materials. While the resulting increased demand for wood could increase tree planting, boost carbon stocks temporarily and replace plastics, if not properly regulated it could cause additional forest and associated biodiversity loss if mature trees are harvested and monocultures replace natural systems. Within the EU, demand for wood will additionally increase because the EU Renewable Energy Directive of 2018[27] treats wood as a renewable energy source, even that from biologically diverse forests, and the EU has pledged to double the 2015 renewable energy levels in Europe by 2030. Such commercialisation of forest biomass could increase loss of primary and other biodiverse forests and exacerbate climate change. Sutherland *et al.* (2020) also highlighted risks to biodiversity associated with the decline of the kelps (brown algae - Laminariales) found around about 25% of coastlines, that have high primary productivity and provide complex habitats for many species. Kelps are declining and could be affected by many potential drivers of decline including climate change, non-native invasive species, eutrophication, and harvesting. Should kelp declines continue and complex kelp systems be replaced by simple macroalgal systems this would significantly affect biodiversity and ecosystem processes, with potentially substantial costs to the coastal communities and fisheries.

26 https://ec.europa.eu/environment/nature/conservation/species/pollinators/index_en.htm
27 https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018L2001&from=EN

4. Development of the Global Strategy for Plant Conservation

In August 1999, thousands of botanists from across the world convened at the XVI International Botanical Congress in St Louis, Missouri, U.S.A. to highlight the urgent loss of the world's plant diversity and continuing threats. The participants recognised the dependence of humanity upon the services provided by flora globally, and that risks to our plant species also put at risk our ability to maintain a healthy planet supporting sustainable and happy livelihoods for future generations. This was noted in a resolution from the congress that also called for the exceptional importance of plant conservation to be recognized as a global priority for biodiversity conservation. As a consequence, a group of organisations from 14 countries met in Gran Canaria, Spain, in April 2000 and concluded that a Global Strategy for Plant Conservation (GSPC), and an implementation programme, were urgently needed within the framework of the United Nations Convention on Biological Diversity (The Gran Canaria Declaration 1999)[28] (see Appendix III for history). A subsequent decision in 2000 at CBD COP 5 (United Nations Convention on Biological Diversity Conference of the Parties) resolved to consider this and at CBD COP6 in 2002 the first GSPC was adopted (Decision VI/9), with 16 accompanying outcome-orientated targets aimed at achieving measurable goals by 2010. The GSPC was considered to provide a framework for activities, some of which were already under way or envisaged in existing initiatives.

Organisations within the European region were proactive in advancing the global plant conservation agenda. At the third Planta Europa European conference on the conservation of wild plants (June 2001 Průhonice, Czechia) the First European Plant Conservation Strategy (EPCS), 2002-2007, was developed, by Planta Europa[29] and the Council of Europe (Planta Europa and the Council of Europe, 2002), as a contribution to, and part of, the proposed Global Strategy for Plant Conservation, submitted to CBD COP 6 in 2002 (UNEP/CBD/COP/6/INF/22). This strategy was subsequently updated and the 'A Sustainable Future for Europe: the European Strategy for Plant Conservation 2008–2014' was published in 2008 and provided a regional contribution to the implementation of the GSPC (circulated at CBD COP 9; Planta Europe 2008). This second European Strategy for Plant Conservation (ESPC) included a range of specific targets (Appendix II), nested within the GSPC 2002 targets. Mid-term reviews of the European strategies were conducted (Planta Europa and Plantlife International 2005; 2012), and the second ESPC has been extended until 2020 to correspond with the timeframes of relevant International Agendas.

At CBD COP 10 (Nagoya, Japan) a consolidated update of the Global Strategy for Plant Conservation was adopted, including revised outcome-oriented global targets for the period 2011-2020 (Appendix I). It was also decided that implementation of the Strategy should be part of the broader framework of the Strategic Plan for Biodiversity 2011-2020. A mid-term assessment of progress towards the implementation of the Strategic Plan for Biodiversity 2011-2020 was conducted and published in October 2014 (Global Biodiversity Outlook 4) accompanied by a companion document 'Plant Conservation Report 2014: a review of progress towards the Global Strategy for Plant Conservation 2011-2020'. Sharrock *et al.* (2014) reviewed progress towards the 16 targets of the GSPC and found that while actions were underway, progress had generally been too slow to fully achieve the targets by 2020. Insufficient information was available on the distribution and conservation status of plants, both *in situ* and *ex situ* and financial and botanical capacity for plant conservation were decreasing in parallel with increasing threats. In a more recent review of progress, Sharrock (2019) found that while progress had been made towards most of the targets, only Target *1: An online flora of all known plants,* was likely to be achieved, and little progress had been made towards *Target 10: Effective management plans in place to prevent new biological invasions and to manage important areas for plant diversity that are invaded.*

The objective of the current report is to review progress made in the European region towards the 2011-2020 GSPC targets. While not specifically addressed, this has an obvious bearing on the 2008-2014 (extended to 2020) ESPC targets.

Pulsatilla grandis - *Erika Penzesné Kónya*

28 A table of history and milestones in the development of the Global Strategy for Plant Conservation and the European contribution, along with weblinks is provided in Appendix III

29 Planta Europa https://www.plantaeuropa.com/ is a network of organisations, non-governmental, scientific and governmental, working together to conserve European plants and fungi. In the early 2010s, Planta Europa had 78 members in 35 countries. Plantlife International hosted the Secretariat of Planta Europa, today hosted by the National Museum of Natural History, Paris-FRANCE.

5. European Progress on delivering the targets of the GSPC 2011-2020

5.1. Methods

Orchis simia – *Sébastien Filoche*

Implementation responses to the GSPC have varied among countries. These range from the development of national plant conservation strategies or responses (e.g. Ireland[30]), roadmaps (e.g. Austria[31]), coordinated networks of organisations that deliver and report on progress with the GSPC targets (e.g. the UK[32]) and other ways of guiding GSPC implementation[33] and charting progress. Some countries have set national targets to contribute to all or some of the GSPC targets, other have adopted national biodiversity conservation strategies that incorporate some of the GSPC targets, and some countries have adopted GSPC targets within sectoral or cross-sectoral strategies (see national reports to CBD[34]). Irrespective of the national mechanisms used, the GSPC has driven considerable progress across Europe towards delivering on some or all of the targets, at least in some sectoral responses and sometimes across nations. It has also stimulated considerable international collaboration.

This report was compiled between January and May 2020, and draws extensively on information that was available in advance of January 2020. This includes the 6th National Reports[35] submitted by European nations to the CBD supplemented by other sources, such as reporting under Article 17 of the EU Habitats Directive (Box T7.1; Appendix V). Reporting on the GSPC targets within the 6th National Reports is voluntary. Thirteen countries reported on progress with GSPC targets using the Red/Amber/Green system of denoting progress where 'Green' denotes being on track to achieve the target at a national level, 'Amber' denotes progress being made towards the target at national level but at an insufficient rate, and 'Red' denotes a lack of progress towards achieving the target at a national level. These reported national scores have been collated for all of the GSPC targets in the progress reports below. In addition, a number of countries provided text reports on the GSPC targets, but did not rate progress. Some other countries did not report on the targets, but mentioned relevant information elsewhere in their 6th Reports.

In compiling the current report, we have primarily focussed on results from those countries that specifically reported on GSPC targets. Under the 'National Progress' sections of this progress report we have drawn relevant examples from the 6th National Reports, and have supplemented these with case studies from published and grey literature, and some additional information provided by experts from Hungary, Republic of Moldova, Norway, Poland and Ukraine in response to an information request. Case studies presented are aimed at illustrating particular issues (positive or negative) and do not imply that the country concerned is the only country with similar issues. We have attempted to present a broad geographical and issue-based spread of case studies, but have not presented examples from all countries. Specific sources are referenced in the text where examples do not originate from the 6th National Reports or supplementary information from country experts[36].

We have also drawn on major recent reviews of the status of plants or of the European environment. In particular these include:

- Bilz *et al.* 2011. European Red List of vascular plants. IUCN
- RBG Kew 2016. The State of the World's Plants Report – 2016
- Willis, K.J. (ed.) 2017. State of the World's Plants 2017, RBG Kew
- Sharrock, 2019. A review of progress towards the Global Strategy for Plant Conservation 2011-2020 Draft 3 November 2019.
- IPBES 2018: Summary for policymakers of the regional assessment report on biodiversity and ecosystem services for Europe and Central Asia of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services.
- EEA 2019. The European environment —state and outlook 2020. Knowledge for transition to a sustainable Europe. European Environment Agency
- Rivers *et al.* 2019. European Red List of Trees. IUCN.
- Hodgetts *et al.* 2019. A miniature world in decline: European Red List of mosses, liverworts and hornworts. IUCN.
- State of the World´s Fungi 2018[37]

The GSPC targets link in with many of the headline 'Aichi targets[38]' that sit under the five strategic goals of the CBD Strategic Plan for Biodiversity 2011-2010. They also contribute significantly to the 2030 Agenda for Sustainable Development, adopted by all United Nations Member States in 2015, particularly Sustainable Development Goal (SDG) 12 on sustainable production and consumption, and SDG 15, on the protection, restoration and sustainable use of terrestrial ecosystems, and halting of biodiversity loss. Progress with goal 15 in 2019 can be found here:

https://sustainabledevelopment.un.org/sdg15

To facilitate the use of this report a reference list is provided at the end of each section on a specific GSPC target, in addition to a full reference list at the end of the report. Hyperlinks are provided to web pages where possible, and web pages were accessed between 5th January and the end of April 2020 to prepare this report.

30 http://botanicgardens.ie/2019/04/09/irelands-national-strategy-for-plant-conservation-progress-to-2020/
31 http://www.biologischevielfalt.at/ms/chm_biodiv_home/chm_strat_arterhaltung/chm_gspc_/
32 https://www.plantlife.org.uk/uk/our-work/working-partners/plantlink
33 https://www.jstor.org/stable/23044616?seq=1
34 https://www.cbd.int/reports/
35 https://www.cbd.int/nr6/

36 To avoid constant repetition we do not reference the 6th National Reports of individual countries when they are mentioned, e.g. under national progress in section 5, but simply mention the country. All information on the GSPC targets reported by individual countries can be found at https://www.cbd.int/nr6/
37 https://stateoftheworldsfungi.org/
38 https://www.cbd.int/sp/targets/

5.2. European progress towards the GSPC targets

5.2.1. Objective I: Plant diversity is well understood, documented and recognized

Target 1: An online flora of all known plants

Much of the recent knowledge about plant diversity comes from The International Plant Names Index[39], the World Checklist of Selected Plant families[40], Tropicos[41] and The Plant List[42] and at European level the Euro+Med PlantBase[43].

Much of the recent knowledge about fungal diversity comes from the three main fungal taxa registration depositories Index Fungorum, MycoBank and FungalNames.

Responding to Target 1 of the GSPC on how best to meet the need for "An online flora of all known plants" by 2020 was discussed in January 2012 in St Louis, Missouri, U.S.A., by representatives from: the Missouri Botanical Garden, the New York Botanical Garden, the Royal Botanic Garden Edinburgh, and the Royal Botanic Gardens, Kew (all members of the Global Partnership for Plant Conservation - GPPC[44]). A proposal for a World Flora Online (WFO) resulted, and an international consortium of institutions and organisations[45] collaborate to populate the database. The Consortium now includes over 40 participating institutions and organisations worldwide. The World Flora Online[46] database is an open-access, online and searchable database of all known plant species and aims to become the primary curated global source of information on the world's plant diversity. It draws extensively on information collected for The Plant List which provided the initial taxonomic backbone for World Flora Online. This taxonomic backbone is now being updated by taxonomic experts, of which a range of networks (Taxonomic Expert Networks -TENs) are being formed.

The naming and counting of plant species requires a continuous international effort. New species are identified every year, about 2,000 globally, and are categorised by their physical and molecular features, and their resemblance to already-described plant species (Willis *et al.* 2017). Since 2012 great efforts have been made to bring together verified information from floristic accounts worldwide and present them in a carefully synthesized way through the WFO public portal. To date (September 2020), the World Flora Online includes the following information: 1,325,205 plant names; 350,634 accepted species names; 56,141 Illustrations; 437,915 descriptions; 129,179 distributions and 1,382,149 references. New data from many parts of the world are being constantly added and the WFO Consortium is committed to continuing to develop the World Flora Online beyond the achievement of this 2020 GSPC target. While the World Flora Online builds upon a considerable amount of existing information, much effort is still required to collect new information on poorly known plant groups, and on all plant groups from parts of the world that are not well investigated.

39 http://www.ipni.org
40 http://apps.kew.org/wcsp/
41 https://www.tropicos.org/home
42 http://www.theplantlist.org/
43 http://www.emplantbase.org/home.html
44 https://www.plants2020.net/gppc A partnership of international, regional and national organisations that contributes to the implementation of the GSPC.
45 http://about.worldfloraonline.org/partnerorg.shtml
46 http://www.worldfloraonline.org/

Box T1.1. Contributions of European organisation to flora beyond the European region

In some countries collaborative projects exist to enable the production of national or regional flora beyond the European region. One of several examples is **Belgium**, where the Meise Botanic Garden (an active member of the World Flora Online consortium), contributes to work on both Belgian and Central African Plant species, including through coordinating the production of the Flore d'Afrique Centrale, which will include c. 11,000 species of vascular plants, with 6,500 species already covered. The Flora is due to be completed in 2028. Working with Naturalis Biodiversity Center at Leiden, the Netherlands, Meise Botanic Garden also coordinates the production of Flore du Gabon. This will include c. 5,000 vascular plant species, with 3,300 already covered and the Flora due in 2023.

Box T1.2. Macromycete distribution database and national Red List assessment in Austria

In several European countries recent databases on fungal distribution maps exist (e.g. Albania, Austria, Denmark, Finland, Germany, Netherlands, Norway, Poland, Portugal, Sweden, Switzerland, UK) and also rather recent Red Lists on Fungi are available (e.g. Austria, Croatia, Germany, North Macedonia, Netherlands, Norway, Poland, Portugal, Sweden, Switzerland).

In Austria, there are an estimated 16,640 fungal species. However, many of these species have not yet been recorded due to a lack of experts and funding for certain fungal groups. The situation is somewhat better for macromycetes. A checklist of macromycetes is available since 2017 (Dämon & Krisai-Greilhuber 2017). It contains basidiomycetes (except rust and smut fungi) and discomycetes (Pezizales), in total 4,450 taxa. It is based on the online open access Datenbank der Pilze Österreichs with 475,000 fungal records from 13,650 localities from 440 data sources. Less than 1,000 species (21%) are "frequent to very frequent", ca. 1,700 species (38%) "widespread to moderately frequent", ca. 1,300 species (30%) "rare" and almost 500 species (11 %) are only known from one single record. The Red List of threatened fungi in Austria is integrated into the checklist. Of the 4,450 species, ca. 1,300 species (= 29%) are vulnerable, endangered, critically endangered or regionally extinct, while 790 (= 17%) are near threatened. The Red List thus comprises a total of 2,086 species (= 46%). The main risk factors for Austria's fungal species are eutrophication, destruction of habitats, reduced ecological value of habitats, random events and effects of climate warming.

National implementation[47]

Target 1

Over half of the countries that provided reports and scored GSPC targets were on track to achieve target 1 and all countries reported progress with implementing this target. Active networks for plant conservation incorporate a wide range of organisations, both governmental and non-governmental. In many countries, universities, museums of natural history and botanical gardens play a key role in taxonomic work and collation of data. Numerous online databases and checklists of flora are available. Many organisations, particularly botanic gardens, also contribute to developing the lists of flora for countries or regions beyond Europe (e.g. Box T1).

Target 1 – issues to consider

Delivery across Europe against this target has been good. The World Flora Online provides a database for all known plant species that effectively delivers this target. However, even in countries with some of the most studied and documented flora in the world, significant knowledge gaps remain and much needs to be done to develop the description of difficult taxonomic groups or genus, and to describe new species. In a review of the UK's contribution towards the 2020 GSPC targets (Plantlife 2014), gaps in knowledge of fungi were evident (Figure T1). In addition to some taxa being less well studied, the constant rediscovery of plants, ongoing research that results in taxonomic revisions, and gaps in knowledge about the plant species present in some parts of Europe mean that delivery and maintenance of '*an online flora of all known plants*' will continue to be an ongoing process, not only across Europe but globally. Key issues to consider are:

- Increased effort in compilation of national flora (and especially fungi and lichens) from European countries and regions where information is less complete
- There is a significant need in Europe for more digitisation of plant lists and Floras for inclusion in online databases, including World Flora Online
- The importance of ongoing taxonomic research to ensure that all plants, including groups that are taxonomically difficult to describe, can be identified, classified and tracked across space and time

47 Pie charts presented at the start of 'National Implementation' sections for each of the GSPC Targets refer to progress reported in the 6th National Reports. 'Green' denotes being on track to achieve the target at a national level, 'Amber' denotes progress being made towards the target at national level but at an insufficient rate, and 'Red' denotes a lack of progress towards achieving the target at a national level.

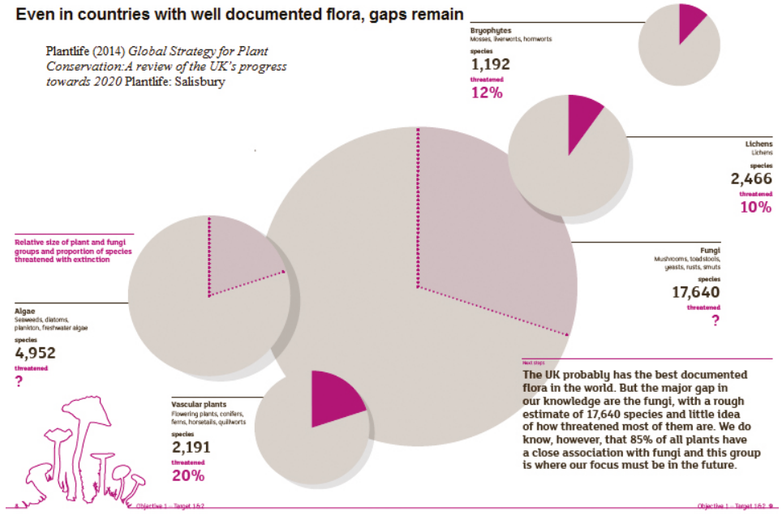


Figure T1. Proportion of plant groups that are threatened in UK with data gaps.

References

Dämon, W., Krisai-Greilhuber, I., 2017: Die Pilze Österreichs. Verzeichnis und Rote Liste 2016. Teil Makromyzeten. – Wien: Österreichische Mykologische Gesellschaft. 608 Seiten.

Österreichische Mykologische Gesellschaft, 2017: Datenbank der Pilze Österreichs. Bearbeitet von Dämon, W., Hausknecht, A., Krisai-Greilhuber, I. - www.austria.mykodata.net

Willis, K.J. (ed.) 2017. *State of the World's Plants 2017.* Report. Royal Botanic Gardens, Kew.

Target 2: An assessment of the conservation status of all known plant species, as far as possible, to guide conservation action

A global initiative to help measure progress towards Target 2 is the 'ThreatSearch[48]' database, set up by Botanic Gardens Conservation International (BGCI) in collaboration with the National Red List and the Royal Botanic Gardens, Kew. ThreatSearch aims to provide a global, searchable database of all known conservation assessments of plants and thus provide a one-stop shop. ThreatSearch lists regional and national red list assessments as well as IUCN global (the Red List) assessments. It lists conservation assessments from a variety of sources. NatureServe and CNCFlora are also significant contributors to the project and both new and older non-digitised sources are being added to the database.

48 www.bgci.org/threat_search.php

European Progress

Dracunculus vulgaris – *Debbie Pain*

IUCN evaluates the extinction risk of large numbers of plant and animal species across the world using a set of quantitative criteria. The IUCN Red List of Threatened Species™ is thus recognised as the world's most comprehensive inventory of the global conservation status of plant species, and IUCN assessments have also been recently developed regarding the risk of ecosystem collapse. The IUCN Red List approach provides the scientific basis that underpins many of the CBD indicators adopted to monitor progress towards the achievement of the GSPC and Aichi Targets. IUCN Red Lists are also used by national government agencies across the world to help guide national conservation policies, such as National Park regulations.

There are considered to be more than 30,000 vascular plant taxa in Europe (Allen *et al.* 2014 from Euro+Med 2006-2014). Several regional European assessments have added to knowledge of the conservation status of European plants over the last decade, including:

- The European Red List of Vascular Plants (Bilz *et al.* 2011) which assessed the European conservation status of 1,826 selected species native to Europe or naturalised before AD 1500.
- The European Red List of Medicinal Plants (Allen *et al.* 2014) which assessed the European conservation status of 400 vascular plant species from ninety families, including large trees, aquatic plants and epiphytes.
- The European Red List of Lycopods and Ferns (García Criado *et al.* 2017) which assessed the European conservation status of all 194 species.
- The European Red List of Trees (Rivers *et al.* 2019) which assessed the European conservation status of all of Europe's 454 native tree species.
- A miniature world in decline: European Red List of mosses, liverworts and hornworts. IUCN (Hodgetts *et al.* 2019) which assessed the European conservation status of all of Europe's 1,817 species of bryophyte.
- The European Red List of selected endemic shrubs (Wilson *et al.* 2019) which assessed the European conservation status of 262 species.
- European Red List of Habitats.

Section 3.2 gives the proportion of assessed plants in Europe listed as regionally or globally threatened. IUCN Red List assessments are available for only a small proportion of plants across Europe, and these include many of the species most likely to be of poor conservation status. For example, species selected for the European Red List of Vascular Plants assessment included those listed under various policy instruments[49] thus had probably already been identified as being of poor conservation status. Several groups however have been assessed in their entirety. These include Europe's tree species which are particularly threatened with over half of those being endemic to Europe assessed as threatened (Box T2.1). Similarly, Europe's lycopods and ferns and bryophytes (Box T2.2) have been assessed.

Pyrus gergerana – *Anna Asatryan*

While IUCN criteria-based assessments of the conservation status of plants is essential for identifying species at risk and highlighting threats and appropriate conservation actions, the resource-intensive nature of assessments mean that they cannot be conducted as rapidly as needed. Consequently, scientists have searched for predictors of extinction risk to see if it is possibly to make generalisations about those taxa most likely to be at risk, based upon their traits (be they morphological, physiological or other traits). Willis (2017) reported on a preliminary analysis of 204 threatened or near-threatened monocotyledon plant species and 120 possible trait–threat combinations. Seven significant interactions were found, including between epiphytes and biological resource use, probably reflecting the horticultural trade in epiphytic monocotyledons including orchids and bromeliads. Causes of some of the interactions found were less obvious, such as that between single-seeded species and pollution threat. While more work needs to be conducted to understand both why and how certain traits are linked to extinction risk, this could help with plant conservation prioritisation.

Philonotis calcarea – *Olivier Bardet*

49 Including plants listed under European (Appendix V) or global policy instruments such as the Habitats Directive, Bern Convention, Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and the EU Wildlife Trade Regulation, along with crop wild relatives (CWR) of priority crops and aquatic plant species.

Box T2.1. The European Red List of Trees

In 2019 the European Red List of Trees was published (Rivers *et al.* 2019). This reviewed the conservation status of all of Europe's native species of tree according to IUCN regional Red Listing guidelines. This analysis was part of the Global Tree Assessment initiative[50], led by BGCI and the IUCN Species Survival Commission (SSC) Global Tree Specialist Group which aims to provide conservation assessments of all the world's tree species by 2020.

Over half (58%) of Europe's endemic tree species are threatened

Of Europe's 454 native tree species, 168 are regionally threatened with extinction with a further 57 species classified as Data Deficient (DD), with additional research needed before a conservation status can be assigned. Overall about 42% of native tree species are estimated to be threatened (taking account of possible conservation status of DD species). Almost all threatened tree species (155) are endemic to the European region. Invasive or problematic species were identified as the main threat, affecting 38% of tree species, followed by deforestation and wood harvesting, and urban development, which both affected 20% of tree species. Threatened tree species were particularly affected by livestock farming, land abandonment, changes in forest management, fire and other ecosystem modifications.

***Sorbus* – a particularly vulnerable genus**

Trees in the *Sorbus* genus are particularly threatened. Of 170 native *Sorbus* species found in Europe more than three quarters are threatened: 57 species are Critically Endangered, 48 Endangered and 24 Vulnerable with a mere 19 of the more widespread species being Near Threatened or of Least Concern and 22 species Data Deficient. Europe is one of the centres of diversity of *Sorbus* species with many species being restricted to only one country. The often small populations of *Sorbus* species are frequently vulnerable to threats including succession to tall woodland, deforestation or selective forestry, quarrying and grazing (Rich, T. in Rivers *et al.* 2019).

Source: Rivers *et al.* 2019

50 https://www.bgci.org/plant-conservation/globaltreeassessment/

Box T2.2. Key results from the European Red List of Mosses, Liverworts and Hornworts (bryophytes)

Polytrichum piliferum - *Erika Penzesné Kónya*

In September 2019, the European Red List of Mosses, Liverworts and Hornworts (collectively known as bryophytes) was published (Hodgetts *et al.* 2019). This included assessments of all 1,817 species of bryophyte native to or naturalised in Europe. The assessment was continent-wide, from Iceland in the west to the Urals in the east (including European parts of the Russian Federation), and from Franz Josef Land in the north to the Mediterranean in the south. The Canary Islands, Selvagens, Madeira, the Azores, Malta and Cyprus were also included. In the southeast, the Caucasus region and Anatolia are excluded.

At the European level, 22.5% of species are considered threatened (i.e., assessed as having an elevated risk of extinction). As a number of species are Data Deficient, the actual percentage that are threatened will lie between 21.4% (if all DD species are not threatened) and 26.6% (if all DD species are threatened).

The European analysis assessed that:

- 6 species (0.3%) were Regionally Extinct
- 2 endemic species (0.1%) were Extinct
- 59 species (3.3%) were Critically Endangered
- 143 species (8%) were Endangered
- 180 species (10%) were Vulnerable

Source: Hodgetts *et al.* 2019

National implementation

Target 2

National Red Lists or Red Data Books of vascular plant species published over the last 10 years (2010-2019) are available for the following countries: Albania (Government of Albania, 2013), Armenia (Tamanyan *et al.*, 2010), Belarus (Kachanovskiy *et al.*, 2015), Bosnia and Herzegovina (Đug *et al.*, 2013; Anon., 2012), Bulgaria (Peev *et al.*, 2015), Czech Republic (Grulich, 2012), Finland (Rassi *et al.*, 2010), France (UICN France *et al.*, 2012; 2019[51]), Ireland (Wyse Jackson *et al.*, 2016), Italy (Rossi *et al.*, 2013), Republic of Moldova (Duca *et al.*, 2015), Norway (Henriksen &

51 Updated 2019 https://uicn.fr/liste-rouge-flore/

Hilmo, 2015), Poland (Kaźmierczakowa *et al.* 2016), Slovakia (Eliáš *et al.*, 2015), Spain (Bañares *et al.*, 2010), Sweden (ArtDatabanken, 2015).

References mainly extracted from Rivers *et al.* 2019, from which please see full references.

Many other countries have National Red Lists or Red Data Books published prior to 2010[52]. The Netherlands has a more recent proposed Red List (Sparrius *et al.* 2014) and other countries have work underway and due for publication in the near future (e.g. Portugal[53] and Sweden[54]). National Red Lists of ecosystems are also available, i.e. in France with the Mangroves of Mayotte, the Mediterranean forest and the Mediterranean costal ecosystem.

Target 2 – issues to consider

- IUCN conservation assessments are available for only about 10-20% (global or regional assessments) of plants across Europe, including some species likely to be of poor conservation status. While the European conservation status of particular groups has been assessed comprehensively, e.g. lycopods and ferns, trees and bryophytes (García Criado *et al.* 2017; Rivers *et al.* 2019; Hodgetts *et al.* 2019), data are lacking for others.

Grossheimia ahverdovii – *Anna Asatryan*

- There has been little regional (European) conservation as¬sessment of fungi and there is insufficient knowledge of their ecology, distribution and status. This is despite their high spe¬cies richness, and the critical role that they play in the envi¬ronment. A list of threatened fungi has previously been pro¬posed as candidates for addition to Appendix I of the Bern Convention (Dahlberg and Croneborg 2003) and it is important that fungi are considered in nature conservation agreements. Although national assessments exist for all or most plants and some fungi in certain countries, gaps remain, for example in the assessment of bryophytes, lichens, fungi and algae.
- Both at national and EU levels, many species assessed remain Data Deficient and more work is needed to assess their conservation status. Additional work investigating predictors of extinction risk based upon species traits would be useful.
- While GSPC Target 2 specifically considers the conservation status of plant species, in a complementary approach the conservation status of European habitats has been reviewed and a European Red List of Habitats[55] produced. This covers all natural and semi-natural terrestrial, freshwater and marine habitats, highlighting the pressures they face (Gubbay *et al.* 2016; Jannsen *et al.*, 2016). As habitat degradation is often a precursor to species decline, the identification of threatened habitats and implementation of measures to conserve them could potentially help avert or reduce plant species declines and conservation measures for habitats and species can be synergistic.
- Further extending this approach, there is also a Red List Process for Ecosystems[56] which assesses whether an ecosystem is not facing imminent risk of collapse, or whether it is vulnerable, endangered, or critically endangered. Several national assessments have been produced for ecosystems in European countries and more work is needed to evaluate the risk of collapse of additional ecosystems.

52 Austria (Niklfeld & Schratt-Ehrendorfer, 1999), Belgium (for Flanders; Van Landuyt *et al.*, 2006), Croatia (Nikolić & Topić, 2005), Cyprus (Tsintides *et al.*, 2007), Denmark (NERI, 2007), Estonia (Lilleleht, 2008), France (Olivier *et al.*, 1995) Germany (Ludwig & Schnittler, 1996), Great Britain (Cheffings & Farrell, 2005), Greece (Phitos *et al.*, 1995), Hungary (Király, 2007), Iceland (Náttúrufræðistofnun Islands, 1996,; Náttúrufræðistofnun Íslands, 2008), Latvia (Andrušaitis, 2003), Liechtenstein (Broggi *et al.*, 2006), Lithuania (Rašomavičius, 2007), Luxembourg (Colling, 2005), Malta (Lanfranco, 1989), the Netherlands (Van der Meijden *et al.*, 2000), Poland (Mirek *et al.*, 2006), Romania (Dihoru & Negrean, 2009), Russian Federation (Trutnev *et al.*, 2008), Serbia (Stevanović, 1999), Slovenia (Skoberne, 1996), Switzerland (Moser *et al.*, 2002) and Ukraine (Didukh, 2009) (references pre and post-2010 extracted from Rivers *et al.* 2019, from which please see full references).

53 https://listavermelha-flora.pt/projeto/

54 https://www.artdatabanken.se/en/the-red-list/

55 https://ec.europa.eu/environment/nature/knowledge/redlist_en.htm

Box T2.3. European Diploma for Protected Areas

Nature conservation has very wide implications. It encompasses the protection of natural and semi-natural areas and landscapes, the protection of flora and fauna, the sustainable management of all of these resources. This places responsibilities on all governments and communities to develop appropriate sectoral policies, provide education and make information available to everyone.

The Council of Europe is active in all these domains, particularly with regard to the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention).

The European Diploma for Protected Areas was instituted by the Council of Europe in 1965 as a mean of granting recognition to certain areas for the quality of their protection and conservation. This implies that there are measures to ensure the continuation of this protection in the long term and establishes methods to monitor the state of conservation.

Although the conditions for the European Diploma's award are strict, it can be applied to a wide variety of areas. It is only granted to natural or semi-natural areas or landscapes which are judged to have exceptional European interest, from the standpoint of conserving biological, geological or landscape diversity. A European Diploma for Protected Areas can be held by any of the Council of Europe's member and observer States. Appropriate protection systems, however, must be in place for the area's scientific, cultural and aesthetic interest.

The nature of protection varies considerably between European Diploma areas. There are national parks established by countries' highest authorities, regional parks answerable to local authorities, reserves run entirely by private associations and areas in which a mosaic of different forms of protection apply. In every case, however, the long-term conservation of natural features and landscapes must be guaranteed and managed accordingly in an exemplary manner.

Source: Council of Europe, 2020[57]

56 https://www.iucn.org/theme/ecosystem-management/our-work/red-list-ecosystems

57 https://www.coe.int/en/web/bern-convention/european-diploma-for-protected-areas

References

Allen, D., Bilz, M., Leaman, D.J., Miller, R.M., Timoshyna, A. *et al.* 2014. European Red List of Medicinal Plants. Luxembourg: Publications Office of the European Union.

Bilz, M., Kell, S. P., Maxted, N. & Lansdown, R. V. 2011. European Red List of vascular plants. IUCN Luxembourg: Publications Office of the European Union. https://portals.iucn.org/library/sites/library/files/styles/publication/public/book_covers/BC-RL-4-016.jpg

Dahlberg, A. and Croneborg, H. 2003. 33 threatened fungi in Europe. Complementary and revised information on candidates for listing in Appendix I of the Bern Convention. A document compiled for EU DG Environment and the Bern Convention Secretariat by Anders Dahlberg and Hjalmar Croneborg at the Swedish Species Information Centre on behalf of the Swedish Environmental Protection Agency (EPA) and the European Council for Conservation of Fungi (ECCF). https://www.researchgate.net/publication/248581348_33_Threatened_Fungi_in_Europe

Euro+Med. 2006-2014. Euro+Med PlantBase – the information resource for Euro-Mediterranean plant diversity. Accessed on 12 August 2014 by Allen *et al* 2014: http://ww2.bgbm.org/EuroPlusMed/.

García Criado, M., Väre, H., Nieto, A., Bento Elias, R., Dyer, R., *et al.* 2017. European Red List of Lycopods and Ferns. Brussels, Belgium: IUCN.

Gubbay, S., Sanders, N., Haynes, T., Janssen, J.A.M., Rodwell, J.R. *et al.* 2016. European Red List of Habitats. Part 1. Marine habitats. European Union 2016. ISBN 978-92-79-61586-3. doi: 10.2779/032638.

Hodgetts, N., Cálix, M., Englefield, E., Fettes, N., García Criado, M. *et al.* 2019. A miniature world in decline: European Red List of Mosses, Liverworts and Hornworts. Brussels, Belgium: IUCN.2019. https://portals.iucn.org/library/node/48520

Janssen, J.A.M., Rodwell, J.S., García Criado, M., Gubbay, S., Haynes T. *et al.* 2016. European Red List of Habitats. Part 2. Terrestrial and freshwater habitats. European Union 2016. ISBN 978-92-79-61588-7. doi: 10.2779/091372.

Kaźmierczakowa R., Bloch-Orłowska J., Celka Z., Cwener A., Dajdok Z., Michalska-Hejduk D., *et al.* 2016. Polska czerwona lista paprotników i roślin kwiatowych. Polish red list of pteridophytes and flowering plants. Ss. 44. Instytut Ochrony Przyrody Polskiej Akademii Nauk, Kraków. ISBN 978-83-61191-88-9.

Sparrius, L.B., Odé, B. and Beringen R. 2014. Basisrapport Rode Lijst Vaatplanten 2012 volgens Nederlandse en IUCN-criteria. FLORON Rapport 57. FLORON, Nijmegen. DOI: 10.13140/RG.2.2.19320.9600.

Rivers, M.C., Beech, E., Bazos, I., Bogunić, F., Buira, A. *et al.* 2019 European Red List of Trees. Cambridge, UK and Brussels, Belgium: IUCN. viii + 60pp.

Tamanyan, K., Fayvush, G., Nanagyulyan, S. and Danielyan, T. (eds.) 2010. The Red Book of Plants of the Republic of Armenia. Higher Plants and Fungi. Yerevan: Zangak-97 Publishing House. 591 pp

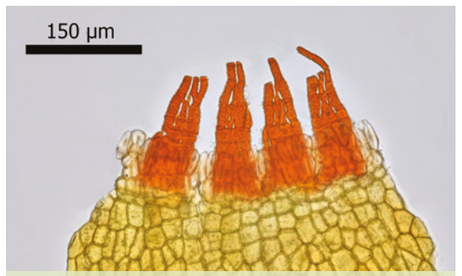
Wilson, B., Beech, E., Window, J., Allen, D.J. and Rivers, M. 2019. European Red List of selected endemic shrubs. Brussels and Cambridge: IUCN

Willis, K.J. (ed.) 2017. State of the World's Plants 2017. Report. Royal Botanic Gardens, Kew.

Target 3: Information, research and associated outputs, and methods necessary to implement the Strategy developed and shared

To effectively conserve plant diversity and ensure its sustainable use it is essential that the information, research methods and technology necessary to implement the strategy are developed and shared, both within and among nations. This will enable use of the most up to date and appropriate methods and expertise. Readily accessible information and expertise also helps reduce duplication of effort, of particular importance as human and financial resources are often very limited. Target 3 is a cross-cutting target that promotes the generation of new knowledge to fill information gaps (largely identified under other targets in this progress report), and the sharing of information.

Grimmia orbicularis - *Olivier Bardet*



Grimmia crinita - *Olivier Bardet*

There is a long history of plant research across Europe and much information is available to support conservation initiatives. However, some of this remains unpublished or is poorly accessible. Target 3 encourages the development and sharing of best practice in plant research and conservation methods across the global community.

Target 3 is cross-cutting and examples of the development and sharing of research outputs and methods are given throughout this report. Data and research gaps and knowledge exchange needs for the effective delivery of plant conservation have been highlighted in the discussion (section 6).

European Progress

Many different information sharing mechanisms have been used and activities undertaken as part of this target globally. Numerous universities, natural history museums, botanic gardens and other research institutes across Europe play an essential role in both conducting the research and sharing the information necessary to deliver the GSPC (Box T3.2.).

One initiative, developed by BGCI, is the Plants 2020[58] website which provides a platform for sharing the experiences of GPPC members. This website contains a variety of information, including how to implement the individual targets of the GSPC and links to tools and resources that can help. Some national and regional responses to the GSPC have been posted, including those from Austria, France, Ireland, and the UK, along with the European regional response, the European Plant Conservation Strategy, which is one of the most developed of regional responses.

58 www.plants2020.net

Botanical gardens across Europe play a key role in research, plant conservation, horticulture and information sharing, often in collaboration with universities and other research institutes. BGCI convenes the European Botanic Gardens Consortium (EBGC[59]), which includes representatives from all countries across Europe.

Box T3.1. BGCI – examples of sharing information and connecting people

In May 2018 the EBGC and the Botanic Garden of Ajuda, University of Lisbon, organised the Eighth European Botanic Gardens Congress: Botanic Gardens, People and Plants for a Sustainable World. Held in Lisbon, Portugal, 302 people from 39 countries worldwide attended the conference which shared information on a range of issues including botanic gardens and science, global change, conservation, sustainability and education.

BGCI coordinates a range of databases (set up individually or in collaboration with other organisations) that contribute to information sharing around the world, including:

- **The Seed Conservation Directory of Expertise**[60]: with information on individuals, facilities and expertise related to seed conservation, focused on plant species of wild origin.
- **ThreatSearch** including over 300,000 conservation assessments of plants with assessments at national, regional and global scales (also contributing to GSPC Target 2).
- **PlantSearch** documenting living plant, seed, and tissue collections maintained by botanic gardens. PlantSearch anonymously connects researchers, horticulturists, conservationists, and educators to collection managers with species of interest. In 2018, *via* PlantSearch, 1,879 requests were sent to collection managers.
- **GlobalTreeSearch** lists the world's tree species names and their country distributions. Launched in 2017, the database now lists over 60,000* tree species. In 2018, 678 species were added to the tree list. Geographic and taxonomic changes are made based upon feedback from partners and taxonomic progress in many groups.
- **GardenSearch** is BGCI's digital directory of botanic gardens, containing information on staff, facilities, and expertise at over 3,666* botanical institutions worldwide.

Source: BGCI 2018[61]

59 http://www.botanicgardens.eu/
60 https://www.bgci.org/resources/bgci-tools-and-resources/directory-of-expertise-seed-conservation/
61 https://www.bgci.org/resources/bgci-tools-and-resources/bgci-annual-reports/ and 'our work'

Box T3.2. The TRANSLOCPLANT DATABASE initiative

The TransLocPlant database (http://translocations.in2p3.fr/) is an online repository for information about plant and lichen translocations in The Western Palearctic (Europe and the Mediterranean). The project aims to set up long-term collaboration between researchers and non-academic translocation actors, with exchanges of information on past translocations, in order to better judge the relevance of translocation projects and improve their protocol. The database has a population basis. To be included in the database, a population must contain a significant proportion of individuals that have been voluntarily displaced (or the descendants of such individuals) in order to achieve population viability. The taxon must be identified and the date of translocation and the location of the population's host site must be known with some precision. The necessary objective of establishing a viable population or increasing the viability of an existing one may be accompanied by other objectives such as improving the conservation status of the species on a global or regional scale, or contributing to the restoration of a community, or a utilitarian objective for human well-being. Optional information is collected when available. This information relates to the (i) context of the translocation (e.g., organizations involved, rationale for translocation, possible causes of taxon decline), (ii) type of translocation (reinforcement or reintroduction or creation of a population in a new site), (iii) characteristics of the host site (e.g., habitat type, distance to nearest population), (iv) biological material used (e.g., location of original population, diversity of life cycle stages), (v) various technical aspects (e.g., time spent *ex situ* in cold storage, greenhouse or garden, habitat preparation, post-translocation management), (vi) post-translocation monitoring effort (e.g., frequency and types of observations), and (vii) translocation results (e.g., population size, consequences on ecosystems). The sources of information are peer-reviewed scientific articles, books, theses, conference papers, presentations, reports, newspaper articles, maps, webpages, interviews, and personal communications.

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TransLocPlant

National implementation

Target 3

Most countries reporting on this target indicated that progress is being made and a quarter were on track to meet the target. Activities range from professional data collection to citizen science programmes that raise awareness of plants and the conservation issues that they face, and enable everyone from novice to experienced botanists to contribute to data collection and science projects (Box T3.3). They also include innovative research techniques, including DNA based species identification. As a result of a collaboration led by National Botanic Garden of Wales and the Royal Botanic Garden Edinburgh (RBGE), DNA barcoding of the British vascular plant flora is now complete providing a baseline resource for DNA-based plant identification.

This work contributes to wider **UK** input to the International Barcode of Life[62] project, and its application to biodiversity discovery and species identification[63]. Other examples include the recent publication of a national habitat classification of **Ukraine** (Box T3.4), and moves towards online publication of biodiversity data in the **Russian Federation** (Box T3.5).

62 https://ibol.org/
63 http://rstb.royalsocietypublishing.org/content/371/1702

Box T3.3. Examples of Citizen Science

A range of participatory citizen science programmes are underway aimed at improving biodiversity knowledge and raising awareness of the challenges faced. Organisations in many countries implement such projects and a few examples are given below.

In **France**, the OPEN (Observatoires Participatifs des Espèces et de la Nature[64]) database provides access to all national participatory (citizen) science programmes, with 69,914 participants and 153 observatories*[65]. These include:

- Vigie-Nature, founded by the Muséum National d'Histoire Naturelle (MNHN). This participative science programme aims to use simple but rigorous protocols to enable everyone to contribute to biodiversity research. Vigie-Nature covers a broad range of taxa including plants under Vigie-Flore[66]. Fifteen thousand volunteers participate in the whole Vigie-Nature[67] programme.
- The Tela Botanica network[68] contributes to citizen and participatory science programmes, in partnership with research and other institutions. The network has been running for almost 20 years and has more than 40,000 subscribers, more than 50 participatory projects and a growing activity on its website with nearly 2 million visits per year.

The SIB (Système d'Information sur la Biodiversité) collates data relating to biodiversity status, threats to species and habitats, and the many actions undertaken by public policy to face these trends in France[69].

In **Switzerland**, Citizen Science plays a key part in mapping and monitoring the country's plant diversity. Working on several projects, the Swiss Flora Data Centre "Info Flora[70]" has mobilised up to 300 volunteers that have carried out field controls, inventories, population censuses and other botanical work.

In the **Netherlands**, FLORON (Plant Conservation Netherlands) monitors flora in about 1/30th of the country every year. Monitoring of plants including identification and distribution mapping is largely carried out by volunteers as part of a long term citizen science project. Data collected by volunteers and professionals are stored in the National Database Flora and Fauna (NDFF). As part of the Dutch government-supported Network Ecological Monitoring (NEM), three long-term citizen science projects are carried out by FLORON[71]; mapping species occurring in kilometre squares, visiting under-recorded areas, and revisiting "forgotten" sites with rare plants.

In **Sweden**, the Swedish Species Information Centre in collaboration with NGOs and a stakeholder council, Artportalsrådet, maintains a species reporting system[72] including a citizen science programme that enables people to report species sightings and contribute to knowledge of the Swedish vascular plants, fungi and fauna as well and their response to climate change.

64 https://www.open-sciences-participatives.org/home/
65 As of January 2020
66 http://www.vigienature.fr/fr/vigie-flore
67 http://www.vigienature.fr/
68 https://www.open-sciences-participatives.org/sciences-participatives/reseau/4/tela-botanica
69 http://www.naturefrance.fr
70 https://www.infoflora.ch/en/
71 https://www.floron.nl/about-us
72 https://www.slu.se/en/environment/report-species-sightings/

Box T3.4. A National Habitat Catalogue of Ukraine

In 2018, a National Catalogue was published describing Ukraine's habitats. For each habitat, information is provided on:

- relationship to the European Nature Information System (EUNIS) habitat classification scheme (used in Annex I of Resolution 4 of the Bern Convention on endangered natural habitat types)
- relationship to habitat types listed in Annex I of the EU Habitats Directive
- relationship to the Green Book of Ukraine
- syntaxonomic units
- dominant ecological characteristics
- habitat distribution in Europe and Ukraine
- conservation status
- characteristic species present (mainly plants, in some cases also animals and micro-organisms
- species present listed in the Red Data Book of Ukraine, Resolution 6 of the Bern Convention and Annexes II and IV of Habitats Directive
- main threats and habitat management

It is intended that the catalogue be used to help with mapping the habitats in Ukrainian protected areas and Emerald Network sites to facilitate the development of management plans. The Catalogue should be of use to biologists, environmentalists, students and teachers of biological and agricultural specialties of universities.

Source: Kuzemko *et al.*, 2018

Box T3.5. Biodiversity databases in the Russian Federation: towards a national portal

A huge amount of botanical and other biodiversity data has been collected in Russia. This is largely held in botanical collections, reserves and other nature conservation project and annual reports, scientific and other publications. While some data are held digitally in databases, most remains digitally inaccessible. While the concepts of open access to research data is spreading, there is no national biodiversity information system and data that are available are not consolidated.

However, interest in publishing data through international biodiversity portals is increasing among Russian researchers. Since 2014, various Russian institutes have published about 140,000 species occurrences (plant and animal) through gbif.org. The increase in data publishing activity calls for the creation of a GBIF node in the Russian Federation, aiming to support Russian biodiversity experts in international data work.

Source: Ivanova & Shashkov, 2017.

Target 3 – issues to consider

Ongoing dissemination channels need to be continued and updated, and a wide range of additional research, from genetic to ecosystem level, and information dissemination needs are associated with this cross-cutting target. These include those needed to fill gaps in knowledge and to monitor progress towards the other targets.

Data and research gaps and knowledge exchange needs for the effective delivery of plant conservation have been discussed throughout the report and collated in the discussion (section 6). As examples, a few specific information needs highlighted in the 6th National Reports and this review include:

- The need for further research, and dissemination of existing research, into the key roles both individual plant species and plants collectively play in ecosystem services to better promote their integration into decision and policy making.
- Developing ways to ensure that rare species with low encounter rates are better represented in surveys.
- Further research into ways of ensuring that ecosystem approaches to conservation do not overlook conservation needs of individual species.
- Across the EU, policy-relevant research is needed to ensure that the ecological requirements of plants are well integrated into agri-environmental policy (under the reformed CAP) and nationally funded agri-environment schemes.

References

Ivanova, N.V. and Shashkov, .P. 2017. Biodiversity databases in Russia: towards a national portal. Arctic Science 3: 560-576. https://www.nrcresearchpress.com/doi/10.1139/as-2016-0050#.Xk5YXjL7TIU

Kuzemko, A. A., Didukh, Y., Onyshchenko, V., Borsukevych, L., Moysiyenko, I. *et al.* 2018. National Habitat Catalogue of Ukraine. Раритетне фіторізноманіття Нижньодніпровських пісків. ISBN: 978-966-7775-63-6. https://www.researchgate.net/publication/331935396_NATIONAL_HABITAT_CATALOGUE_OF_UKRAINE

5.2.2. Objective II: Plant diversity is urgently and effectively conserved

Target 4: At least 15 per cent of each ecological region or vegetation type secured through effective management and/or restoration

Actions taken to implement Aichi Targets[73] 11 and 15 contribute towards this GSPC target. Aichi target 11 aims for 17% of terrestrial areas to be conserved by 2020, especially those important for biodiversity and ecosystem services, and Aichi target 15 aims for 15% of degraded ecosystems to be restored to contribute to climate change mitigation and adaptation.

European Progress

The Natura 2000 network of sites in EU Member States established under the Habitats Directive, and the Emerald Network[74] beyond the EU, established under the Bern Convention (Council of Europe, 1979), are the key European networks of protected[75] areas (see Appendix V). The Natura 2000 network is considered as the EU's contribution to the Emerald Network and covers 18% of the EU's land area, with around 28,000 sites (EEA 2019). Although the Emerald Network is at an earlier stage of development than Natura 2000, sites have been adopted in 7 countries and candidate sites officially nominated in another 8 countries (as of December 2019).

> *"Designation of protected areas is not in itself a guarantee of effective biodiversity protection. Establishing or fully implementing conservation measures and management plans to achieve effectively managed, ecologically representative and well-connected systems of protected areas are crucially important and remain a challenge up to 2030."*
> EEA 2019

In terms of the proportion of terrestrial area conserved, Global Aichi biodiversity target 11 has been reached in the EU as the Natura 2000 network alone covers 18 % of the EU land area supplemented by protected nature reserves in most countries. However, Aichi target 11 states that these areas be *"... conserved through effectively and equitably managed, ecologically representative and well connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscapes and seascapes"* and this may not have been met. Many habitats are not in favourable condition (Figure T4), and Natura 2000 sites may not be sufficiently ecological representative and well connected (T7; Angelstam *et al.* 2020).

Precise figures are not available as to whether GSPC Target 4 has been met in terms of area of each ecological region or vegetation type secured. However, the target has probably not been met in terms of the *effectiveness* of management or restoration. Favourable conservation status was reported for only 15 % of the assessments of habitats protected under the EU Habitats Directive (EEA 2015b from EEA2019 see Figure T4.), with grasslands and bogs, mires and fens having a high proportion of unfavourable assessments (EEA 2016b from EEA 2019).

73 https://www.cbd.int/aichi-targets/
74 https://www.coe.int/en/web/bern-convention/emerald-network
75 The protection required by the Habitat Directive does not mean that Natura2000 sites are legally protected by EU Member States

Vegetation of shallow water bodies - Sébastien Filoche

To help address this issue IUCN has a programme for illustrating good practice in area-based conservation. This involves a 'Green List of Protected and Conserved Areas[76]' that enables certification for protected and conserved areas that are effectively managed and fairly governed. However, as of May 2020 few European sites were listed; one in Italy, two in Spain and 15 in France (one of which is an Overseas Territory site). Similarly, the Committee of Ministers of the Council of Europe has since 1965 granted an international award, 'The European Diploma for Protected Areas[77]' to those areas of exceptional European importance for the preservation of biological, geological and landscape diversity that are very well managed (see Box T2.3.). By May 2020, 73 protected areas in 29 European countries had been granted the Diploma.

"Europe is not on track to meet the 2020 target of maintaining and enhancing ecosystems and their services by establishing green infrastructure and restoring at least 15% of degraded ecosystems. While Natura 2000 areas have a positive effect on ecosystem condition and biodiversity in surrounding areas, pressures remain high and the conservation measures undertaken are still insufficient" and "Europe is not on track to meet the 2020 target of improving the conservation status of protected species and habitats (bogs, mires, fens, freshwater habitats and amphibians) and the cumulative pressures remain high." EEA 2019

76 https://www.iucn.org/theme/protected-areas/our-work/iucn-green-list-protected-and-conserved-areas
77 https://www.coe.int/en/web/bern-convention/european-diploma-for-protected-areas

Europe is a region with a long history of human land use and considerable pressure on land from urbanisation, agriculture and development. Consequently, although many protected sites have been listed under these networks, most are small with 78% being under 100 ha (EEA 2018 from EEA 2019[78]); larger protected areas are found in countries with lower population densities. The size and fragmented nature of many sites, along with the continuing pressures upon them and surrounding land, undoubtedly contribute to this poor conservation status. In addition to the designation of Natura 2000 sites, the Habitats Directive calls for broader landscape measures to improve the coherence of the network (see Box T4.1). One complementary approach that can help guide the conservation of key habitats, both within and beyond the Natura 2000 network, is through the preparation of habitat action plans (Box T4.2).

Box T4.1. Provisions within the EU Habitats Directive for measures to improve the ecological coherence of the Natura 2000 network

Article 3.3.

Where they consider it necessary, Member States shall endeavour to improve the ecological coherence of Natura 2000 by maintaining, and where appropriate developing, features of the landscape which are of major importance for wild fauna and flora, as referred to in Article 10.

Article 10.

Member States shall endeavour, where they consider it necessary, in their land-use planning and development policies and, in particular, with a view to improving the ecological coherence of the Natura 2000 network, to encourage the management of features of the landscape which are of major importance for wild fauna and flora.

Such features are those which, by virtue of their linear and continuous structure (such as rivers with their banks or the traditional systems for marking field boundaries) or their function as stepping stones (such as ponds or small woods), are essential for the migration, dispersal and genetic exchange of wild species.

Source: EUR-Lex Access to European Union Law ELI: http://data.europa.eu/eli/dir/1992/43/oj

78 https://www.eea.europa.eu/themes/biodiversity/natura-2000

Box T4.2. European Union Habitat Conservation and GSPC Targets

The conservation status of European habitats has been reviewed and a European Red List of Habitats produced (see Target 2). This covers all natural and semi-natural terrestrial, freshwater and marine habitats, highlighting the pressures they face (Gubbay *et al.* 2016; Jannsen *et al.*, 2016). As habitat degradation is often a precursor to species decline, the identification of threatened habitats and implementation of measures to conserve them could potentially help avert or reduce plant species declines and conservation measures for habitats and species can be synergistic.

An EU habitat action plan has been prepared for the European Commission: Action plan to maintain and restore to favourable conservation status the habitat type 6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates (*Festuco-Brometalia*) (*important orchid sites) (Olmeda *et al.* 2019). The habitat type 6210 is protected under the Habitats Directive (92/43/EEC) and considered a priority habitat if it is an important orchid site. The action plan aims to guide the actions needed to maintain and restore favourable conservation status of the habitat across its range in the EU. Dry calcareous grasslands are a species-rich and highly threatened European habitat. In addition to their importance for plants, they support a diverse invertebrate fauna including wild bees, butterflies and moths, and as such are vital for pollinators.

Dry calcareous grasslands are degraded across Europe as a result of poor management (loss of grazing activity or overgrazing), nitrogen pollution, invasive alien species, land use changes and habitat fragmentation. Fifty seven percent of the habitat surface is included in the EU Natura 2000 network, where its conservation status appears to be better than outside the Natura 2000 sites (EU News 2019).

A second habitat action plan is being prepared for European dry heaths, another threatened habitat.

This habitat prioritisation and conservation approach can play an important role in contributing to GSPC Targets 4, 5 and 6, and is complementary to the measures described under those targets in the current report.

Other initiatives also contribute to GSPC Target 4, and one relatively new initiative is the concept of 'Rewilding'. 'Rewilding' of European ecosystems, through the restoration and maintenance of ecologically functional and connected landscapes, wetlands and floodplains (Box T4.3.) can help improve the status of biodiversity while helping tackle climate change.

A botanic gardens initiative set up to contribute to habitat restoration efforts is the Ecological Restoration Alliance of Botanic Gardens[79] (ERA). Co-ordinated by BGCI, the ERA builds capacity for restoration of degraded areas through setting up demonstration sites around the world, training and skills sharing. European partners include Paignton Zoo Environmental Park (UK), The Eden Project (UK) and Meise Botanic Garden (Belgium).

79 https://www.erabg.org/index/

Box T4.3. Rewilding Europe

A coalition of international NGOs and research organisations[80] have called for 'Rewilding' to be a key part of the EU post 2020 biodiversity strategy. Rewilding is large, landscape-scale nature restoration, where activities taken create the right conditions for natural processes to be restored and for landscapes and biodiversity to thrive with minimal human management in the long-term. Such activities can include removing dykes and dams to free up rivers, reducing active management of wildlife populations, allowing natural forest regeneration, and reintroducing species that have disappeared as a result of human activities. Rewilding can contribute to:

- Tackling both the biodiversity and climate crises
- Improving the conservation status and connectivity of the Natura 2000 network
- Protecting and restoring carbon stocks, hence help stabilizing the climate below a 1.5° C rise in average global temperatures

The consortium proposes that this requires, at EU level:

- A legally binding target for Member States to increase the area of habitats in good ecological condition with concrete targets based on number of ha/km^2
- That financing for climate action delivers active habitat restoration

Project areas[81] for this pioneering approach are already being selected across Europe to provide inspiration for future initiatives.

'Rewilding', as explained in Box T4.3, cannot be confused with the idea to recover species which have been extinct for millennia, as often said for animals (i.e. re-introducing European bisons in the Mediterranean region of Europe).

Source:https://rewildingeurope.com/wp-content/uploads/2020/01/Ecological-restoration-in-the-EU-post-2020-biodiversity-strategy-The-opportunities-of-rewilding-European-landscapes-for-nature-and-climate.pdf

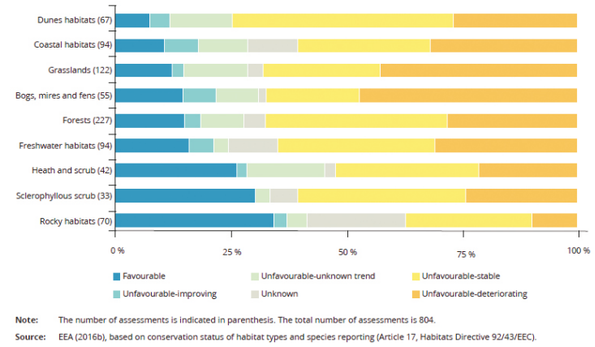
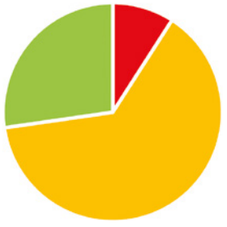


Figure T4. Trends in conservation status of assessed habitats at EU level
(Reproduced from FIGURE 3.4, European Environment Agency State and Outlook 2020 – EEA, 2019).

80 WWF European Policy Office, BirdLife Europe & Central Asia, the European Environmental Bureau, Rewilding Europe and the German Centre for Integrative Biodiversity Research (iDiv) Halle-Jena-Leipzig
81 https://rewildingeurope.com/areas/

National implementation



Target 4

Most countries reporting against target 4 consider that progress is being made but at an insufficient rate; no countries reported no progress against this target.

Switzerland has established an official national vegetation classification scheme with more than 200 habitat types, out of which 50 are listed as "worth protecting" in a federal ordinance. While Switzerland currently lacks a natural habitat map and only a few habitat types have been inventoried, a project is ongoing to build a natural habitat map based on remote sensing and *in situ* observations.

Green Infrastructure is a strategically designed network of areas managed to deliver a wide range of ecosystem services. It includes natural and semi-natural areas and can incorporate a range of environmental and physical features and be present in rural and urban settings. Networks of green, and blue if water is involved, features can provide a wide range of benefits, for example through protecting biodiversity and the services it delivers like clean water and air, climate change mitigation and adaptation, and improving the quality of life. **France** started developing 'turquoise Infrastructure' in areas where blue and green infrastructures strongly interact. Previously, green infrastructure was incorporated into existing national legislation **in Spain**, with no explicit strategy[82]. However, it was anticipated that the State Green Infrastructure Strategy would be approved in 2019 (State Strategy IVyCRE). The draft of this strategy included among its goals the restoration of habitats and ecosystems in key areas to favour connectivity and the provision of ecosystem or biodiversity services, through nature-based solutions. The identification of the need for ecological restoration should contribute to the restoration of 15% of degraded ecosystems.

Box T4.4. Mapping the habitats: the French programme CarHAB

The French Ministry of Ecological Transition launched in 2019 an extensive programme of vegetation mapping named CarHAB[83] ('Cartographie des Habitats'). This programme tends to overcome the actual situation of 27% of the natural and semi-natural areas mapped using different habitat typologies and different mapping scales.

This nationwide five-year programme aims at mapping natural and semi-natural habitats at 1:25,000 scale and using an homogeneous modelling methodology. The habitat modelling will concern those of Community interest, inside and outside of the Natura 2000 sites network.

Both floristic and vegetation data collected by the Conservatoires botaniques nationaux feed an innovative modeling system using remote sensing and aerial photography that describe vegetation patterns on one part and 7 parameters of environmental data that describe the biotope on the other part.

The CarHAB programme will improve the knowledge on local biodiversity issues at the habitat level as well as the ecosystem services they provide. CarHAB enables improving the tools for biodiversity preservation focusing on maintaining or restoring corridors. The CarHAB data could also serve to the extension and the creation of new protected areas.

Source: OFB, 2020

82 https://ec.europa.eu/environment/nature/ecosystems/pdf/Green%20Infrastructure/GI_ES.pdf
83 https://professionnels.ofb.fr/fr/doc-guides-protocoles/cartographie-vegetation-lechelle-unites-paysageres-volume-1-principes

Target 4 – issues to consider

Chalk cliffs of the Seine valley – Sébastien Filoche

- While progress has been made in many countries, issues remain in some places around the mapping of ecological regions and vegetation or habitat types, whether natural or semi-natural.
- Irrespective of the extent to which national area targets concerning ecological regions or vegetation types secured have been met, the issues of representativeness and connectedness of networks has been highlighted, along with their sufficiency with respect to projected climate change impacts and the population dynamics of threatened species.
- While the numbers of protected sites and the proportions of biogeographical regions listed as protected has increased, and is high in some places, not all have management or restoration tools associated with them. A key issue in many countries individually and across Europe as a whole is that a high proportion of those sites designated as protected are nonetheless in poor conservation status. Resourcing and finding appropriate mechanisms for implementing site protection and conservation management is key to the effective conservation of these networks and the services they provide.
- Restoration is needed for both protected and unprotected habitats in order meet GSPC and Aichi targets. Habitat action plans can help prioritise actions and areas (Box T4.2).

References

Angelstam, P. Manton, M., Green, M., Gunnar Jonsson, B., Mikusinski, G. *et al.* 2020. Sweden does not meet agreed national and international forest biodiversity targets: a call for adaptive landscape planning. Landscape and Urban Planning, in press.

EEA 2019. The European environment —state and outlook 2020. Knowledge for transition to a sustainable Europe. European Environment Agency. Luxembourg: Publications Office of the European Union, 2019 ISBN 978-92-9480-090-9. doi: 10.2800/96749

EEA 2018. 'Land recycling and densification (LSI 008)'. European Environment Agency (https://www.eea.europa.eu/data-and-maps/indicators/land-recycling-and-densification/assessment-1). Cited in EEA 2019 as accessed 29 May 2019.

EU NEWS 18 November 2019 (Brussels Environment) First EU action plan for restoring a key habitat for wild pollinators. https://ec.europa.eu/info/news/first-eu-action-plan-restoring-key-habitat-wild-pollinators-2019-nov-18_en

Gubbay, S., Sanders, N., Haynes, T., Janssen, J.A.M., Rodwell, J.R. *et al.* 2016. European Red List of Habitats. Part 1. Marine habitats. European Union 2016. ISBN 978-92-79-61586-3. doi: 10.2779/032638.

Janssen, J.A.M., Rodwell, J.S., García Criado, M., Gubbay, S., Haynes T. *et al.* 2016. European Red List of Habitats. Part 2. Terrestrial and freshwater habitats. European Union 2016. ISBN 978-92-79-61588-7. doi: 10.2779/091372.

Olmeda C., Šefferová V., Underwood E., Millan L., Gil T. *et al.* (compilers). 2019. EU Action plan to maintain and restore to favourable conservation status the habitat type 6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco Brometalia) (*important orchid sites). European Commission Technical Report XXXX-2019.

https://ec.europa.eu/environment/nature/natura2000/management/pdf/EUHabitat_ap6210.pdf

Target 5: At least 75 per cent of the most important areas for plant diversity of each ecological region protected with effective management in place for conserving plants and their genetic diversity

Juniper woodland in Artanish IPA, Armenia - Anna Astrayan

While extensive Important Bird Area (IBA) networks have long existed and been used to help in conservation planning, congruence with priority areas for plants is variable within and among countries. The need for the development of systematic and clear plant-based site priorities that could be made readily available to policy makers resulted in the development of Important Plant Area (IPA) criteria in the early 2000s by Plantlife International.

IPAs are important for identifying gaps in national protected area networks and can help assess the importance of existing protected area mechanisms for plant conservation. IPAs are identified according to a set of objective criteria[84] based on the presence of threatened species, exceptional botanical richness, or threatened habitats.

IPAs influenced the development of Target 5 and are directly aligned with it (Darbyshire *et al.* 2017).

European Progress

There are 1,918 IPAs listed from 18 European countries. For 17 of these countries, IPAs cover an area of at least 37 million ha, or 11.82% of the surface area[85]. Some IPA networks have been integrated into national conservation planning and monitoring schemes: they are legally protected in Belarus (Maslovsky pers. comm. cited in Darbyshire *et al.* 2017), and many IPAs in Croatia were included in the expanded protected area network under the Natura 2000 scheme as part of their accession to the European Union in 2013 (Darbyshire *et al.* 2017).

84 http://www.plantlifeipa.org/criteria

85 As of January 2020 in: Albania, Armenia, Belarus, Bulgaria, Croatia, Czech Republic, Estonia, Italy, Montenegro, North Macedonia, Poland, Romania, Serbia (surface area of IPAs not known), Slovakia, Slovenia, Turkey, Ukraine and the UK – data from Plantlife International

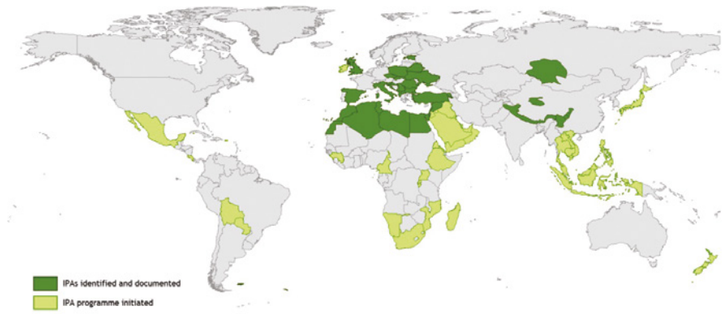
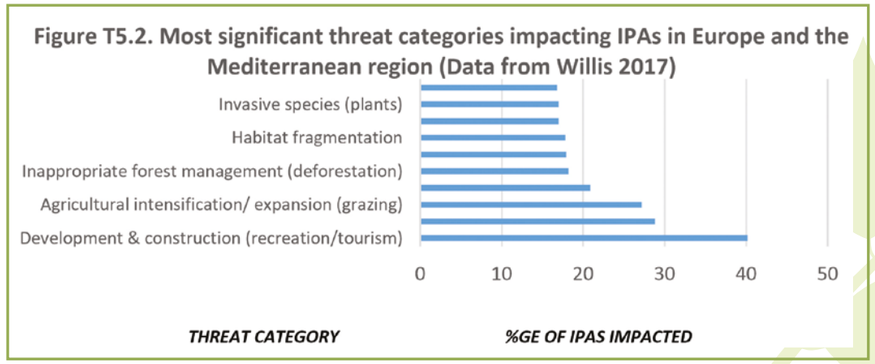


Figure T5.1. Important Plant Areas
From: Plantlife International http://www.plantlifeipa.org/about

State of the World's Plants (SOTWP - Willis, 2017) examined the effectiveness of the IPA initiative in protecting plant biodiversity, using sites in Europe and the Mediterranean region as a case study[86]. An Analysis of IPA data against the World Database of Protected Areas (IUCN & UNEP-WCMC 2016) in SOTWP found that 85% of IPAs in Europe and the Mediterranean region have some formal protection, even if this is for only part of the site. Given that only parts of some sites are protected this is broadly similar to the 75% protection objective in GSPC Target 5, although it does not indicate whether effective management is in place. There is less congruence between IPAs and Important Bird Areas in Europe and the Mediterranean region with a 53% overlap and no individual countries exceeding a 75% overlap, suggesting that it is important not to be over reliant on datasets for one taxon when designating sites.

Over the last 10 years IPA protection status has improved substantially in some countries with only 18 (19%) of the 97 IPAs in Croatia protected in 2010 compared with 90 IPAs (93%) as reported by Willis (SOTWP) in 2017. However, many IPAs are subject to a range of threats with development and tourism and agricultural factors, including both abandonment and intensification, among the most significant, affecting a high proportion of IPAs (Figure T5.2.).

A supplementary approach to that of larger protected areas that has now been introduced in some European countries is that of Plant Micro-Reserves (Box T5.1.). Some of these small reserves may be within IPAs or protected areas, and others may be additions to existing networks.



86 While this is not geographically totally congruent with the European region defined for GSPC targets, there is nonetheless considerable overlap.

Mediterranean relictic vegetation with Laurus nobilis *in the Plant Micro Reserve Els Cingles, Spain - Emilio Laguna*

Box T5.1. Plant Micro-Reserves as a supplementary approach to larger protected areas

There has long been debate over the optimal size of nature reserves (single large or several small - SLOSS). While it is generally accepted that larger and more connected protected areas or landscapes will be the most beneficial to the broadest range of species, in particular facilitating migration or dispersal (especially as environmental conditions change), generalisations cannot readily be made for all taxa or species. One supplement to the network of large protected areas is that of 'Plant Micro-Reserves' (PMR), a concept introduced in the early 1990s in the Valencian region of Spain, where about 65% of endemic plants grow, generally as small patches, in microhabitats (e.g.in dunes, salt lagoons, coastal cliffs, temporary ponds, relict forest, etc.). The Regional Wildlife Service developed a PMR initiative to conserve such populations and their habitats. This PMR network of small (<20 ha) legally protected sites are a complement (not an alternative) to large protected areas in the region and in 2021, 312 sites were included (Laguna *et al.* 2016; Fos *et al.* 2017). This model has now been adapted to use in other regions of Spain, Bulgaria, Greece and Cyprus.

However, a convergent idea has been successfully developed in Latvia, where more than 2,000 MR (micro-reserves, also for animals, fungi, algae, etc.) have been selected and legally protected.

Sources: Fos *et al.* 2017; Laguna *et al.* 2016; Kadis *et al.* 2013

National implementation

Target 5

Most countries reporting against target 5 consider that progress is being made but at an insufficient rate; no countries reported no progress against this target.

In some countries, IPAs have considerable overlap with other nationally designated sites that are already part of nationally protected areas with associated planning and monitoring schemes (Box T5.2. for UK example). In countries with no IPAs, Natura 2000 sites or other nationally protected areas are expected to include many important areas for plant diversity.

For example **in Finland**, while IPAs have not been identified, a preliminary study of the most valuable areas for threatened species was presented in the action plan for protection of threatened species (Ministry of the Environment 2017) and most of the hot spots are well known and at least partly protected. According to the national threatened species database 30–50% of vascular plant populations are situated in protected areas.

A combination of approaches was used by Lockhart *et al.* (2012) **in Ireland** to identify 47 Important Bryophytes Areas. The areas identified were generally large and contained a mix of both protected and unprotected sites. Nineteen (c. 40%) of the identified Important Bryophyte Areas were found within the protected area network.

Box T5.2. Oak-dominated woodlands in Eastern Austria protected for fungi

How can fungi be protected? Should it be the site, the habitat, or the host? And is habitat conservation able to provide protection for all existing life, including fungi?

Different approaches focusing on fungi can be mentioned since the 90's such as the "key biotopes for wood-inhabiting fungi" or the 'crown-jewels' established in Norway and in The Netherlands respectively. In the new millennium Croatia made surveys as part of the European Natura 2000 project on "Important Sites for Fungi" and thanks to the IPA programme in the not EU countries in central-east and south-east various selected areas results important also from a mycological point of view (Perini et al., 2011).

In this context during a regional project for the protection of ecologically valuable woodlands and veteran trees (Waldumweltprogramm Burgenland) the first two Austrian nature reserves explicitly for fungal biodiversity were created. They comprise different types of forest communities dominated by Quercus petraea with highly diverse and complementary assemblages of rare and red-listed macrofungi. One location is the type locality of two species recently described as new: Russula nausea and Neoboletus xanthopus and the only recently confirmed site where the rare bolete Lanmaoa fragrans occurs in Austria. While the consideration of mycological data in the delineation of new forest reserves is an important step forward, the cancellation of three of the originally five reserves still demonstrates the weakness of fungal conservation efforts, as long as mycologists are at best informally consulted in nature conservation decisions, which is a possible reasons for the failure to recognise fungal biodiversity as an equally important part of our natural heritage and as an asset of nature conservation in its own right (URBAN, A., KRISAI-GREILHUBER, I., 2017).

Box T5.3. Identification of Important Plant Areas: Case Study from the UK

165 Important Plant Areas (IPAs) have been identified in the UK - 47 in Scotland, 90 in England, 24 in Wales and 4 in Northern Ireland. A key feature in the identification of UK IPAs is the consideration of a wide range of taxonomic groups – with IPAs identified for lichens, bryophytes, marine algae, stoneworts, freshwater algae and vascular plants (including arable plant assemblages). Almost a third (32%) of UK IPAs have lichen features, 29% have bryophyte features and 16% have stonewort features. In total, 38% of UK IPAs have been identified for non-vascular plant features.

This wide taxonomic coverage has been critical to the establishment and acceptance of UK IPAs as a conservation tool, accurately reflecting the true importance of these areas. It provides a focus on often lesser known, understood or studied groups and highlights the diversity and complexity of sites and areas. It has also generated detailed reports on specific taxonomic groups – for example, Important Stonewort Areas report (Stewart 2004), Important Fungus Areas (Evans *et al.* 2004), and a review of IPAs for algae (Brodie *et al.* 2007).

The identification of the UK IPA network was a major landmark in the UK for plant diversity, however it has been through subsequent focus and partnership action that IPAs have enabled targeted conservation action. The UK IPA network has influenced agri-environment schemes, the assessment of plant diversity within protected landscapes, and strategies such as National Park Action Plans and site management plans.

UK IPA features, and the threats to them, have provided the catalyst for developing partnerships of land owners and managers to deliver large scale conservation work. For example, the removal of Rhododendron ponticum at a catchment-scale from Atlantic woodland IPAs in Wales[87], and large scale dune conservation across England and Wales[88].

87 https://celticrainforests.wales/
88 https://www.dynamicdunescapes.co.uk/

Target 5 – issues to consider

Habitat mosaic of temporary ponds and moors on sandstone – Sébastien Filoche

- The lack of identified IPAs, and of associated schemes aimed at monitoring their condition when they have been identified, limits the evaluation of progress towards Target 5 in many countries. Progress with identifying IPAs depends upon the availability of readily accessible data on the distribution, rarity and conservation status of plant species and their habitats including national habitat classification schemes. The collection of such data is resource intensive, and this is likely to be the main reason why IPAs and national IPA networks have not been identified in some countries. The collection of such data is a priority.
- Particularly poorly represented groups of plants include lichens and fungi and increased effort is needed on these taxa.
- Additional effort is needed to integrate identified IPAs into national and regional conservation initiatives. Community based research and conservation projects focused on IPAs can also contribute to effective management and conservation.
- Collaboration with the tourism sector through professional assistance and promotion of responsible tourism practices may help to minimise negative impacts on species and habitats.

References

Anderson, S. (2002). Identifying Important Plant Areas. Plantlife International

Brodie, J., John, D. M., Tittley, I., Holmes, M.J. Williamson, D.B. (2007) Important Plant Areas for algae: a provisional review of sites and areas of importance for algae in the United Kingdom. Plantlife International, Salisbury, UK.

Byfield,A.J. & Wilson, P. J. (2005). Important Arable Plant Areas: identifying priority sites for arable plant conservation in the United Kingdom. Plantlife International, Salisbury, UK.

Darbyshire, I., Anderson, S., Asatryan, A., Byfield, A., Cheek, M. *et al.* 2017. Important Plant Areas: revised selection criteria for a global approach to plant conservation. Biodivers. Conserv. 26:1767–1800. DOI 10.1007/s10531-017-1336-6

Edwards, B.E. (2007) Selecting Important Plant Areas for Lichens. British Lichen Society report to Plantlife.

Evans, S., Harper, M., Marren. P (2004) Important Fungus Areas – A provisional assessment of the best sites for fungi in the United Kingdom.

Fos, S., Laguna. E., Jiménez, J. and Gómez-Serrano, M-A. 2017.-Plant micro-reserves in Valencia (E. Spain): A model to preserve threatened flora in China? Plant Diversity 39: 383e389.

Hutchinson, N., Dines, T. (2008) Important Plant Areas in the UK: technical report. Plantlife International, Salisbury, UK

IUCN & UNEP-WCMC 2016. The World Database on Protected Areas (WDPA). Available: http://www.protectedplanet.net.

Kadis, C., Thanos, C. & Laguna, E. (eds.). 2013. Plant micro-reserves: From theory to practice. Utopia Publishing. Athens.

Laguna, E., Fos, S., Jiménez, J. and Volis, S. 2016. Role of micro-reserves in conservation of endemic, rare and endangered plants of the Valencian region (Eastern Spain). Israel J. Plant Sci. 63 (4): 320e332. https://doi.org/10.1080/07929978.2016.1256131.

Lockhart, N. Hodgetts, N and Hollyoak, D. 2012. Rare and threatened Bryophytes of Ireland. National Museums Northern Ireland.

Perini, C., Leonardi, P., Pecoraro, L., Salerni, E., 2011: The Important Plant Areas program from a mycological point of view: the regional experience in an European context. Fitosociologia vol. 48 (2) suppl. 1: 155-161, 2011

Stewart, N.F. (2004). Important Stonewort Areas of the United Kingdom. Plantlife International, Salisbury, UK.

Urban, A., Krisai-Greilhuber,I., 2017: Are current environmental programmes adequate for conservation of fungal biodiversity? Exemplary experiences from the protection of oak-dominated woodlands in eastern Austria. – Fungal conservation in a changing Europe.The Challenges Ahead. Ohrid, Macedonia. Programme and Abstracts 58–59.

Target 6: At least 75 per cent of production lands in each sector managed sustainably, consistent with the conservation of plant diversity

About 37% of the earths land surface is used for agricultural purposes, with about 11% (1.5 billion ha) being used for crop production (arable land and land under permanent crops) and the remainder for pasture[89]. Sustainable management of production lands is therefore critical for plant diversity.

GSPC Target 6 links closely to the CBD Strategic Plan for Biodiversity 2011-2020 Aichi Biodiversity Target 7 *"By 2020 areas under agriculture, aquaculture and forestry are managed sustainably, ensuring conservation of biodiversity"*. Implementation of this goal also contributes to the UN 'Transforming our World: the 2030 Agenda for Sustainable Development' Goal 2 *"End hunger, achieve food security and improved nutrition and promote sustainable agriculture"* and the work of the UN's Food and Agriculture Organisation (FAO).

While progress has been made towards introducing more sustainable management of production lands in recent years, including arable, pastoral and forestry lands, plants and other elements of biodiversity are not usually sufficiently incorporated into national policies and practices, and the measures taken have clearly not been sufficient to ensure sustainable management. In 2019 a report on progress towards the SDGs, with respect to Goal 2, highlighted the urgent need for increased investment in technology and infrastructure for sustainable agriculture against a backdrop of declining public investment in agriculture globally (UN Economic and Social Council 2019).

89 https://earth.esa.int/web/guest/earth-topics/agriculture; http://www.fao.org/3/y4252e/y4252e06.htm.

European Progress

Production lands and arable weeds – Sébastien Filoche

Land used for agriculture covers about 41% of EU (28) land area. Forests and other wooded land cover about 43% of land area, with forest available for wood supply covering 32% of land area in 2015[90]. Land production for agriculture or forestry thus represents a high proportion of the total terrestrial land surface of the EU.

The European Union's Common Agricultural Policy (CAP) has had a substantial influence on how land is managed across in Europe for the last half century.

For most of this time the primary objectives of the CAP have concerned increasing agricultural productivity and market stability, and ensuring the availability of affordable food for consumers.

This has frequently had major negative impacts on biodiversity, natural resources and the ecosystem services they provide. Increasing awareness of this has resulted in successive reforms to the CAP over the last 20 years aimed at reducing these impacts through integrating environmental and more recently climate considerations into how the agriculture and forestry sectors deliver their commodity production objectives. However, while the intentions of these reforms were good, and there have been some positive outcomes, they have been inadequate to address the negative impacts of farming systems on biodiversity loss and natural resources and have not sufficiently addressed the role of agriculture in climate change. The CAP has the potential to play a major role in how a large part of Europe is managed by farmers, incentivising sustainable land management practices and discouraging those that continue to have negative impacts on biodiversity and the climate. Although previous attempts at radical reform of the CAP have not proven very successful, the current environmental and climate crises provide an urgent imperative for a more sustainable CAP.

In 2013, the area under agri-environmental commitments varied considerably among Member States from c. 2% to c. 94% of UAA with the total agricultural area under agri-environmental commitments at nearly 46.9 million ha, being 26.3% of the UAA in the EU-28 (Eurostat 2017). The target for the EU-28 in 2020 was that 44 million hectares should be enrolled in Measure 10: Agri-environment-climate and Measure 11: Organic farming. The 2007-2013 and 2014-2020 targets are not directly comparable due to revision of the CAP.

Pywell *et al.* (2012) compared richness of common and rare plants on an intensively managed cereal crop (control) with one subject to quite broad agri-environment management prescriptions (general option) and another specifically based on the ecological requirements of the target taxa (evidence-based). Species richness of both common and rare plants was highest on evidence-based habitats and similar between general and control habitats showing that, to be effective, agri-environment measures need to be evidence-based, and based around a sound knowledge of the ecological requirements of key species. A subsequent analysis similarly stressed the need for measures to be carefully designed and targeted (Batáry *et al.* 2015).

90 From Eurostat database: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Forests,_forestry_and_logging#Forests_and_other_wooded_land

National implementation

Target 6

Most countries reporting against Target 6 consider that progress is being made but at an insufficient rate; and two countries reported no progress against this target. No countries reported being on track to meet this target. While mechanisms for encouraging or supporting sustainable management of productive lands (agriculture and forestry) exist throughout Europe both within and outside the EU, and are increasingly implemented in a number of countries, studies show that these are insufficient to ensure the long-term conservation of biodiversity and its ecosystem services. A number of positive initiatives are nonetheless underway (e.g. agroecology in France Box T6.1).

In **Switzerland** more than half of the forested area is certified by the FSC (Forest Stewardship Council) and one of the main goals of the federal government's Forest Policy 2020 is to ensure sustainable forest management, which includes the promotion of biodiversity.

UK organisations have contributed to sustainable management of productive lands internationally. Many of RBG Kew's projects have focused on agroforestry, including those aimed at: improving agroforestry and silvopastoral systems in the Amazon[91], developing a model for sustainable agroindustry in Peru[92] and others.

A wide range of research has been conducted on the reintroduction or supplementation in the wild of threatened vegetation types (also relevant to Target 7). One example of rare arable plants in Germany is given in Box T6.2.

Box T6.1. Agroecology in France

In 2012, France launched its agroecology project[93]. The project aims to shift agriculture towards a model where economic, environmental and social objectives are combined. - Agroecology is based on a 'whole farm' approach, where sustainable management techniques are developed for each specific context, based on a set of common principles.

These principles include encouraging positive biological interactions and supporting the resilience of farms through sustainable on-farm management of biological and geochemical cycles (water, nitrogen, etc.). For example the use of hedges and grass strips, and appropriate crop rotations, can encourage more natural management of pests and diseases. The use of appropriate crop rotations and between-crop cover can help reduce dependence on artificial inputs and create the right conditions for soil fertility. Synergistic relationships between livestock and arable farming can help to reduce reliance on synthetic fertilisers and manage organic effluents. This integrated approach to economic and environmental issues can both help support efficient and more sustainable management of natural resources while improving farm resilience.

The project is run by a committee made up of the French Ministry of Agriculture and key partners in the sector. The French Law for the Future of Agriculture, Food and Forestry (LAAAF of October 13, 2014) actively promotes agroecological approaches and has set a target of implementing these on 200,000 French farms by 2025[94].

91 https://www.kew.org/science/our-science/projects/amazon-agroforestry-silvopastoral
92 https://www.kew.org/about-us/reports-and-policies/conservation-and-sustainable-use
93 http://agriculture.gouv.fr/telecharger/58144?token=84c0ffff0caf34ea89f434e9745865a2
94 https://www.pan-uk.org/site/wp-content/uploads/Agroecology-Update-French-National-Agroecology-Programme-Sep-16.pdf

Box T6.2. Conserving rare arable plants in Germany

The diversity of arable plant communities has declined substantially due to intensification of farming practices. Albrecht *et al.* (2014) explored the potential for reintroduction of two rare arable plant species to organic farming areas, where management is less intense.

The investigation took place in the northern Munich Plain (Germany) where there is high percentage of arable farming used to support a number of rare species that have declined. Seeds of two species *Consolida regalis* and *Legousia speculum-veneris*, classified as 'endangered' in the Red List of endangered plants in Germany, were sourced from an arable field reserve, 'Kastner Grube', previously established to conserve the remaining populations of rare arable plants in this region. These two species are also important arable plant species requiring conservation at a European scale. Seeds from the reserve were propagated and sown in experimental field plots of the Seidlhof Stiftung, close to Gräfelfing to the west of Munich. A preliminary survey found the species to be absent from trial plots prior to sowing.

Seeds of the two species were sown along with different densities of winter rye and winter spelt to test how they established under normal, and two levels of reduced, arable crop sowing rates. A trial also involved different sowing dates. The results suggested that under certain conditions these rare arable plants could be successfully introduced to organically-managed fields. The best results were found when the seeds were sown in the early autumn, and under reduced crop sowing rates, which reduces competition. With reduced crop sowing rates, winter spelt resulted in a much better seedling establishment than winter rye. The result showed considerable potential for the introduction of rare arable species to organic farmland.

Source: Albrecht *et al.* 2014.

Target 6 – issues to consider

- Achieving this target is critical for future sustainability and to tackle the dual climate and biodiversity crises. Within the EU, measures to help tackle these crises are a key feature of the post 2020 CAP but for new measures to succeed where previous reforms have failed the CAP must be fully aligned with the SDGs and the EU must have clearly defined 2030 targets as to where agriculture and forestry must make a measurable contribution (e.g. see Meredith 2019).
- From a reporting perspective, there may be insufficient communication between the agricultural and environmental sectors in some countries, and data collected under FAO/agriculture frameworks may not always be accessed for CBD reporting.

References

Albrecht, H., Prestele, J., Altenfelder, S., Wiesinger, K. and Kollmann, J. 2014. New approaches to the conservation of rare arable plants in Germany. Deutsche Arbeitsbesprechung über Fragen der Unkrautbiologie und -bekämpfung, 11.-13. März 2014 in Braunschweig. Julius-Kühn-Archiv, 443: 180-189. 2014. DOI 10.5073/jka.2014.443.021

Batáry, P. Dicks, L.V., Kleijn, D. and Sutherland, W.J. 2015. The role of agri-environment schemes in conservation and environmental management. Conserv. Biol.29: 1006–1016.

Eurostat 2017. Statistics Explained. Agri-environmental indicator – commitments. Data from June 2017. https://ec.europa.eu/eurostat/statistics-explained/index.php/Agri-environmental_indicator_-_commitments

Meredith, S. 2019. Getting to the roots of sustainable land management: A briefing on the Common Agricultural Policy in the EU Post-2020, Briefing for iSQAPER by IEEP. https://ieep.eu/uploads/articles/attachments/0f3a7514-3c95-4e10-aba5-012624caedc1/Getting%20to%20the%20roots%20of%20sustainable%20land%20management%20(IEEP,%20December%202019).pdf?v=63742773501

Pywell, R.F., Heard, M.S., Bradbury, R.B., Hinsley, S., Nowakowski, M. *et al.* 2012. Wildlife-friendly farming benefits rare birds, bees and plants. Biol. Lett. 8: 772–775. doi:10.1098/rsbl.2012.036

UN Economic and Social Council 2019. Report of the Secretary-General 8 May 2019. Special edition: progress towards the Sustainable Development Goals United Nations publication issued by the Department of Economic and Social Affairs ISBN: 978-92-1-101403-7 https://undocs.org/E/2019/68

Target 7: At least 75% of known threatened plant species conserved *in situ*

One in five of the world's vascular plants is currently threatened with extinction (RBG Kew, 2016): the need for conservation and restoration of plant diversity is urgent. Where possible, *in situ* conservation is the primary aim of conservationists, although *ex situ* conservation can play a key role in helping to achieve this (e.g. see Target 8). Species *in situ* function as parts of ecosystems and sometimes play roles that cannot readily be replicated by other species. In situ, evolutionary processes can continue, providing the opportunity for species to adapt to changing environmental conditions. Also, some species can be difficult to conserve *ex situ*, for example those whose life histories are closely bound to other species in their direct environment or those whose seeds are very difficult to store (such as recalcitrant seeds).

The conservation of threatened plants *in situ* requires the identification and protection of the habitats and locations in which they occur, identifying and addressing the factors that have caused them to become threatened, often the direct conservation of the species through active management, and monitoring the success of these actions.

Geum rivale *introduction to reinforce the populations on the edge of its range - Philippe Bardin*

European Progress

European conservation status has been assessed for only a small proportion of vascular plants (c. 10-20%[95]) (Section 5.2 T2), although a higher proportion of threatened than non-threatened species are likely to have been assessed. GSPC Target 7 is for *known* threatened species; as the number of known threatened species increases with each new IUCN European Red List assessment this target will require increasing and ongoing effort. However, many countries have information on plant species threatened at national level.

The conservation of plant species *in situ* in Europe is delivered by actions taken as a result of national requirements and as a part of European agreements and EU regulation. The Emerald Network[96] is the network of sites established at European level to ensure the long term conservation of species and habitats of European importance and protected under the Bern Convention. The EU contribution to this is *via* the Natura 2000 network of sites established under the EU Birds and Habitats Directives (Box T7.1; Appendix V). Between the Habitats Directive reporting periods 2007-2012 and 2013-2018[97] the proportion of all EU Member State assessments for habitats that reported Good (Favourable) conservation status did not increase[98]. While the figures for these two periods are not necessarily directly comparable, as reporting methods or data quality may have changed, this is nonetheless of concern.

95 depending upon the definition of Europe and whether regional or global conservation status are considered – see Sections 3.2 and 5.2T2

96 https://www.coe.int/en/web/bern-convention/emerald-network

97 https://www.eea.europa.eu/themes/biodiversity/state-of-nature-in-the-eu/article-17-national-summary-dashboards/conservation-status-and-trends Source: Member State reported data on the conservation status of habitat types (Article 17, Habitats Directive 92/43/EEC). Accessed 03.05.20.

98 NB. Filtering with the function (All) for Member States does not show the EU conservation status and trends but only the sum up of the relevant national data.

Box T7.1. The EU Habitats Directive and Natura 2000 Network

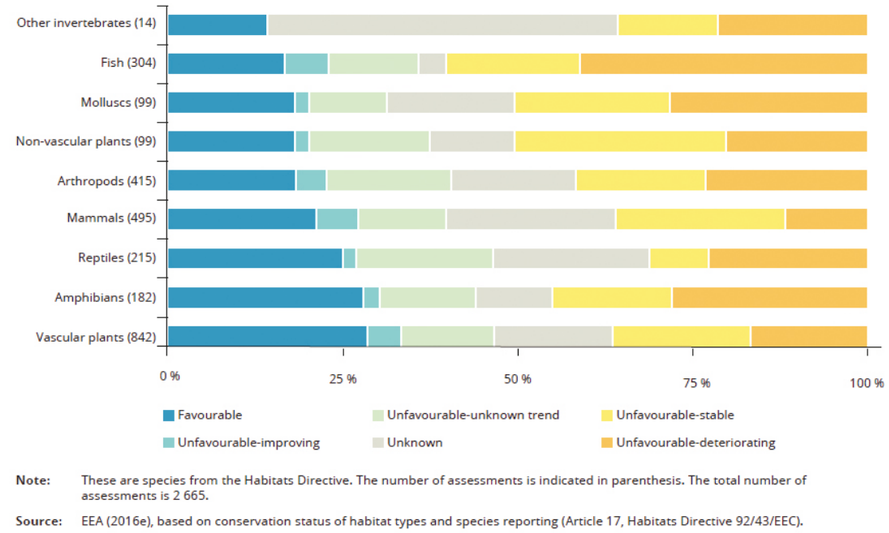
Under the EU Habitats Directive[99], certain natural habitat types of community interest (listed on Annex I) and species of plants and animals of community interest (that are rare, threatened or endemic - listed on Annex IIb for plants) require the designation of Special Areas of Conservation (SACs). The Habitats Directive also lists plants and animals (except birds which are covered by the Birds Directive) in need of strict protection (i.e. those in Annex IIb plus additional plant species listed in Annex IVb). Such protection prohibits: (a) the deliberate picking, collecting, cutting, uprooting or destruction of such plants in their natural range in the wild and (b) the keeping, transport and sale or exchange and offering for sale or exchange of specimens of such species taken in the wild, except for those taken legally before the Directive was implemented. Together, SACs listed under the Habitats Directive and Special Protection Areas (SPAs) listed under the Birds Directive form the Natura 2000 network of EU protected sites. The Natura 2000 network now includes about 28,000 sites and covers over a million square kilometres, 18% of the EU's land area, and almost 6% of its marine territory[100] making it the largest coordinated network of protected areas in the world.

Habitats Directive Article 6 (Paragraphs 6(1) and 6(2)) requires Member States to take measures within the Natura 2000 network to maintain and restore the habitats and species in a favourable conservation status. This includes avoiding those activities that could significantly disturb these species or result in deterioration of their habitats or damage habitat types. Member States are required to report every six years on progress made with the implementation of the Habitats Directive. This involves monitoring and reporting on the conservation status and trends of habitat types and species of community interest. This is not restricted to Natura 2000 sites and data need to be collected both inside and outside the Natura 2000 network to obtain a more complete picture of conservation status. The most recent assessments of species and habitats protected under the Habitats Directive show predominantly unfavourable conservation status at 60 % for species and 77 % for habitats (EEA 2019 - SOER 2020). Figures T4 and T7 show trends in conservation status for assessed habitats and plants (vascular and non-vascular) respectively.

While the Natura 2000 network is widely acknowledged as one of the best policy tools for conserving sites, improvements have been suggested. For example the Annexes, based upon best available information at the time, only include a proportion of threatened species and are not regularly updated to take account of new knowledge (Cardoso 2012). However, it has been argued that the key priority is to ensure effective implementation of the Habitats Directive and that calling for changes presents a distraction from this urgent task (Maes *et al.* 2013).

The extensive Natura 2000 network already protects a wide range of species, habitats and functions not specifically mentioned within the Annexes, and the Habitats Directive (Article 10) makes provision for Member States to improve the ecological coherence of the Natura 2000 network. This includes maintaining and managing landscape features outside of the network that are particularly important for wild species. To ensure adequate protection of all threatened plants additional measures are undoubtedly needed, along with mechanisms for making available European Union and other funding to support their conservation.

99 https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:01992L0043-20130701
100 https://ec.europa.eu/environment/nature/natura2000/index_en.htm

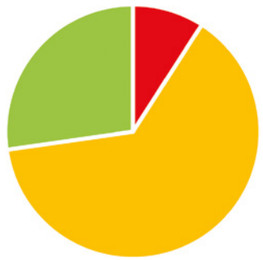


Note: These are species from the Habitats Directive. The number of assessments is indicated in parenthesis. The total number of assessments is 2 665.

Source: EEA (2016e), based on conservation status of habitat types and species reporting (Article 17, Habitats Directive 92/43/EEC).

Figure T7. Trends in conservation status of assessed non-bird species at EU level (Reproduced from FIGURE 3.3 European Environment Agency State and Outlook 2020, EEA 2019)

National implementation



Target 7

Most countries reporting against Target 7 consider that progress is being made but at an insufficient rate; three countries reported being on track to meet this target and one country reported no progress.

Most EU countries reporting on this Target have reported against requirements under the Habitats Directive (FigureT7.1), although it has been acknowledged that this is not necessarily a direct measure of progress towards Target 7. **In Austria**, at least one Natura 2000 site is listed for each of 37 plant species occurring on Annex IIb. **In Finland**, almost all vascular plant and bryophyte species listed in Appendices IId and IVb have populations on Natura 2000 sites.

In Ireland 60-80% of locations of rare species of conservation concern occur within nationally designated areas. Plant species of conservation concern found outside designated areas were mainly found in pastures (49.3%) and land occupied by agriculture (5.6%). (cited from Walsh *et al.* 2015).

In **Norway**, under the 'Prioritized Species' instrument, small *in situ* protected areas have been established for a limited number of plant species.

While the inclusion of species within protected sites represents a key step, the conservation of species, particularly when they are threatened, usually requires active management. Such management may include removing the factor(s) that resulted in a species becoming threatened and/or taking actions required for its restoration to favourable conservation status (e.g. see Box T7.2.). Provision is made for active conservation management within the CBD Articles that GSPC helps to deliver. These are: CBD Article 8 clause (d) *"Promote the protection of ecosystems, natural habitats and the maintenance of via-*

ble populations of species in natural surroundings"; and Article 8 (f) *"Rehabilitate and restore degraded ecosystems and promote the recovery of threatened species, inter alia, through the development and implementation of plans or other management strategies"*. Active conservation strategies, e.g. action plans, have proven a very useful tool to help guide the conservation of threatened species and in **Metropolitan France and several overseas territories** a number of national action plans[101] have been developed to help define actions needed to conserve and restore to good conservation status of some of the most threatened plant species in the Metropolitan France and in the overseas territories. These plans will soon include multi-species and habitat plans which aim to identify actions that contribute to the conservation of several species simultaneously. In **Switzerland**, action plans exist for about 60 of 196 threatened plant species with high or very high priority for conservation action, and an estimated 25-50 % of the 725 threatened plant species on the Swiss Red List are conserved *in situ*. In the **UK** plant species individually, or as components of habitats, are a designated feature on many protected areas. A high proportion of the good quality habitat that remains is protected by statutory designations such as SSSIs (ASSIs in Northern Ireland) and most of these sites have management plans that are actively being implemented. In **Spain** recovery or conservation plans are developed for endangered or vulnerable plant species respectively. There are 82 approved recovery or conservation plans for flora species; 19 for listed species, 8 for vulnerable species and 55 for endangered species. Through a gap analysis, Muñoz Rodríguez *et al*. (2016) found that only 44.4% of threatened plant species were effectively conserved *in situ* in Spain, and suggested that additional natural protected areas were needed with a management focus on the conservation of threatened plants for Spain to meet GSPC Target 7.

Box T7.2. Dianthus morisianus reintroduction in Sardinia

Dianthus morisianus (*Caryophyllaceae*) is a Critically Endangered species endemic to the island of Sardinia (**Italy**). A conservation project including the introduction of protective fences, reintroduction and other measures was funded by the Autonomous Region of Sardinia. Two hundred seeds were collected over a 2 year period and germinated and 113 surviving juvenile plants were reintroduced 150m from the wild population. Monthly monitoring showed a survival rate in excess of 95% two years after reintroduction, with a fruit yield per plant higher than that of the original wild population. The success of this project was considered to have resulted from the use of juvenile plants, good knowledge of the species' biology, and the identification of an appropriate microhabitat for reintroduction.

Source: Cogoni *et al*. 2013.

Once sites containing rare plants have been designated and actions are being taken to improve their conservation status, monitoring is essential to judge their success and adapt measures if necessary. In **Ireland** a new rare plant-monitoring scheme was launched by the National Biodiversity Data Centre (NBDC[102]) in 2017 focussed on monitoring vulnerable, near threatened and those least concern species that are rare as highlighted in the 2016 Vascular plant Red Data book. Volunteer recorders visit rare plant populations annually, record numbers and locations and submit the data online. In 2017, volunteers monitored 37 populations across 22 species. In 2018, volunteers monitored 108 populations across 53 species.

101 https://inpn.mnhn.fr/telechargement/documentation/plans-nationaux-d-actions
102 https://www.heritagecouncil.ie/our-work-with-others/national-biodiversity-data-centre

Target 7 – issues to consider

- For most species, reintroductions or other conservation methods as translocations are not strictly needed, but an acceptable conservation level only can be reached through habitat management and/or ecological restoration.
- Precise information on the distributions of threatened species is lacking in many countries and additional data are needed. This will help with the targeting and evaluation of *in situ* conservation measures.
- In terms of evaluating the number of threatened plant species identified in Europe that are present in protected areas, a comparison could be made of the distribution of threatened plants in Europe (where this is known with sufficient precision) (see IUCN Red Lists under Target 2) and the World Database of Protected Areas (IUCN & UNEP-WCMC 2016). A similar analysis has recently been conducted for the world's trees (Figure 7 in Sharrock 2019) but as far as we are aware no Europe-wide assessments are currently available for either threatened trees or vascular plants in general. However, an analysis has been conducted for vascular plants in Spain (Muñoz Rodríguez *et al*. 2016) and other national analyses may exist.
- Updating of the Habitats Directive Annexes should be considered. In addition, some species protected by the Directive have been recently classified as exotic species (i.e. *Marsilea azorica*). Only a proportion of threatened species are included and updating of the Annexes would also enable account to be taken of more recent information (Box T7.1).
- In some countries additional sites are needed with a management focus on the conservation of threatened plants if Target 7 is to be met
- The effective conservation of threatened species requires protection of the habitats and sites where they occur, usually supplemented by active conservation measures. Action plans have been developed in some countries and provide a useful guide and set of targets to help with species conservation. However, resources limit this activity and additional effort in this area would be beneficial.
- Regional collaboration is important for species whose distributions cross national boundaries. For example, it may be important to conserve individuals of a species on the edge of its distribution, even if the species as a whole is not presently threatened, in order to capture unique diversity.

Topsoil and vegetation removal to restore rich acidic forest ponds in Rambouillet forest, France - A. Potier CBNBP/MNHN

References

Cogoni, D., Fenu, G., Concas, E. and Bacchetta, G. 2013. The effectiveness of plant conservation measures: The Dianthus morisianus reintroduction. *Oryx* 47(2): 203-206. doi:10.1017/S003060531200169X

EEA 2019. (SOER 2020).The European environment —state and outlook 2020. Knowledge for transition to a sustainable Europe. European Environment Agency. ISBN 978-92-9480-090-9 doi: 10.2800/96749

RBG Kew, 2016. State of the World's Plants. Royal Botanic Gardens, Kew, Richmond.

IUCN & UNEP-WCMC 2016. The World Database on Protected Areas (WDPA). Available: www.protectedplanet.net

Maes, D. Collins, S., Munguira, M.L., Martina Sašić, M., Settele, J. *et al.* 2013. Not the right time to amend the annexes of the European Habitats Directive. *Conserv. Lett.* 6: 468–469.

Muñoz Rodríguez, P., Draper Munt, D. and Moreno Saiz, J.C. 2016. Global strategy for plant conservation: inadequate *in situ* conservation of threatened flora in Spain. *Israel J. Plant Sci.* 63(4):1-12. DOI: 10.1080/07929978.2016.1257105

Sharrock, 2019. A review of progress towards the Global Strategy for Plant Conservation 2011-2020 Draft 3 November 2019.

Walsh, A., Finn, J., Jebb, M. Waldren, S. and Sullivan, C. 2015. The distribution of vascular plant species of conservation concern in Ireland, and their coincidence with designated areas. *J. Nat, Conserv.* 24: 56-62.

Target 8: At least 75 per cent of threatened plant species in *ex situ* collections, preferably in the country of origin, and at least 20 per cent available for recovery and restoration programmes

Ex situ *multiplication of the very rare and threatened fern* Marsilea quadrifolia – *Philippe Bardin*

The conservation of intact wild populations *in situ* is vital (see Target 7). However, the high proportion of species threatened with extinction (one in five - RBG Kew 2016) as a result of threats ranging from habitat loss and degradation to the effects of invasive species and climate change means that their continued survival in the wild often requires the use of a number of active management techniques. A key technique used for both plant and animal taxa is population supplementation or reintroduction. For plants, the *ex situ* maintenance of wild plant species and their genetic diversity, along with associated research, is usually carried out by botanic gardens and other similar institutions. These institutions play an important role in aiding in the conservation of the world's plant species in the wild. Ex situ plant collections include both 'living collections' of actively growing plants, and plant material stored in a variety of other ways that can include seed banks, tissue cultures and other techniques. One of the most frequently used techniques is seed banking, where seeds collected from wild plants are dried and stored in cool conditions.

PlantSearch[103] is a searchable database set up by BGCI and is the only global database containing information on plant taxa held in botanic gardens and other similar organisations. It holds data on hundreds of living plant collections and taxon-level data from gene and seed banks, cryopreserved and tissue culture collections. It is a useful tool for horticulturists, scientists, conservationists and other land managers and policy makers. The PlantSearch database revealed that around 30% of all known plants are represented in living collections and/or seedbanks (Sharrock 2019).

Effective *ex situ* conservation of the European flora and its genetic diversity remain incomplete if Northern Africa and Western Asia are not included in the networks of seed banks. GENMEDA (http://www.genmeda.net/), the Network of Plant Conservation Centers, created in 2010, currently counts 18 institutions from Southern Europe, Northern Africa and the Middle East. They develop joint projects associating *ex situ* conservation actions with in situ recovery actions for endangered species and ecological restoration of their critical habitats.

While *ex situ* collections provide a key conservation tool, it is recognised that there are phylogenetic and biogeographical gaps in species representation. For example globally, about three quarters of the species absent from living collections are tropical species; phylogenetically, over half of vascular genera but only about 5% of non-vascular genera are conserved *ex situ*. Botanic garden collections include about 41% of known threatened plant species (Mounce *et al.* 2017).

European Progress

Mounce *et al.* (2017) in their analysis of *ex situ* plant conservation found that botanic gardens are disproportionately temperate, with 93% of species held in seed banks located in the Northern Hemisphere.

Europe has at least 884 botanical gardens in the 46 countries[104]. A disproportionately large number of botanic gardens and arboreta involved in seed banking, relative to plant diversity in the wild, occur in Europe. Over 20 institutions occur in France alone, mainly through the Conservatoires Botaniques Nationaux network (O'Donnell & Sharrock 2017). The largest wild plant seedbank is held at RBG Kew (Box T8.1.).

Seed harvesting for threatened species - Philippe Bardin

103 https://www.bgci.org/resources/bgci-databases/plantsearch/
104 https://tools.bgci.org/garden_search.php

Box T8.1. The Millennium Seed Bank

Over half of the diversity known to exist in botanic garden collections around the world is conserved as seed, and the Millennium Seed Bank (MSB[105]) at the Royal Botanic Gardens Kew's Wakehurst Place (UK) is a key repository holding about two thirds of the taxa held as seeds globally (i.e. 37,000 of 57,000 taxa held as seeds - O'Donnell and Sharrock, 2017). The MSB's seed collection is growing and it aims to provide a safety net for species at risk of extinction. Thanks to the contributions from a network across more than 95 countries (the Millennium Seed Bank Partnership), the MSB is the largest and most diverse wild plant species genetic resource in the world.

In 2009, Britain became the first country in the world to have preserved *ex situ* its botanical heritage as the MSB had stored seeds from all the UK's native plant species – except for a handful of species that are either very rare or whose seeds are particularly difficult to store.

See also Chapman *et al.* 2018 for discussion and details of the MSB.

A Consortium of European native seed conservation organisations (ENSCONET)[106], collaborates to preserve seeds for the future. In 2017, Rivière *et al.* (2018) assessed the contribution of ENSCONET (2004-2009) and the ENSCONET Consortium (since 2010) towards meeting GSPC target 8 and found that 62.7% of European threatened species were conserved *ex situ* in seed banks. The Consortium identified key actions needed to help meet Target 8 by 2020.

Freeze-dried seeds of very rare species in the seed bank of the Conservatoire botanique national du Bassin parisien- Philippe Bardin

105 https://www.kew.org/wakehurst/whats-at-wakehurst/millennium-seed-bank
106 ENSCONET members: Royal Botanic Gardens, Kew (UK), National and Kapodistrian University, Athens (Greece), Institute of Botany, Slovak Academy of Sciences, Bratislava (Slovakia), Budapest Zoo & Botanical Garden (Hungary), Mediterranean Agronoic Institute Chania (Crete), IMGEMA - Jardín Botánico de Córdoba (Spain), Trinity College Dublin (Ireland), Jardín Botánico Viera y Clavijo Gran Canaria (Spain), Agricultural Research Institute (Cyprus), Universidad Politécnica de Madrid (Spain), National Botanic Garden (Belgium), Muséum National d'Histoire Naturelle Paris (France), Università di Pavia/Centro Flora Autoctona della Lombardia (Italy), Università di Pisa, Orto Botanico (Italy), Jardí Botànic de Soller (Spain), Museo Tridentino di Scienze Naturali Trento (Italy), Jardí Botànic, Universitat de València (Spain), Department of Biogeography & Botanic Garden, University of Vienna (Austria), Botanical Garden Polish Academy of Sciences Warsaw (Poland), Botanischer Garten und Botanisches Museum Berlin-Dahlem (Germany), Helsingin yliopisto, Helsinki (Finland), Jardim Botânico - Fundação da Universidade de Lisboa (Lisbon), Botanical Garden, Natural History Museum, University of Oslo (Norway), Institute of Botany - Bulgarian Academy of Sciences (Bulgaria).

National implementation

Target 8

Most countries reporting against Target 8 consider that progress is being made but at an insufficient rate. Three countries reported being on track to meet this target and two countries reported no progress against this target.

Ex situ conservation activities are active in the majority of countries providing national reports on this target.

An example of a recent project is the Pannon Seedbank (Research Centre for Agrobiodiversity 2014), established under an EU LIFE+ funded project between 2010 and 2014[107].

The Pannonian region has a diverse vascular flora and a gene bank was established in **Hungary** comprising approximately 50% (844 species) of Hungarian native wild vascular flora, including 197 protected species and 45 strictly protected species. Krigas *et al.* (2016) investigated the extent to which *ex situ* conservation of **Greek** flora, particularly threatened flora, meets Target 8. They found that 268 of 558 threatened and near-threatened endemic species were represented *ex situ*. Of these, 44.8% were accessioned in a single botanic garden. 48.9% were accessioned in a single seed bank, with 25% represented by a single accession number. These authors reported that only 6.4% of taxa were represented by five or more accessions deposited in two institutions of two countries, and thus effectively conserved *ex situ*. In **Serbia**, the Bryophyte Biology Group in Belgrade maintains a collection of over 260 mainly European bryophyte species, over 60% of which are rare, threatened or protected in some European countries or Europe wide (Marko Sabovljevic *pers comm.*).

National networks exist in some countries to facilitate the sharing of expertise and material in addition to regional networks and the ENSCONET Consortium. An example is the Conservatoires botaniques nationaux[108] in **France** that partner with botanic gardens within several French regions.

Many national botanic gardens across Europe (including RBG Kew, Box T8.1) contribute significantly to both *ex situ* and *in situ* conservation of threatened plants from other global regions, and make available or use material for restoration programmes in Europe or elsewhere (e.g. see Box T8.2.). Some national botanic gardens specialise in flora from certain regions, or certain floral taxa. For example, Meise Botanic Garden in **Belgium** aims to hold 75% of threatened *Euphorbia* and *Xanthorrhoeaceae* in its *ex situ* collections (it currently holds at least one accession for 50% of the 199 Euphorbia species assessed by IUCN as VU, EN or CR), and has one of the most species-diverse orchid collections with 470 orchid species.

107 Coordinated by the Research Centre for Agrobiodiversity at Tápiószele in cooperation with Centre for Ecological Research Institute of Ecology and Botany of the Hungarian Academy of Sciences at Vácrátót and Aggtelek National Park Directorate, with the financial support of LIFE+ Biodiversity fund and Ministry of Agriculture.
108 http://www.fcbn.fr/nous-conna%C3%AEtre/les-cbn

Box T8.2. The Conservatoire botanique national de Brest (France) - Helping save the threatened plants of Mauritius

Along with the in and *ex situ* conservation of their indigenous flora, The Conservatoire botanique national de Brest[109] has been involved in reintroducing extinct or endangered species to Mauritius. Mauritius has a high rate of endemism with many plant species endangered or extinct in the wild. A collection initiated in the 1970s and held at the Conservatoire botanique national has contributed to the conservation of a number of species that may otherwise have gone extinct.

From 2011-2015, the Conservatoire botanique national led a programme to help return about 30 species of endangered plants to Mauritius. This was made possible by decades of scientific, technical and financial collaborations with a wide range of organisations[110]. Advances in the conservation of some of these species included the following:

- The endemic *Dombeya mauritiana* is a dioecious tree with male and female reproductive systems on separate plants. In 1993, the only known plant was male, so to avoid extinction, it was cultivated at the Conservatoire botanique national. Hormone therapy was used to convert male flowers to female flowers and after pollination these flowers produced seeds.
- In 1977, Jean-Yves Lesouëf harvested the seeds from wild *Cylindrocline lorencei* plants just before they disappeared in 1990. Although the Conservatoire botanique national stored them in their seed bank, they would not germinate naturally. However, in collaboration with the Institut national de la recherche agronomique (INRA) of Ploudaniel, the use of new biotechnologies enabled the successful regeneration of plants in 2000. This has enabled reintroductions to be planned.

Target 8 – issues to consider

- Increased emphasis on threatened species could substantially increase the plant conservation role of botanic gardens. While they already play a key role, only 10% of capacity in the botanical garden network is devoted to threatened species (Mounce *et al.* 2017). Similarly, an analysis of data from the BGCI databases suggested that while institutions are increasingly conserving plant species *via* seed banking, most species in collections that have a conservation assessment are not threatened with extinction (O'Donnell and Sharrock 2017). Conservation of threatened species is a high priority and the BGCI database can help prioritise new species for seed banking.

Geum rivale *seeds - Radia Dahmani*

- Although there is a good proportion of wild European species included in germplasm banks, their accession often are not representing the true diversity of the species' populations (Ferrando et al. 2016). A significant effort must be done to capture the maximum diversity, collecting seeds from a large range of populations, particularly for the endangered species.
- There are lots of germplasm banks and seed reservoirs devoted to active conservation of seeds for forestry or agricultural practices, but often few connected with the networks of seedbanks of botanical gardens. A stronger collaboration between all these institutions is needed.
- The disproportionately large number of institutions conducting seed banking in Europe relative to the number of wild plants, compared with other global regions rich in plant diversity, highlights the international contribution that they can make, but also sheds light on the need for more *ex situ* conservation in the countries of origin of threatened plants.
- Genetically representative *ex situ* collections of threatened species are important for research and restoration activities. Maximising genetic diversity in collections, and increasing the number of accessions of threatened species across the networks of botanic gardens and seed banks will increase their utility for conservation actions including restoration, translocation, reintroduction and other uses.
- As noted recently (Sharrock 2019) monitoring progress towards both Targets 7 and 8 is hampered by the low proportion of species whose conservation status has been assessed, and this highlights the need for additional effort on Target 2, assessing the conservation status of species, at national and global levels. Additional work on threatened species whose seeds are difficult to store is needed along with alternative of supplementary storage and conservation methods including tissue culture, cryopreservation, or maintenance in living collections.

109 http://www.cbnbrest.fr/nos-actions-phares/109
110 Organisations included L'Arche aux plantes, Lafarge, National Parks and Conservation Service, Vegenov, INRA Ploudaniel, Contributors to the crowdfunding call "Return of a missing plant to its native island"

References

Chapman, T., Miles, S. and Trivedi, C. 2018. Capturing, protecting and restoring plant diversity in the UK: RBG Kew and the Millennium Seed Bank. *Plant Diversity* 41: 124-131

Ferrando, I., Ferrer-Gallego, P.P. & E. Laguna. 2016. Assessing the conservation value of ex situ seed bank collections of endangered wild plants. Israel Journal of Plant Sciences 63(4): 333-346.

Krigas, N., Menteli, V. and Vokou, D. 2016. Analysis of the *ex situ* conservation of the Greek endemic flora at national European and global scales and of its effectiveness in meeting GSPC Target 8, *Plant Biosystems* - An International Journal Dealing with all Aspects of Plant Biology, 150:3, 573-582, DOI: 10.1080/11263504.2014.988194

Mounce R., Smith P. and Brockington S. 2017. Ex situ conservation of plant diversity in the world's botanic gardens. *Nat. Plants* 3: 795-802. DOI:10.1038/s41477-017-0019-3

O'Donnell, K and Sharrock, S. 2017 The contribution of botanic gardens to *ex situ* conservation through seed banking[J]. *Plant Diversity* 39(6): 373-378.

Research Centre for Agrobiodiversity 2014. Pannon Seedbank. Laymans Report. Establishment of the Pannon Seedbank for the long-term *ex situ* conservation of Hungarian vascular wild plants.

http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=home.showFile&rep=file&fil=LIFE08_NAT_H_000288_LAYMAN.pdf

Rivière, S., Carta, A., Breman, E., Müller, J.V. and Kiehn, M. 2018. How to meet the 2020 GSPC target 8 in Europe priority-setting for seed banking of native threatened plants *Biodivers. and Conserv.*27(8): 1873-1890. DOI 10.1007/s10531-018-1513-2

Sharrock, S. 2019. A review of progress towards the Global Strategy for Plant Conservation 2011-2020 Draft 3 November 2019.

Target 9: 70 per cent of the genetic diversity of crops including their wild relatives and other socio-economically valuable plant species conserved, while respecting, preserving and maintaining associated indigenous and local knowledge

A collection or Armenia's wild pear leaves, demonstrating the genetic diversity within the genus (FFIGTC project) - Anna Asatryan

Genetic variation in plant species that are valuable to human society depends upon that in their wild ancestral species and on subsequent variety breeding. For example, plant breeders exploit the gene pool in wild relatives of current crops (Crop Wild Relatives – CWR) and landraces (LR)[111] to help to introduce new genetic variation to a crop's gene pool when needed. This technique helps to ensure that crops or other valuable plants are more able to adapt to environmental changes and changing human demands. The full range of genetic variation needs to be maintained and allowed to evolve in wild relative species to provide a key part of the plant genetic resources for food and agriculture (PGRFA) that can be used to help to protect crops and other valuable plants against losses in genetic variation and to improve food security (e.g. see Maxted *et al.* 2013).

Globally, the process of conserving PGRFA is managed by the Food and Agriculture Organisation (FAO) of the UN, on behalf of the Commission on Genetic Resources. Thirty eight of 47 European countries are full Contracting Parties to the International Treaty on Plant Genetic Resources for Food and Agriculture[112].

The Crop Trust[113] established by Bioversity International on behalf of CGIAR (formerly the Consultative Group on International Agricultural Research) and the UN Food and Agriculture Organization, aims to ensure the conservation and availability of crop diversity for food security worldwide. It provides funding, coordination between crop conservation storage organisations, tools to support gene bank management and a backup of crop seeds in the Svalbard Global Seed Vault[114]. Global crop conservation strategies have been developed for 26 crops.

Conservation of crops and CWR requires a combination of both *in situ* and *ex situ* techniques. An investigation of the conservation status and availability of 1,076 taxa related to 81 crops found that the diversity of CWRs was poorly represented in herbaria and gene banks with >95% insufficiently represented with respect to their geographic and ecological variation in the wild. Key collection gaps included the Mediterranean and the Near East along with western and southern Europe (Castañeda-Álvarez *et al.* 2016). However, this analysis did not include all botanic garden collections, many of which contain a large number of CWRs. Southeastern Europe was previously recognised as having a particularly high number of CWR with 181 species identified (Vincent *et al.* 2013).

European Progress

> *"The species diversity of arable crops has decreased by 20 per cent since 1950 in Western and Central Europe, and the abundance of rare arable plants has also decreased (established but incomplete). The genetic diversity of plants cultivated* in situ *declined until the 1960s, owing to the replacement of landraces by modern cultivars, and no further reduction or increase of diversity was observed after the 1980s* (well established)".
>
> Source: IPBES 2018
>
> PBES (2018): Summary for policymakers of the regional assessment report on biodiversity and ecosystem services for Europe and Central Asia of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. M. Fischer, M. Rounsevell, A. Torre-Marin Rando, A. Mader, A. Church, M. Elbakidze, V. Elias, T. Hahn, P.A. Harrison, J. Hauck, B. Martín-López, I. Ring, C. Sandström, I. Sousa Pinto, P. Visconti, N.E. Zimmermann and M. Christie (eds.). IPBES secretariat, Bonn, Germany. 48 pages.

Within the European Union, at Commission level, activities for the conservation and sustainable use of genetic resources for food and agriculture cut across several policies and competencies including agriculture, the environment, health, industry and research and innovation[115]. EU research on genetic resources for agriculture and forestry includes work on; genetic diversity, *in situ*/*ex situ* conservation, use of and access to genetic resources, CWR and LR, genetic characterisation and advances in crop production through optimising Genotype x Management x Environment (GxMxE) interactions. The funding for such research comes under a variety of Framework Programmes. Collaborative initiatives receiving such funding have included the PGR Secure (Plant Genetic Resources Secure[116]) project with 11 partners from agrobiodiversity conservation institutions across 8 countries collaborating on research for the conservation and characterization of Crop Wild Relatives and Landraces as a basis for crop improvement.

The European Search Catalogue for Plant Genetic Resources (EURISCO[117]) provides information on over 2 million accessions of crop plants and CWRs, preserved *ex situ* by almost 400 institutes. It provides information on the genetic diversity kept by collaborating institutions in 43 member countries and is based on a network of national inventories.

111 A traditional domesticated plant variety that has adapted to local conditions over time and through isolation from other populations of the species.
112 http://www.fao.org/plant-treaty/countries/en/
113 http://coptrust.org
114 https://www.seedvault.no/

115 Including: Directorate General for the Environment (DG ENV): Convention on Biological Diversity, Nagoya Protocol etc.; Directorate General for Health and Food Safety (DG SANTE): International Treaty on Plant Genetic Resources for Food and Agriculture and seed legislation; Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs (DG GROW): Patents (including in breeding); Directorate-General for Agriculture and Rural Development (DG AGRI): Promotion and use of genetic resources agriculture (and forestry); DG AGRI (+Directorate-General for Research and Innovation): Research and innovation for genetic resources in agriculture and forestry). From: Schneegans, A.

https://ec.europa.eu/newsroom/document.cfm?doc_id=41433. Accessed 24.01.20
116 https://pgrsecurespain.weebly.com/
117 https://eurisco.ipk-gatersleben.de/apex/f?p=103:1

The European Cooperative Programme for Plant Genetic Resources (ECPGR[118]) is a collaborative programme among most European countries that aims to ensure the long-term conservation and facilitate the increased utilization of plant genetic resources in Europe. A number of ECPGR working groups have been set up including for many crops and also for medicinal and aromatic plants. The two concepts described below, together with the "A European Gene bank Integrated System" (AEGIS[119]) initiative, will form ECPGR's contribution to a future European strategy for the conservation of genetic resources for food and agriculture.

- The AEGIS initiative of ECPGR aims to efficiently conserve and provide access to unique germplasm in Europe through the establishment of the European Collection. The collection is a virtual European gene bank comprising European accessions conserved for the long-term by AEGIS Associate Members[120] on behalf of the ECPGR Member countries. The European Collection is available for use or conservation only for the purposes of research, breeding and training for food and agriculture.
- The ECGPR concept for *in situ* conservation of crop wild relatives in Europe in 2015 (Maxted *et al.* 2015, Box T9.1.) was developed because historically CWR conservation priorities in Europe had fallen between the agricultural and conservation communities.
- LR and sometimes obsolete cultivars are usually grown under non-mainstream agricultural systems, predominantly in marginal areas. They can offer various advantages, including adaptation to specific environments and economic or cultural values for farmers and local communities. The maintenance of the genetic diversity also provides benefits, including socioeconomic and environmental benefits, along with value associated with LR and related genetic resources as a source of useful traits for future crop improvement. The ECPGR Concept for on-farm conservation and management of plant genetic resources for food and agriculture (ECPGR 2017) was developed partly for these and associated reasons, but also to assure choice for farmers as many landraces and varieties remain in production.

Local children collect medicinal plants Hypericum alpestre *and* Thymus kotschyanus - *Anna Asatryan*

118 http://www.ecpgr.cgiar.org/about/overview
119 www.ecpgr.cgiar.org/aegis
120 http://www.ecpgr.cgiar.org/aegis/aegis-membership/overview/

Box T9.1. Recommendations for the *in situ* conservation of Crop Wild Relatives in Europe from the ECPGR Concept

1. European countries should nominate national Most Appropriate Wild Populations for inclusion in the European Integrated In situ CWR Network
2. The ECPGR In Situ and On-farm Conservation Network should nominate European Most Appropriate Wild Populations for inclusion in the European Integrated In situ CWR Network
3. Include *in situ* populations as well as *ex situ* accessions in the AEGIS project
4. Carry out IUCN Red List assessments of priority CWR taxa
5. Promote improved integration of CWR conservation with other biodiversity conservation activities in Europe
6. Integrate CWR conservation into *in situ* conservation activities
7. Undertake systematic and effective complementary CWR conservation at European and national levels
8. Engender greater collaboration and coordination among national and European efforts to promote CWR conservation and use and their integration with allied networks
9. Establish the evidence research base to underpin CWR conservation and use, e.g. a systematic assessment of climate change impacts on CWR conservation and use is needed
10. Create mechanisms to enhance the use of conserved CWR diversity in crop improvement programmes
11. Promote access to *in situ* conserved CWR diversity
12. Promote awareness of the value of CWR diversity
13. Establish a policy context for CWR diversity conservation in Europe
14. ECPGR should lobby the EC for greater *in situ* CWR conservation and broader PGRFA funding in Horizon 2020[121]

Recommendations are headlines adapted from Maxted *et al.* (2015).

Target 9 covers all economically valuable plant species and medicinal plants are an important group in this respect. The European Red List of Medicinal Plants (Allen *et al.* 2014) assessed the status of 400 vascular plants and found that 2.4% (nine species) were threatened and that insufficient information was available for status assessment for an additional 25 species. The key threat identified was collection in the wild (see Targets 11, 12, 13). Genetic conservation of these commercially important plants is covered by various programmes described above (e.g. ECPGR etc.).

121 Horizon 2020 is a EU Framework Programme that has provided funding for tackling genetic resource issues

National implementation

Target 9

The majority of countries reporting on GSPC Target 9 consider that progress is being made but at an insufficient rate. Two countries reported being on track to meet this target and two countries reported no progress against this target.

With respect to the inventory of crop plants, CWR and LR, and the storage of viable genetic material, there exist good coordination mechanisms across Europe as described above. However, the extent to which individual countries have been able to deliver on all aspects of the conservation of the genetic diversity of crops and other valuable plants, CWRs and LRs is variable. This requires survey and inventory and adequate conservation actions both *in situ* and *ex situ*.

A substantial number of species are valuable to society as crops of for other purposes, and identifying and documenting them, along with associated indigenous knowledge, presents a significant challenge.

In **Norway**, a recent analysis (Phillips *et al.* 2016 Box T9.2) has provided targeted recommendations for *in situ* and *ex situ* conservation of CWR.

Box T9.2. *In situ* and *ex situ* diversity analysis of priority crop wild relatives in Norway

Phillips *et al.* (2016) created a complete checklist of 2,538 CWR for indigenous Norwegian taxa and/or those populations of introduced taxa that have stable populations. This was prioritized according to the factors below to give a priority list of 204 CWR:

- CWR within the same genera as crops of high economic value
- CWR present in Annex 1 of International Treaty on Plant Genetic Resources for Food and Agriculture ITPGRFA
- CWR highlighted as being of specific importance to Norwegian research, culture and environment
- Taxa within the Harlan and de Wet inventory (using genepool concepts)

Species presence data were gathered from the Global Biodiversity Information Facility (GBIF) and used to predictively model species distribution. An ecogeographic land characterization (ELC) map was created to identify the best combination of *in situ* genetic reserves and *ex situ* collecting to represent the full range of ecogeographic diversity of taxa.

Complementarity analysis using a 10 km^2 grid cell network found that 201 priority taxa were represented in 19 complementary grid cells, with 54% (109) of the priority taxa having five or more populations within the network. An analysis of Protected Areas identified that 181 priority taxa were represented in 23 PAs.

For *ex situ* conservation, 24 taxa had accessions, and of these 15 had the minimum of five populations conserved throughout their ecogeographic range. 177 taxa did not have *ex situ* accessions.

This study provided recommendations for *in situ* and *ex situ* conservation of 204 priority CWR within Norway and highlighted the complementary nature of these and the need for both types of actions, particularly in light of climate change.

Source: Phillips *et al.* 2016

In **Finland**, approximately 87% of the CWR priority species are reported to have populations growing within the protected area network, although most are not being actively conserved. In contrast, only about 30% of Finnish CWR priority species are present in Finnish and Nordic seedbank collections.

In some countries, such as **Bosnia and Herzegovina**, rural depopulation is high resulting in a decline in traditional knowledge and practices, with an associated impact on indigenous varieties. In contrast, in other countries, for example **Ireland**, interest is increasing in some heritage varieties, such as grain crop varieties for craft brewing, and DAFM (The Department of Agriculture, Food and the Marine) have projects to genetically characterise these varieties. Information on indigenous and local knowledge and practices associated with Irish plant resources is also included in: "Ireland's Generous Nature: The Past and Present Uses of Wild Plants in Ireland" (Wyse Jackson 2014).

While most countries consider that they are not making sufficient progress to meet this target, many countries nonetheless contribute to the delivery of this target internationally as well as nationally. Some botanic gardens and national collections specialise in particular taxa from around the world with substantial collections of material held for specific crop plant taxa, e.g. wild banana species and varieties and wild beans at Meise Botanic Gardens, **Belgium**, and there is sharing of expertise between Europe and other global regions (e.g. Box T9.3.). The Millennium Seed Bank (RBG Kew, **UK**) holds accessions for 200 taxa related to 25 of 29 of the world's most important crops.

In addition to crop plants and CWRs, a wide range of other arable plants, including cornfield flowers and bryophytes, are highly threatened. The importance of these plants has been highlighted and key sites for their conservation in the **UK** identified (Byfield & Wilson 2005).

Box T9.3. *Coffea* in the Democratic Republic of Congo

Meise Botanic Garden in **Belgium** has studied wild *Coffea* diversity in Central and West Africa for almost 25 years. Two projects were recently initiated to better conserve Coffea genetic diversity in the DR Congo.

Staff of the Institut National des Etudes et Recherches Agronomique (INERA) in Yangambi are trained in coffee collection. This largely comprises *Coffea canephora* (Robusta), enriched with genetic diversity collected in the wild and in backyards. The project is a collaboration between Meise Botanic Garden and local partners.

In a collaborative project with local Universities, Research Institutes, INERA Mulungu and an NGO which is supporting local coffee farmers, Meise Botanic Garden will contribute to *ex situ* conservation and knowledge on Coffee in the Kivu. The focus will be on an endemic coffee species from the high altitude forests.

Assessments of the genetic diversity of wild coffee species in the DR Congo are also being conducted, along with surveys of local (medicinal) use and consumption of coffee.

Target 9 – issues to consider

- The number of species involved and magnitude of work required for inventory and adequate *in situ* and *ex situ* conservation is the main constraint faced by most countries in the delivery GSPC Target 9. In some places this can be hampered by rural depopulation and the associated decline in local, indigenous and cultural knowledge. Sharrock (2019) notes that maintenance of such knowledge presents a particularly significant problem as few tested methodologies and assessments of such knowledge are associated with plant genetic diversity.

Wild grapevine (Vitis vinifera subsp. sylvestris) seeds – Radia Dahmani

- The inadequacy of human and financial resources limits progress with this target, e.g. inventory work.
- Conservation of CWR concerns both the agricultural and conservation sectors, and the ECPGR concepts described above, and implementation of the recommendations in Box T9.1, can help achieve better integration of what have often been sectoral responses. ECPGR recommendations for on-farm conservation and management of crop genetic resources need to be implemented.
- The frontier between agricultural and nature conservation technical frameworks is yet too impermeable. An option to ensure the best connection between these two viewpoints could be to support the concept of 'genetic reserve of Crop Wild Relatives' (Maxted et al., 2008), which can be deployed in protected areas, or on sites where landowners maintain long-term stewardship contracts with conservation NGOs.

References

Allen, D., Bilz, M., Leaman, D.J., Miller, R.M., Timoshyna, A. and Window, J. 2014. European Red List of Medicinal Plants. Luxembourg: Publications Office of the European Union.

Byfield, A.J. and Wilson, P. J. 2005. Important Arable Plant Areas: identifying priority sites for arable plant conservation in the United Kingdom. Plantlife International, Salisbury, UK.

Castañeda-Álvarez, N., Khoury, C., Achicanoy, H., Bernau, V., Dempewolf, H. *et al.* 2016. Global conservation priorities for crop wild relatives. Nature Plants 2, 16022 https://doi.org/10.1038/nplants.2016.22

ECPGR. 2017. ECPGR Concept for on-farm conservation and management of plant genetic resources for food and agriculture. European Cooperative Programme for Plant Genetic Resources, Rome, Italy. http://www.ecpgr.cgiar.org/fileadmin/bioversity/publications/pdfs/ECPGR_Concept_for_on_farm_final__05_05_2017_bis.pdf

IPBES 2018: Summary for policymakers of the regional assessment report on biodiversity and ecosystem services for Europe and Central Asia of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. M. Fischer, M. Rounsevell, A. Torre-Marin Rando, A. Mader, A. Church *et al.* (eds.). IPBES secretariat, Bonn, Germany. 48 pages. https://ipbes.net/sites/default/files/spm_2b_eca_digital_0.pdf

Maxted, N., Ford-Lloyd, B.V., Kell, S.P., Iriondo, J.M., Dulloo, M.E. & Turok, J. (eds.). 2008. Crop Wild Relative Conservation and Use. CABI. Wallingford

Maxted, N., Dulloo, M.E., Ford-Lloyd, B.B., Frese, L., Iriondo, J. *et al.* 2013. Agrobiodiversity Conservation: Securing the Diversity of Crop Wild Relatives and Landraces. *CABI International* 2012.

Maxted, N., Avagyan, A., Frese, L., Iriondo, J.M., Magos Brehm, J. *et al.* 2015. ECPGR Concept for *in situ* conservation of crop wild relatives in Europe. Wild Species Conservation in Genetic Reserves Working Group, European Cooperative Programme for Plant Genetic Resources, Rome, Italy. http://www.cropwildrelatives.org/fileadmin/templates/cropwildrelatives.org/upload/documents/Portal_Content/ECPGR_Concept_for_in__situ_conservation_of_CWR_in_Europe_Maxtedetal_2015.pdf

Phillips, J., Asdal, A., Brehm, J.M., Rasmussen, M. and Maxted, N. 2016. In situ and *ex situ* diversity analysis of priority crop wild relatives in Norway. *Diversity and Distributions 22*: 1112–1126.

Vincent, H., Wiersema, J., Kell, S., Fielder, H., Dobbie, S. *et al.* 2013. A prioritized crop wild relative inventory to help underpin global food security. *Biol. Conserv.* 167: 265-275 https://doi.org/10.1016/j.biocon.2013.08.011

Wyse Jackson, P. 2014. Ireland's Generous Nature: The Past and Present Uses of Wild Plants in Ireland. Missouri Botanical Garden Press, St. Louis.

Target 10: Effective management plans in place to prevent new biological invasions and to manage important areas for plant diversity that are invaded

Non-native invasive animal and plant species (Invasive Alien Species - IAS) are a major driver of biodiversity loss globally. In Europe they present a key threat to native plants and animals and cost the European economy billions of Euros every year (Kettunen *et al.* 2008; section 3.3.3). Dealing with invasive species involves a hierarchy of *prediction* of likely invasions, *prevention* of invasions, *early warning* of arrival and *eradication, management* to minimise impacts of those that have become established. Often *restoration* of damage caused is also needed. It is far more cost effective to prevent the arrival of IAS than to eradicate or manage IAS post-invasion. This requires collaborative and coordinated efforts between a range of public and private sectors and agencies nationally and internationally, e.g. in transport, trade, business, collections, environmental agencies, tourism, water management and others. More details are given in Section 3.3.2.

Many coordinating mechanisms for research, funding and information sharing have been set up to help manage invasive species and their impacts globally and regionally. These include a relatively recent initiative, the International Plant Sentinel Network (IPSN[122]) (hosted by BGCI), set up to enable botanic gardens, arboreta, and other relevant institutions to collaborate in developing an early warning system of new and emerging pest and pathogen risks. This will help inform and develop activities to manage them and protect susceptible plant species. This currently includes 56 member institutions, over twenty of which are in Europe.

Heracleum mantegazzianum – *Fabrice Perriat*

The European and Mediterranean Plant Protection Organization (EPPO[123]) is an intergovernmental organisation responsible for cooperation in plant health within the Euro-Mediterranean region with 52 members. It provides a number of resources that help with the prioritisation and management of invasive plants. Among these is CAPRA[124], a computer-based tool for undertaking risk assessment of any non-native species.

Considerable information on invasive species across the world is available on the CABI website[125]. This includes the Invasive Species Compendium which is an encyclopaedic resource collating scientific information on all aspects of invasive species. Within Europe, CABI Centres in the UK and Switzerland contribute to work on IAS.

122 https://plantsentinel.org
123 https://www.eppo.int/
124 https://www.eppo.int/RESOURCES/eppo_databases/capra
125 CABI is an international, inter-governmental, not-for-profit organisation applies scientific expertise to solve problems in agriculture and the environment thus improving people's lives worldwide https://www.cabi.org/about-cabi/. Information on the ISC can be found here: https://www.cabi.org/isc/overview

European Progress

Target 5[126] of the EU Biodiversity Strategy to 2020 is "Combat Invasive Alien Species". The two actions within this are to (1) strengthen the EU Plant and Animal Health Regimes, and (2) establish a dedicated legislative instrument on Invasive Alien Species. With respect to the second of these, in January 2015 EU Regulation 1143/2014 on Invasive Alien Species, entered into force[127]. This Regulation includes a list of Invasive Alien Species of Union concern and provides for certain measures to be taken regarding species on the list, including to prevent their introduction, detect early their introduction (early warning) and eradicate them, and to manage those that are already established to minimise their impacts (see also section 3.3.2. and Appendix V).

Box T10.1. EU Regulation 1143/2014 on Invasive Alien Species (the IAS Regulation)

The IAS Regulation fulfils Action 16 of Target 5 of the EU 2020 Biodiversity Strategy and Aichi Target 9 of the Strategic Plan for Biodiversity 2011-2020 under the CBD. A number of Relevant Acts help to implement the Regulation.

Measures to be taken across the EU in relation to species of concern listed on the Union List follow a hierarchical approach of (1) prevention, (2) early detection and rapid eradication and (3) management of already-established species.

A range of documents have been produced under these headings to support implementation of the Regulation.

The Committee on IAS and a number of expert groups assist the Commission including:

- The Invasive Alien Species Expert Group (IASEG)
- The Scientific Forum on IAS
- The Working Group on IAS

The European Alien Species Information Network (EASIN) has been developed by the European Commission to facilitate implementation. This is an online platform providing access to existing information on alien species from a range of sources.

The Commission provides financial support for actions on IAS through existing mechanisms including:

- LIFE
- Horizon 2020
- The EU Rural Development policy 2014-2020
- Cohesion funding

Details of and links to this information can be found here:
https://ec.europa.eu/environment/nature/invasivealien/index_en.htm

126 (https://europa.eu/capacity4dev/file/19601/download?token=tcE_ejAs
127 https://ec.europa.eu/environment/nature/invasivealien/index_en.htm

Various collaborative projects between different EU Member States are underway with EU funding, for example a project[128] funded under Interreg 2014-2020 on protecting European biodiversity from IAS.

In Europe, the Euphresco[129] network coordinates transnational phytosanitary work and the activities of national funders of collaborative research. This funding coordination should reduce duplication of effort and optimise limited national plant health research resources. The provision of evidence to support essential policy work is another aim of Euphresco and together these should reduce the impact of plant pests on the economy, the environment and the health of people at national, European and international levels.

National implementation

Target 10

The majority of countries reporting on GSPC Target 10 consider that progress is being made but at an insufficient rate. No countries reported being on track to meet this target and two countries reported no progress against this target. Some countries have not reported in detail on GSPC Target 10 but in their 6th National Reports have reported under Aichi Target 9[130] as these two targets are similar.

Some countries have national management strategies for IAS. Most countries reported that there are national databases and national and/or regional lists of priority invasive species, with associated controls on trade and movement of priority damaging species. A recent checklist of alien flora in **Turkey** has been produced providing their first comprehensive list of alien plants and an analysis of their taxonomic composition, origin and ecological structure (Uludağ *et al.* 2017).

The control or eradication of invasive species is often a component of management plans in nationally protected areas and dedicated management plans exist to tackle some invasive species. Monitoring schemes are undertaken in a number of countries along with public awareness and participation through web-based alert networks to facilitate rapid identification and track movement of invasive species.

The requirement to implement Invasive Alien Species (IAS) Regulation (EU) 1143/2014 has provided a framework and impetus for actions in EU countries and horizon scanning, risk assessment and risk management strategies are well developed (at least for species of EU concern) in some countries. However, even where this is the case (e.g. in the **UK**, Box T10.2), IAS continue to have a significant and increasing impact[131] across terrestrial, freshwater and marine environments. Consequently, even where targeted regulation is in place and management strategies and mechanisms have been developed and are being implemented, the scale of the problem and complexities of management are such that they are not generally sufficiently effective. Additionally, national level implementation alone is insufficient to control many IAS.

128 https://www.interregeurope.eu/INVALIS/
129 https://www.euphresco.net/
130 Aichi Biodiversity Target 9: By 2020, invasive alien species and pathways are identified and prioritized, priority species are controlled or eradicated, and measures are in place to manage pathways to prevent their introduction and establishment.
131 http://jncc.defra.gov.uk/page-4246

Box T10.2. Examples of action across the UK to tackle Invasive Non-native Species

The **GB Invasive Non-native Species Strategy** (INSS) was developed (updated in 2015) to meet the challenge posed by invasive non-native species in Great Britain. The GB non-native species secretariat (NNSS - comprising the Department for Environment Food and Rural Affairs and the Scottish and Welsh Governments) has a website[132] that provides tools and information for people working to support the GB Strategy. Public awareness activities include an annual **Invasive Species Week**, where organisations from across the UK raise awareness of invasive non-native species, their impacts, and how everyone can help to prevent their spread.

A risk assessment scheme for non-native species in Great Britain was developed from a scheme used by the EPPO[133].

The Scottish Government has funded a virtual centre of expertise, 'The Plant Health Centre[134] to help tackle plant health challenges for Scotland, and a number of research projects on plant health and invasive species are underway.

The RBG Edinburgh has worked with six other Scottish research institutes involved in the PROTREE[135] project to promote tree health issues to the next generation. This has included working with designers at Hyper Luminal Games to create CALEDON[136], a computer game where you manage your own virtual forest.

RBG Kew has also worked long-term with partners in the UK Overseas Territories[137] on threats to plant conservation including invasive non-native species.

Target 10 – issues to consider

- The most significant challenge in delivering GSPC Target 10 (and the closely aligned Aichi Target 9 and EU Biodiversity Strategy Target 5) is the scale of the challenge. Global movements of people, wildlife and goods have increased massively and this seems set to continue. Population densities have also increased, and environmental conditions are changing, especially with respect to climate change. This results in a continuously evolving situation regarding the likelihood of invasions and the establishment of IAS. For many countries, financial resource constraints are a key factor at national scale in terms of prevention, eradication and management of IAS. However, the economic impacts of inaction, or of inadequate systems to address these issues, will be far higher still.
- These issues need to remain of high priority at local, national and international scales, and require cooperation between multiple agencies at all of those scales.

132 http://www.nonnativespecies.org/home/index.cfm
133 http://napra.eppo.org/
134 https://www.planthealthcentre.scot/
135 https://stories.rbge.org.uk/archives/23297
136 http://hyperluminalgames.com/caledon/
137 https://www.kew.org/read-and-watch/invasive-species-south-georgia

- Changes to practice and behaviour can play an important role, for example through promoting the use of indigenous and local species and working with stakeholders in various sectors to develop codes of conduct.
- There is a need for research and innovation in means of tackling some of those priority species that have already become established across European countries. Timely and accessible dissemination of policy and management relevant research is important. The Science for Environment Policy thematic issues provide an EU example of relevant research dissemination (SEP 2014).

References

SEP 2014. Science for Environment Policy. Thematic Issue: Invasive Alien Species. September 2013, Issue 4 https://ec.europa.eu/environment/integration/research/newsalert/pdf/41si_en.pdf

Uludağ, A., Aksoy, N., Yazlık, A., Arslan, Z.F., Yazmış, E. *et al.* 2017. Alien flora of Turkey: checklist, taxonomic composition and ecological attributes. NeoBiota 35: 61–85. https://doi.org/10.3897/neobiota.35.12460.

5.2.3. Objective III: Plant diversity is used in a sustainable and equitable manner

Target 11: No species of wild flora endangered by international trade.

Trade in endangered or potentially endangered wild species is regulated by CITES (but partially as bryophytes are not included in CITES regulation, and trade has grown over the last few years), the Convention on International Trade in Endangered Species of Wild Fauna and Flora. This international agreement between governments aims to ensure that international trade in wild flora and fauna does not threaten their survival. CITES uses a permitting system to either protect species from trade or permit trade. There are two main Appendices to CITES. Appendix I lists species for which all trade is prohibited because they are threatened with extinction and are or may be threatened by trade. Appendix II lists species which may become threatened unless trade is strictly regulated. For these species to be traded legally, "non-detriment findings" must be presented to show that the trade is sustainable, and necessary permits must be in place. No native European bryophyte species nor fungi are listed in the CITES Appendices.

GSPC Target 11 is strongly linked to the CITES Strategic Vision 2008-2020[138], Vision Statement *"Conserve biodiversity and contribute to its sustainable use by ensuring that no species of wild fauna or flora becomes or remains subject to unsustainable exploitation through international trade, thereby contributing to the significant reduction of the rate of biodiversity loss and making a significant contribution towards achieving the relevant Aichi Biodiversity Targets"*. Details of the linkages between CITES and the GSPC and the potential for sharing tools, scientific results and methodologies relating to Target 11 and also Targets 2, 12 and 15 are given in Sharrock (2019).

Certain plant taxa are highly threatened, for example 62% of the world's cycads are threatened (IUCN 2010) with extinction under the IUCN Red List Categories and Criteria, making them the most threatened group of plant species on Earth; illegal trade threatens two thirds of them. The conservation status of cacti, a large plant taxon, has been assessed by IUCN, with approximately a third of species threatened with extinction; almost half of them are threatened by trade in live plants and seeds for horticultural trade and private ornamental collections (Goettsch *et al.* 2015; Phelps *et al.*

138 https://cites.org/sites/default/files/document/E-Res-16-03-R17_0.pdf

2018). Trade, largely for horticulture, also threatens orchids, the largest family of flowering plants, which comprise a high proportion of the species listed on CITES. Within Europe, there has been a recent increase in the number of harvesters of wild orchids using unsustainable practices in Greece and Albania to make salep – a beverage made from dried orchid tubers (Kreziou *et al.* 2016). Nonetheless, CITES makes provision for the artificial propagation in nurseries of specimens of species included in Appendix I on the basis that this should reduce the collecting pressure on wild populations and thus be of conservation benefit.

While many plant species are threatened by illegal wildlife trade (IWT) and international trade is one of the most significant threats to certain plant taxa, they appear to receive little attention compared with threatened animals. Margulies *et al.* (2019) considered that plants (perhaps excepting timber) are overlooked in policy and research into IWT, they receive insufficient attention from funding agencies, and that this may partly result from 'plant blindness' in relation to the way that government laws define "wildlife".

European Progress

Systematic border controls do not exist within the EU due to the Single Market. Consequently, CITES provisions have to be implemented uniformly in all EU Member States, and this is delivered through a set of Regulations known as the EU Wildlife Trade Regulations[139]. In a number of respects, EU Wildlife Trade Regulations go beyond CITES provisions, for example by adopting stricter domestic measures [140]for some species (Appendix V).

While efforts to stem illegal trade in wildlife across the EU previously focussed upon implementing CITES, albeit with some stricter domestic measures, the EU and other parts of Europe have nonetheless remained a destination market and a hub for the trafficking of illegally traded wildlife, including plants, in transit to other regions. Recognition that implementing CITES was insufficient to halt the devastating impacts of wildlife crime on the environment and the economy resulted in the production in 2016 of The EU Action Plan against Wildlife Trafficking (EC 2016). This plan includes measures of enforcement, prevention and cooperation and forms part of the EU's response to the United Nations 2030 Agenda for Sustainable Development, particularly SDG 15, which calls for urgent action to end poaching and trafficking of protected species of flora and fauna and address both demand and supply of illegal wildlife products.

The EU Timber Regulation (EUTR[141]) ((EU) No 995/2010) of 20 October 2010) tackles trade in illegally harvested timber through:

- prohibiting the sale in the EU market for the first time of illegally harvested timber and derived products
- requiring EU traders who place timber products on the EU market for the first time to exercise 'due diligence' (i.e. information, risk assessment and risk mitigation)
- requiring traders that sell or transform timber products already on the market to keep records of their suppliers and customers

139 https://ec.europa.eu/environment/cites/legislation_en.htm
140 https://ec.europa.eu/environment/cites/pdf/differences_b_eu_and_cites.pdf
141 https://ec.europa.eu/environment/forests/timber_regulation.htm

Around the world, illegal harvesting of timber continues, but the EUTR provides a firm regulatory basis for substantially reducing both sale and transit across large parts of Europe. Recent updates on implementation and enforcement of the EUTR are provided in briefings to the competent authorities. These include updates[142] on implementation and enforcement, illegal logging and trade, legislation and policy and other areas.

The EU has played a key role in combatting illegal logging. In 2016, an independent evaluation[143] of the EU's Forest Law Enforcement, Governance and Trade (FLEGT) Action Plan (including the EUTR) concluded that it has improved forest governance in all target countries, has raised awareness of the problem of illegal logging at all levels, contributed to improved forest governance globally particularly in partner producer countries, and helped reduce demand for illegal timber in the EU.

National implementation

Target 11

The majority of countries reporting on GSPC Target 11 consider that they are on track to meet this target. Some countries reported that progress is being made but at an insufficient rate, and one country reported no progress against this target.

All EU countries implement EU Wildlife Trade Regulations and non-EU countries have national mechanisms for implementing CITES provisions. Meise Botanic Garden in **Belgium** is able to receive plants confiscated by the Belgian customs under CITES and when necessary or desirable hold them in their living collection. The Garden has a staff member who sits on the Belgian CITES scientific committee to contribute specialised knowledge of plants that are, or could become, subject to CITES trade controls.

France produced a national action plan to combat wildlife trafficking in 2016. This is a variation of the European plan but with certain measures reinforced, such as scientists support for customs controls. Institutions in various European countries contribute to the delivery of this target internationally, such as RBG Kew (T11.2) and RBG Edinburgh in the **UK**.

Monitoring levels of trade in threatened or protected species can help identify those that merit particular attention to ensure that this is legal and does not threaten plants in the wild. Crete is the largest **Greek** island and its long isolation has resulted in considerable plant endemism. Menteli *et al.* (2019) examined e-commerce in Cretan endemic plants and found 28 (13%) of endemic taxa were traded by 65 nurseries from 14 countries. Among traded plants, 16 are threatened and/or protected. The authors highlight those species that should be monitored with associated controls by the competent authorities to ensure that there is no illegal plant collection.

Cultivation of threatened species that have cultural or commercial value can help to reduce the risks of wild collection (Box T11.1). Although this can make valuable contribution to plant conservation, ways of supporting the livelihoods of those dependant on harvesting from the also need considered.

142 https://ec.europa.eu/environment/forests/pdf/EUTR%20Briefing%20note%20Sept-Nov%202019.pdf
143 https://europa.eu/capacity4dev/public-flegt/blog/independent-evaluation-eu-flegt-action-plan-published

Box T11.1. Conservation and sustainable use of threatened medicinal plant *Sideritis scardica* in Bulgaria

Sideritis scardica (Mountain tee, Pirin tea, Mursalitza tee) is endemic to the Balkan Peninsula. The species is very popular in herbal medicine, used for a range of lung complaints, but it is threatened as a result of habitat loss and anthropogenic factors including wild collection. It is listed as Critically Endangered in the Bulgarian Red Data Book, and while the collection and trade of wild plants is prohibited, this practice continues to threaten the species. To attempt to conserve the species and ensure its sustainable use, plants originating from the Pirin Mountain were cultivated in eight different agro-cultural floristic regions in Bulgaria. The plants developed well, giving an annual economic yield of c.30 kg/100m^2 dry mass annually.

Source: Evstatieva and Alipieva 2012

Box T11.2. Examples of activities of RBG Kew in support of CITES work nationally and internationally

RBG Kew is the designated UK Scientific Authority for plants. Kew has:

- Provided training in: trade-related issues on artificial propagation, sustainable use, taxonomy and nomenclature, horticulture, wood anatomy and DNA techniques.
- Worked with the German Scientific Authority, TRAFFIC International and WWF Germany to develop the current CITES Non-detriment Findings Guidance for Perennial Plants. This guidance has been used in training workshops in Vietnam, Peru, Georgia and China.
- Received specimens of timber products from across the world for identification. Kew's wood reference material includes 36,000 wood anatomy slides and over 42,000 wood collections.
- Showcased CITES-listed plants at the 2018 Illegal Wildlife Trade Conference – the first time plants were featured.
- Housed seized plants in their quarantine house. Experts are regularly required to identify such material and testify when offenders are prosecuted.
- Provided expert advice to enforcement authorities regarding the illegal trafficking of plant specimens.
- Initiated in 2016, a three year project to understand the edible wild orchid (chikanda) trade in Zambia and develop community-led sustainable management strategies to protect orchid biodiversity while benefitting local communities. This included gaining an understanding of wild orchid harvesting and methods of cultivation for income generation and conservation, and the development of molecular barcodes to identify traded tubers.

These activities all help to promote international cooperation, law enforcement and improvement of CITES implementation.

Source: Dhanda *et al.* 2019; https://www.darwininitiative.org.uk

Target 11 – issues to consider

There are many issues associated with CITES implementation that could, if effectively addressed, substantially reduce the impacts of trade on threatened plants (and other taxa). These include:

- **Adequacy of information on species ecology, threats and population.** CITES listing requires adequate information on: a species' population size and trends in the wild; threats to its survival and their potential impacts; ecology, to permit evaluation of what levels of harvest would be sustainable. However, for many species even basic population estimates are lacking, precluding the possibility of a sound judgement on whether any trade is sustainable, and if so at what level. The status of only a small proportion of plants has been evaluated (especially compared with many animal taxa) and this hampers listing on CITES Appendices. Evaluating population levels, trends, and threatened status is a key priority for plants in trade, and highlights the importance of GSPC Target 2.
- **Need for evidence-based decision making about Appendix listing.** While CITES decisions should be evidence based, it has been suggested that political or emotive considerations sometimes influence decisions (Heath 2016).
- **Speed of listing on CITES Appendices following IUCN assessment**, especially for threatened species. When IUCN status is evaluated for new species or taxa, it is important that these are used rapidly to appropriately regulate trade, and to protect species listed as threatened. A recent study found that in almost two-thirds of the cases, there are long delays in banning trade following the IUCN identification of species in need of protection from trade (Frank & Wilcove 2019). Mechanisms for facilitating this process would be beneficial.
- **Need for non-detriment finding guidance**. There has also long-been an absence of specific guidance on how to develop CITES non-detriment findings (NDFs) for specific taxa, although this is being addressed for certain plant taxa (e.g. Timber – Wolf *et al.* 2018).
- **Best use of confiscated stocks.** An ongoing issue relates to the best use of confiscated stocks of CITES listed products that will prevent further illegal take and trade in products originating from wild populations of threatened species. Wilmé *et al.* (2019) discussed this with respect to Madagascar's rosewood stocks.
- **Compliance and accountability.** CITES restrictions need to be strongly enforced by member nations to be effective. However, in most countries with substantial wildlife trafficking governance is weak and few prosecutions take place (DLA Piper 2015). There is a need for strong legislation enforced through an effective judicial process to deter wildlife crime and where this does not exist wildlife criminals are likely to be further emboldened. Considerable work is still needed to strengthen legislation in many countries around the world to improve accountability and transparency and reduce corruption.
- **'Plant blindness'** relative to the attention given to animals threatened by illegal wildlife trade; there is a perceived need for more policy and research attention on plants threatened by illegal trade.

Despite these constraints, CITES is a fundamentally important, legally binding international law that provides the framework for sustainable trade, and there have been some very positive examples of outcomes from its implementation. Sanctions can be imposed by CITES to prevent a nation from trading in CITES-listed

species. If respected by other nations with which they would trade, this can prove effective. However, while strict enforcement forms an essential part of wildlife protection, a range of different approaches are needed according to the situation. As highlighted by Heath (2016), for CITES to be effective it must be adaptive. The power to enforce regulation is important, as are incentives, and approaches where such measures are combined with the promotion of on the ground work including habitat restoration and community engagement.

The value of certain plant resources has resulted in considerable **risks to the personal safety of those protecting threatened forests.** Around the world, rangers and others protecting forest from illegal activities continue to be persecuted. This is also a risk within Europe, with two forest workers killed (UNEP WCMC 2019), reportedly investigating illegal logging activities at the time of their deaths. This occurred after other reports of violence directed towards forest rangers and activists. The risks faced by people working on site to protect plant resources highlights the need for continuing cooperation between nations and the strengthening of government action associated with combatting all stages in the chain of illegal harvest and supply of timber and other plant products. A briefing[144] endorsed by the NGOs Fern, EIA, ClientEarth, Forest Peoples Programme, and Transparency International urges the European Commission to build on governance successes of FLEGT Voluntary Partnership Agreements for timber in order to halt deforestation and human rights abuses caused by forest risk commodities. It also calls for strengthening of the linkages between FLEGT and the climate and SDG agendas.

Galanthus alpinus – *Anna Asatryan*

References

Dhanda, S., Williams, C. and Cowell, C. (eds) 2019. Kew and the Global Strategy for Plant Conservation. Royal Botanic Gardens, Kew

144 https://www.fern.org/fileadmin/uploads/fern/Documents/2019/NGO-Briefing-note-forests-for-livelihoods-development-and-climate.pdf

Frank, E.J. and Wilcove, D.S. 2019. Long delays in banning trade in threatened species. *Science*: 363 (6428):686-688. DOI:10.1126/science.aav4013

DLA Piper 2015. Empty threat 2015: does the law combat illegal wildlife trade? A review of legislative and judicial approaches in fifteen jurisdictions. pp 498. https://www.dlapiper.com/~/media/Files/News/2015/05/IllegalWildlifeTradeReport2015.pdf

EC 2016. European Commission 2016. EU action plan against wildlife trafficking. ISBN 978-92-79-55076-8 doi:10.2779/016138 https://ec.europa.eu/environment/cites/pdf/WAP_EN_WEB.PDF

Evstatieva, L.N. and Alipieva, K.I. 2012. Conservation and sustainable use of threatened medicinal plant *Sideritis scardica* in Bulgaria. *Acta Hortic.* 955, 89-92mDOI: 10.17660/ActaHortic.2012.955.10

Frank, E.J. and Wilcove, D.S. 2019. Long delays in banning trade in threatened species. Science: 363 (6428):686-688. DOI:10.1126/science.aav4013

Goettsch, B., Hilton-Taylor, C., Cruz-Piñón, G., Duffy, J.P., Frances, A. *et al.* 2015. High proportion of cactus species threatened with extinction. Nature Plants 1: 15142. https://doi.org/10.1038/nplants.2015.142 Heath, A. 2016. Spotlight on CITES. https://www.synchronicityearth.org/spotlight-on-cites/

IUCN 2010. The IUCN Red List of Threatened Species™ October 2010 update. Cycad Facts https://www.iucn.org/downloads/cycad_factsheet_final.pdf

Kreziou, A., De Boer, H. and Gravendeel, B. 2016. Harvesting of salep orchids in north-western Greece continues to threaten natural populations. *Oryx* 50(3): 393-396. doi:10.1017/S0030605315000265

Margulies, J.D., Bullough, L-A., Hinsley, A. Ingram, D.J., Cowell, *et al.* 2019. Illegal wildlife trade and the persistence of "plant blindness". *Plants, People, Planet.* 1:173–182. DOI: 10.1002/ppp3.10053

Menteli, V., Krigas, N., Avramakis, M., Turland, N. and Vokou, D. 2019. Endemic plants of Crete in electronic trade and wildlife tourism: current patterns and implications for conservation. *J of Biol Res-Thessaloniki* 26:10 https://doi.org/10.1186/s40709-019-0104-z

Phelps, J., Hinsley, A and Maguiles, J. 2018. Illegal wildlife trade endangers plants — but few are listening Blog on: https://www.iucn.org/news/species/201810/illegal-wildlife-trade-endangers-plants-few-are-listening

Sharrock, S. 2019. A review of progress towards the Global Strategy for Plant Conservation 2011-2020 Draft 3 November 2019.

UNEP WCMC 2019. Briefing Note for the Competent Authorities (CA) implementing the EU Timber Regulation September - November 2019. https://ec.europa.eu/environment/forests/pdf/EUTR%20Briefing%20note%20Sept-Nov%202019.pdf

Wilmé L, Innes JL, Schuurman D, Ramamonjisoa B, Langrand M. *et al.* 2019. Management options for addressing the persistent and unresolved CITES issue of Madagascar's rosewood stocks and stockpile. PeerJ Preprints 7:e27889v1 https://doi.org/10.7287/peerj.preprints.27889v1

Wolf, D., Oldfield, T.E.E. and McGough, N. 2018. CITES Non-detriment Findings for Timber: A nine-step process to support CITES Scientific Authorities making science-based non-detriment findings (NDFs) for timber / tree species listed in CITES Appendix II. Version 3.0 BfN-Skripten 504 https://d-nb.info/1168761131/34 Accessed 27.01.20

Target 12: All wild harvested plant-based products sourced sustainably

Many wild-harvested plants, fungi and lichen are used and traded locally, nationally or internationally. A great variety of mushrooms is edible, and collected in the wild as non-timber products (or cultivated) for this purpose. A major use is for medicinal or aromatic purposes, and approaching 30,000 plant species are documented as useful in this respect. In addition since ancient times fungi were seen as powerful medicine and recently mushrooms are increasingly being used for pharmaceutical purposes. Sixty to ninety percent of medicinal and aromatic plants are wild collected, and there was a reported threefold increase in their trade between 1999 and 2019 (Jenkins *et al.* 2018). Overharvest is a key and immediate risk to populations of wild plants, and it can result in the depletion or disappearance of the harvested species locally, and threaten its overall survival when harvest is throughout a species' range. In a recent analysis of emerging issues, Sutherland *et al.* (2020) highlighted the recent inclusion for the first time of traditional medicine in the World Health Organization's (WHO) International Statistical Classification of Diseases and Related Health Problems (ICD). This has been viewed as an endorsement of traditional medicine and may accelerate already increasing patterns of its use, increasing demand for plant ingredients and potentially putting some species at risk. Target 12 therefore links closely to the Target 11 for internationally traded species.

Hericium erinaceus – *Irmgard Greilhuber*

Target 12 is focussed both on the local harvest of wild plants , fungi and lichens for food, shelter, medicinal cosmetic or other purposes, often at a small scale, and also on larger scale harvesting for regional, national or global medicinal, aromatic, food and other industries. With the increasing use of certain wild-harvested plants it is important that they are, and continue to be, managed in a sustainable fashion. An example is the mycosilviculture, i.e. managing forests for the provision of fungal ecosystem services (De Miguel et al. 2017). This is required both for the conservation status of the plants concerned and the roles that they play in the ecosystem, and for the livelihoods of local communities that may have been using them for long-time periods and may be dependent, or partly dependent, upon them.

Sustainable management is often integrated into national regulation and management planning. In addition, voluntary certification standards have been developed at a range of scales (local, national, regional and global) to provide assurances to local communities, an increasingly aware public, and to regulatory bodies, on the sustainability of harvesting practices.

The Forest Stewardship Council (FSC[145]) have a widely-adopted certification scheme. FSC is a global scheme for forest certification and includes both forest management and chain of custody certification (which can be rolled into a joint certificate where applicable), as well as licensing end users to promote FSC labelled products. The FSC system allows consumers to identify forest products, including non-timber forest products, sourced from well-managed forests and/or recycled sources. The principles of FSC and most certification schemes include benefits to local people, the maintenance of the species being harvested and their role in the ecosystem, and documented management plans including monitoring.

145 https://www.fsc-uk.org/en-uk/about-fsc/what-is-fsc

The other major scheme set up to encourage sustainable production of forest products is the global Programme for the Endorsement of Forest Certification (PEFC[146]). PEFC is an umbrella organisation that endorses national forest certification systems that have been developed through multi-stakeholder processes. Under the PEFC system chain-of-custody certification is rolled into the forest management certificate. As some forest chose to have both PEFS and FCS certification, they decided in 2016 to provide mutually agreed estimates for the total global certified area to ensure that double certified forest area does not appear twice in the statistics[147].

Beyond timber and other forest products, the FairWild Foundation[148] promotes and supports sustainable, traceable, and ethical trade in wild plant ingredients. They provide a management system that includes product certification to provide assurance to consumers that products are sourced in an ecologically and socially sustainable way. FairWild provides a standard and a product certification scheme. Products that can be certified include: those collected from the wild (e.g. medicinal and aromatic plants, gums and resins, wild fruits, nuts and seeds, mushrooms); processed ingredients (e.g. essential oils and fatty oils); finished products containing FairWild ingredients. The standard is a set of ecological and fair trade guidelines that wild plant collection operations can conform with to demonstrate their commitment to sustainable collection, social responsibility and fair trade principles. The social responsibility component respects traditions and cultures, supports stakeholder, including collector and worker, livelihoods. Implementation approaches for the FairWild Standard are given in Figure T12[149].

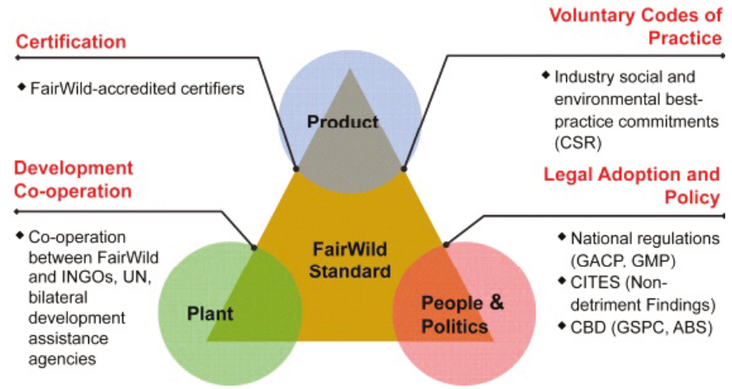


Figure T12. Implementation approaches for the FairWild Standard Version 2.
From: FairWild Foundation. 2010. FairWild Standard: Version 2.0. FairWild Foundation, Weinfelden, Switzerland.

FairWild certification is a third-party audited system. It requires annual onsite visits by authorised certification bodies. Certified operations demonstrate commitment to the FairWild Principles and Criteria and build up operational sustainability by meeting increasing requirements annually over a five year period. An example of FairWild certification is given in Box T12.2.

The Union for Ethical Biotrade (UEBT) is a member-based non-profit association whose members

146 https://www.pefc.org/
147 https://www.pefc.org/news/double-certification-on-the-rise-joint-pefc-fsc-data-shows
148 https://www.fairwild.org/
149 https://static1.squarespace.com/static/5bec424b297114f64cb908d8/t/5cc9724ee4966be23ada7273/1556705876096/FairWild-Standard-V2.pdf

adhere to a set of ethical standards, and UEBT also provides certification of ethical sourcing systems and certification of specific ingredients. Among the principles that guide the UEBT Standard are the conservation and sustainable use of biodiversity, and fair and equitable resource sharing along with local economic development.

Seaweed production through aquaculture has increased massively in recent years and over a million tonnes of wild seaweed is harvested annually. The decline in kelp forests has been highlighted as an emerging issue with potential to significantly affect biodiversity and ecosystem processes (Sutherland *et al.* 2020, see section 3.3.4.). Following increased demand, the Aquaculture Stewardship Council (ASC) and Marine Stewardship Council (MSC) launched a joint ASC-MSC Seaweed Standard[150] for the sustainable and responsible harvesting of seaweed.

The Rainforest Alliance Certified scheme[151] aims to ensure environmental and social sustainability in products from farm or forest operations. For agricultural commodities which are collected *via* wild harvest, the SAI platform[152], a global food & drink value chain initiative for sustainable agriculture, had a 'Wild Harvest Reference Project' ongoing in 2019.

Many other voluntary certification standards exist nationally and internationally.

European Progress

Certain wild plants are protected by international Legislation (like the EU Habitats Directive, Council of Europe's Bern Convention, or against trade by CITES Appendix V). In addition, many countries have national legislation prohibiting the collection or picking or certain plants, or any plants in certain areas, like protected areas. In many countries, wild plants are the property of the landowner, although this is not always the case.

Europe provides both a significant source of and market for wild-harvested plants. For example, Germany is the largest trader of medicinal and aromatic plants in the EU, with imports valued at US$250 million in 2015 (from customs data – but not all relevant plants are covered – Jenkins *et al.* 2018). Wild plant collection in Europe is also very important for the livelihoods of local people, especially in some regions (e.g. see http://www.star-tree.eu/).

Many businesses have decided to commit to sustainability principles through using one of the sets of voluntary standards or audited certification schemes for their products. For example (as of January 2020), the ingredients from 20 species of plant from eight European countries have FairWild certification[153], and UEBT has over 20 trading members[154] that adhere to the UEBT standards from 9 European countries.

Maesano *et al.* (2018) mapped PEFC and FSC certified forest across Europe and found that about six percent of the forest is certified under the FSC scheme, and about seven percent under the PEFC scheme.

150 https://www.asc-aqua.org/what-we-do/our-standards/seaweed-standard/
151 https://www.rainforest-alliance.org/
152 https://saiplatform.org/our-work/projects/wild-harvest-reference/
153 For operators and plants see: https://static1.squarespace.com/static/5bec424b297114f64cb908d8/t/5e17350f81a-b92511ec2f4c8/1578579216025/FairWild_species_products.pdf
154 https://www.ethicalbiotrade.org/membership

National implementation

Target 12

Half of the countries reporting on GSPC Target 12 consider that progress is being made but at an insufficient rate and four countries reported being on track to meet this target. Only one country reported no progress against this target.

The forest area certified under the FSC scheme has increased. **Belgium** reported (as of 05/11/18) 34,334 ha of FSC certified forests (almost 4% of the country's forest area) and 299,324 ha of PEFC certified forests (44% of the country's forest area). For about twenty years, the 1,300 national forests have been PEFC certified in **France** with FSC certification now being additionally sought for certain forests.

In 2012 the Office National des Forêts introduced forest certification in French Guiana. This aims to guarantee to the consumer that the wood or wood-derived products are from forests that are managed sustainably in the long term with respect to the environment, social requirements and product traceability. In **Spain**, in 2015/16, the PEFC certified wooded forest area reached 2,153,431 ha, and the FCA certified area was 235,825 ha. In an analysis of data from 2014 (Maesano *et al.* 2018), the countries with the highest areas of forestry certified by the FSC or PEFC standards were **Croatia** with about 73% of total forest area certified according to FSC standard, and **Belarus**, with about 95% of forest PEFC certified. Other countries with >70% of forest certified under one or other of the schemes were **Estonia**, **Finland** and **Poland**.

Ireland highlighted the importance of seaweed harvest and that consultation occurs with the Marine Institute and other statutory consultees to ensure environmental sustainability prior to the issuing a harvest licence. Irish legislation covering seaweed harvest is contained within the Foreshore Act 1933. Spain also reported on the seaweed harvest. Although the volume of seaweed harvesting and its sustainability is not currently known, some autonomous communities have regulations for the sustainable collection of seaweed (e.g. in Asturias), and research has been conducted (e.g. in Galicia) to establish sustainable exploitation systems for certain species.

Sustainable plant harvesting and local economic development was enhanced in a number of countries in the Danube region as part of a project financed by the EU Interreg Danube Transnational Programme (Box T12.1).

Box T12.1. The Local Economy and Nature Conservation in the Danube Region (LENA) project and sustainable plant harvesting

The LENA project involved a wide range of project partners and ran from 2017-2019 connecting nature and people for well-being and prosperity across 7 Danube countries and 11 protected areas. A key component of this project involved sharing knowledge and experience for sustainable economic development in protected areas through enhancing sustainable income generation from wild plants. Collection, processing and trade in medicinal and aromatic plants (MAPs) provide an important source of income for communities in all countries of the Danube region, and it is important for both biodiversity conservation and local livelihoods that collection of plant products is sustainable and that overexploitation and unsustainable trade does not occur.

The LENA project focused on protected areas adjacent to the Danube and its tributaries in **Hungary** (Szatmár-Beregi Nature Park), **Bulgaria** (Rusenski Lom Nature Park), **Slovenia** (Triglav National Park) and **Serbia** (Deliblato Sands). It included training in sustainable wild plant harvesting, and engagement with local companies to increase those traded products containing wild plant ingredients that had been sustainably collected - based on the FairWild Standard. This is both socially beneficial, ensuring that workers are paid a fair salary and can access the wider market, and environmentally beneficial, preventing overexploitation. In September 2018, the LENA project and its activities towards the sustainable rural development of protected areas was awarded with the German sustainability award for projects: "Projekt Nachhaltigkeit 2018" by the Regional Network Units Sustainability Strategies.

The LENA project[155] was financed by the EU Intereg Danube Transnational Programme.

155 http://www.interreg-danube.eu/approved-projects/lena; see also https://www.traffic.org/what-we-do/projects-and-approaches/promoting-sustainable-trade/fairwild/lena/

Box T12.2. Dog rose Rosa canina in Serbia: an example of FairWild certification in practice[156]

Svrljig is a town and municipality located in the sparsely populated hilly south-east of **Serbia**, and the mainstay of its economy has long been the collection and processing of medicinal and aromatic plant products. Rural depopulation has presented challenges for the local community but the lack of industry and pollution in the area means that the area is ideal for organic and sustainable agriculture.

Plantamell is a company that works with a network of local collectors, using their important local knowledge and providing a supplementary source of seasonal income. Collectors are trained twice a year, including in when and where plants can be collected, and how best to collect the different plant parts. The company works with over 100 different varieties of plants, of which an important one is the dog rose *Rosa canina*. Rosehips from the dog rose are an important source of rose seed oil, which is a high value product. Dog roses are common in the abandoned countryside around Svrljig, and following collection the rosehips undergo a preliminary processing stage. The rosehip seeds are separated from the shell, to prepare them for oil extraction, and the shells are cut and dried, ready for export for use in fruit teas and other products.

Plantamell became involved with FairWild as a result of collaboration with a number of industry partners, Nateva, Neal's Yard Remedies[157] and the Organic Herb Trading Company. Plantamell successfully brought FairWild certified rose hip products to the market in 2017, reported to be the first such initiative for Serbia.

156 https://www.fairwild.org/news/2019/10/11/wild-about-rose-hips-in-serbia-newly-certified-ingredients-on-sale
157 https://www.nealsyardremedies.com/rosehip-sustainability-story.html

Box T12.3. Promote the use of native species for habitat restoration

Native seed production has a strong unexpressed potential and could have a significant positive impact on nature conservation and habitat restoration. However, in Europe the native industry includes mainly small isolated initiatives that lack personnel, coordination and links with academic institutions.

Training early stage reseachers on native seed use – The *NASSTEC* Project

To bridge this gap Trento Science Museum developed a training initiative to deliver well-trained human resources in native seed science and production and to inter-connect industry and academia. This initiative named NASSTEC (The Native Seed Science and Technology ITN) found the financial support of FP7 as a Marie Curie Initial training network (ITN). It ran from 2014 to 2018 and interconnected two small native seed companies, one in Spain (Semillas Silvestres) and one in Scotland (Scotia Seeds) with a large company (Syngenta) and there academic Botanic Gardens (Pavia University BG, RBGK, Trento BGs) and The James Hutton crop Institute.

The project delivered 12 well-trained professionals and was instrumental in developing the European Native Seed Producers network (nativeseed.eu) and the International network for seed based restoration (ser-insr.org). *Contact: Costantino Bonomi* (costantino.bonomi@muse.it)

Since 2012, a collective approach has been initiated in France in order to create references for native seed collection, amplification as well as tree nursing and growing. During two years, about 150 people have been involved in a participative approach to define national rules and seed zones for trees and herbaceous species, including a specific work on segetal species.

Vegetal local collective trademark: the french standards for wild native seeds, plants and trees

Officially registered in January 2015, the collective trademark Végétal local guarantees a local provenance for all kind of native plant (from seed to trees, including herbaceous and aquatic species), regarding a map of 11 eco-regions. This map is based on the compilation of many ecological maps and data: hydrology, climate, topography, geology, vegetation maps, botanical data... Végétal local is defined by a technical toolkit and internal regulations. The use of the trademark by seed harvesters or plant/tree nurseries is submitted to the approval of the trademark board, after the results of an independent audit. Végétal local concerns all common species naturally occurring in France, excluding rare, endangered and protected/law-regulated species. *Contact: Sandra Malaval* (sandra.malaval@cbnpmp.fr)

Target 12 – issues to consider

- Sustainable resource management requires knowledge of the availability of the resource to be harvested, evaluation of acceptable harvesting volume and frequency for maintaining a sufficient and viable wild population, a monitoring plan for the wild population and harvest practices and regular evaluation to adapt harvest practices as needed. This requires ongoing involvement from both socio-economic and environmental stakeholders and shared protocols. Questions remain about the degree to which voluntary certification schemes deliver against the target of ensuring that all wild harvested plant based products are sourced sustainably. This will depend upon many factors, including how stringent the certification standards are, whether they are complied with, and the percentage of (not otherwise protected) habitat from which plant based products are harvested that are covered by these schemes.

- Various analyses have been conducted in Europe on whether sustainability standards meet their environmental and social objectives. A key feature of most schemes is independent audit to evaluate whether certification conditions have been met, and if not, the severity of non-conformity, and whether this is sufficient to compromise the standards or principles set down by the certification scheme. Results for forests are variable and related both to conforming with certification conditions and factors like their sufficiency in maintaining functional connectivity for biodiversity (e.g. for forests see Elbakidze *et al.* 2016; Halalisan *et al.* 2016; Malovrh *et al.* 2019). Nonetheless, although forest certification schemes are voluntary and not perfect, they represent one of the few tools available to help ensure sustainable forest management, and the 'Chain of Custody' standard ensures the traceability of forest products. However, certification schemes still cover only a small proportion of forested area in Europe, although this is increasing (Maesano *et al.* 2018). The increased global demand for nanocellulose derived from trees, along with the potentially increased demand for wood from European forests for renewable energy (Sutherland *et al.* 2020, see section 3.3.4.) highlight the importance of sustainability of forest management that does not impact plant diversity or conservation.

- Global Forest Goal 3 from the United Nations strategic plan for forests, 2017-2030 is to *"Increase significantly the area of protected forests worldwide and other areas of sustainably managed forests, as well as the proportion of forest products from sustainably managed forests."* Taking measures to increase the proportion of forest in Europe that is certified as sustainable will contribute to this goal. Periodically updating the forest certification map of Europe (Maesano *et al.* 2018) to quantify geographically changes over time and evaluate which factors affect these changes would be a useful contribution.

- Lambin & Thorlakson (2018) reviewed the interactions between governments, private companies and NGOs in sustainability standards and concluded that better understanding of these interactions would help design more effective interventions. Given the urgent imperative for a reduction in greenhouse gas emissions it is likely that reforestation projects will be initiated in much of Europe as a contribution. As this occurs, factors such as location, forest type, connectivity and other services that reforested areas can provide, including biodiversity conservation and the sustainable provision of non-timber plant based products, should be part of the mix. The governance of such areas will be an important consideration.

References

Elbakidze, M., Ražauskaitė, R., Manton, M., Angelstam, P. Mozgeris, G. *et al.* 2016. The role of forest certification for biodiversity conservation: Lithuania as a case study. *Eur. J. Forest Res.* 135: 361–376 https://doi.org/10.1007/s10342-016-0940-4

Halalisan, A.F., Ioras, F., Korjus, H., Avdibegovic, M., Maric, B. *et al.* 2016.An Analysis of Forest Management Non-Conformities to FSC Standards in Different European Countries. *Not. Bot. Horti. Agrobo.* 44(2):634-639. DOI:10.15835/nbha44210263

Jenkins, M., Timoshyna, A. and Cornthwaite, M. 2018. Wild at Home: Exploring the global harvest, trade and use of wild plant ingredients. TRAFFIC International, Cambridge, United Kingdom. https://www.traffic.org/site/assets/files/7339/wild-at-home.pdf

Lambin, E.F. and Thorlakson, T. 2018. Sustainability Standards: Interactions between Private Actors, Civil Society, and Governments. *Ann. Rev. Environ. Resources* 43:369-393

Maesano, M., Ottaviano, M., Lidestav, G., Lasserre, B., Matteucci, G. *et al.* 2018. Forest certification map of Europe. *iForest* 11: 526-533. – doi:10.3832/ifor2668-011

Malovrh, S.P., Bećirović, D., Marić, D., Nedeljković, J., Posavec, S. *et al.* 2019. Contribution of Forest Stewardship Council Certification to Sustainable Forest Management of State Forests in Selected Southeast European Countries. *Forests* 10: 648. doi:10.3390/f10080648

Miguel, Sergio de & Martínez de Aragón, Juan & Alday, Josu & Castaño, Carles & Bonet, José. (2017). Mycosilviculture: Managing forests for the provision of fungal ecosystem services.

Sutherland, W.J., Dias, M.O., Dicks, L.V., Doran, H., Entwistle, A.C. *et al.* 2020. A Horizon Scan of Emerging Global Biological Conservation Issues for 2020. *TREE* 35 (1):81-90. https://doi.org/10.1016/j.tree.2019.10.010

Target 13: Indigenous and local knowledge innovations and practices associated with plant resources maintained or increased, as appropriate, to support customary use, sustainable livelihoods, local food security and health care

The use of genetic resources and associated traditional knowledge is primarily regulated by the *Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity* – The Nagoya Protocol[158]. This supplementary agreement to the CBD entered into force on 12 October 2014 and includes traditional knowledge associated with genetic resources that are covered by the CBD and the benefits arising from its use.

Traditional knowledge and practices are developed across the centuries and are relevant to a particular local cultural and environmental context. Traditional knowledge is often associated with the resources used and techniques practiced in agriculture and horticulture, forestry, fisheries and health and is often passed down orally rather than written down. Many indigenous and local communities live in places rich in plant biodiversity and have used it, usually in a sustainable way, for many generations or even thousands of years. The livelihoods of indigenous communities often depend upon the sustainable use of local biodiversity. The continued sustainability of this type of resource use is important for the maintenance of these communities, and has potential value for society more widely.

Many drugs in wide use today have their roots in herbal products. A well-known example is that of current malaria treatments, that often contain semisynthetic derivatives of artemisinin. Artemisinin is derived from sweet wormwood *Artemisia annua*, used in ancient Chinese medicine. Economically, the global trade in traditional medicines is substantial and Traditional Chinese Medicine alone was reportedly worth US$83 billion in 2012. (WHO 2014). In 2013, an estimated €614 million (Allkin 2016)[159] worth of herbal products were imported into the EU alone.

Traditional medicines form either a key or a complementary part of the medicine systems in many countries and demand for traditional medicines is increasing. The WHO recognise the role of traditional medicines and has a strategy (2014-2023, WHO 2014) to harness the potential of traditional medicine and promote its safe and efficient use. This includes building the knowledge base, strengthening safety, quality and effectiveness through regulation and promoting its integration into national health care services. An analysis in SOTWP (Willis 2017) found that some plant families contain an unexpectedly high proportion of medicinal plants, possibly indicating their value for future drug research. Traditional knowledge and the use of plants in traditional medicine can also help signpost useful avenues of scientific research into the value of drugs to medicine.

One area of potential confusion is that many names may be used by different communities and languages for the same medicinal plant. Accurate and consistent naming of plants is especially important with respect to regulation aimed at ensuring the safety and quality of traditional and other plant-based medicines. However, RBG Kew has a Medicinal Plant Names Services (MPNS[160]) Portal that provides a global nomenclatural indexing and reference resource that helps to overcome this. The MPNS enables the user to access a wide range of plant names, to avoid confusion and communicate accurately and effectively about them (see also information on plant names under Target 1).

Concern over the ongoing loss of indigenous and local cultures and the knowledge associated with them has resulted in an increase in ethnobotanical research projects around the world, and the development by The Convention on Biological Diversity Secretariat of a Traditional Knowledge Information Portal[161]. This portal aims to promote and make available information on traditional knowledge, innovations and practices that are relevant for the conservation and sustainable use of biological diversity.

European Progress

As in many other parts of the world, some European countries are increasingly using traditional plant-based medicines alongside pharmaceutical drugs. In the EU, a list of herbal substances, preparations, and combinations for use in certain traditional herbal medicinal products has been established by Commission Decision 2008/911/EC. This list is based on the work of the Committee for Herbal Medicinal Products (HMPC) established at the European Medicines Agency (EMA).

> *"Nature and its contributions to people have value for human health (well established) including their role in contemporary and traditional medicine, dietary diversity (well established) and urban green spaces (established but incomplete). Unsustainable exploitation threatens the survival of, for instance, some medicinal plants (established but incomplete)."*
>
> Source: IPBES 2018

158 https://www.cbd.int/abs/

159 https://www.kew.org/read-and-watch/plant-names-services-used-by-global-health
160 http://www.kew.org/mpns
161 https://www.cbd.int/tk/

National implementation

Target 13

Forty percent of the countries reporting on GSPC Target 13 consider that no progress is being made against this target. Similar numbers of countries (30% each) report that either progress is being made but at an insufficient rate, or that they are on track to meet this target. It is very difficult for countries to measure progress against this target as *'maintained or increased'* implies the existence of a baseline for comparison and this seldom exists. However, a number of initiatives that contribute to this target have been implemented or are underway.

Two countries, the **UK** and **Switzerland**, consider that they do not have indigenous peoples and local communities (IPLCs) as defined in Article 8j of the Convention, i.e. often ethnic groups descended from the original inhabitants of a given region, as opposed to groups that have occupied and settled in an area more recently. However, from most national reports it is clear that in many places there are long histories and traditions associated with the use of plant resources, especially for culinary and medicinal purposes (e.g. Box T13.1). Traditional village agriculture also helps shape the landscape in certain parts of Eastern Europe (Singh & Singh 2017). Ethnobotany has reportedly become more popular among scientists in **Ukraine**, and studies have been conducted in **Armenia** (Hovsepyan *et al.* 2016; 2019).

In order to avoid biopiracy regarding the traditional knowledge, **Spain** has included the ethno-botanical and other ethno-biological information in the framework of its National Inventory of Biodiversity, publishing their results in books and internet. In this way, the traditional knowledge becomes a public property issue which cannot be appropriate by anyone. By 2020, 2 books in 4 volumes have been edited reporting the traditional knowledge on wild species, and a first book on the knowledge linked to agricultural species and cultivation practices, including local varieties, has been also edited.

Box T13.1. Some sources of information on local and traditional use of plant resources

A register for traditional food in **Austria** describes plants that have been cultivated and food derivatives that that have been prepared using traditional knowledge that spans at least three generations or 75 years. These include the traditional cultivation of spelt *Triticum spelta* in Burgenland and the production of brandy from the roots of Yellow Gentian *Gentiana lutea* and Dotted Gentian *Gentiana punctata* in Tyrol[162].

A knowledge platform, FUNDUS AGRI-CULTURA ALPINA[163], exists to help preserve traditional rural knowledge about cultivation, keeping, breeding, use and production techniques of traditional crops and farm animals in the **Alps** region. The platform covers fruit, vegetables, cereals and other crops, medicinal plants, and plants for fibre and oil.

A need for information on indigenous and local knowledge and practices associated with Irish plant resources has been partially met through the publication of a book called "**Ireland**'s Generous Nature: The Past and Present Uses of Wild Plants in Ireland" (Wyse Jackson 2014).

Spain has produced an Inventory of Traditional Knowledge related to Biodiversity (IECTB[164]).The IECTB Database contains information on almost 3,000 plant species with associated traditional knowledge. The inventory contains previously published information based on studies in which data has been collected directly from on-site interviews with local people and observations (primary sources).

In addition to activities within Europe, several countries reported on how needs, knowledge and practices of IPLCs are recognised and integrated into work on overseas territories or international work (Box T13.2).

The work of RBG Kew (**UK**) has also played an important role in providing a global nomenclatural indexing and reference resource. A global data standard, the 'Identification of Medicinal Products' (IDMP), published by the International Standards Organisation (ISO), was formally adopted by the US, European, and Japanese Health Regulators and promoted by the World Health Organisation's Uppsala Monitoring Centre. The IDMP includes all medicinal products including those of plant origin, and MPNS provided a standardised list of terms, 'Controlled Vocabularies'[165], for plant names and parts, with Kew staff co-authoring the ISO implementation guide for herbal medicines.

162 https://www.Federal Ministry for Sustainability and Tourism.gv.at/land/lebensmittel/tradlebensmittel/ getraenke/enzian.html (cited in Austria 6th National Report)
163 https://www.erlesene-kartoffeln.de/fundus-agri-cultura-alpina ; https://fundus-agricultura.wiki/?lang=en
164 https://www.miteco.gob.es/es/biodiversidad/temas/inventarios-nacionales/inventario-espanol-de-los-conocimientos-tradicionales/inventario_esp_conocimientos_tradicionales.aspx
165 https://www.kew.org/read-and-watch/plant-names-services-used-by-global-health

Box T13.2. Examples of international collaboration to maintain and promote sustainable use of plants using traditional knowledge

GADEPAM[166] is an association for the Study and Development of Aromatic, Medicinal and Food Plants in French Guiana. It promotes the traditional uses of plants, including for crafts. A collaborative project[167] between Metropolitan French and French Guianan organisations, this provides an example of research in ethnobiology[168] that aims to promote the sale of traditional handcrafted goods while explaining their cultural context and manufacturing processes along with the resources used.

The Belgian Development Cooperation funds programmes that aim to support indigenous communities in partner developing countries, including the recovery and promotion of traditional knowledge and practices. Most projects are implemented by NGOs, universities or multilateral organisations.

The Meise Botanic Garden in Belgium (2018) published a checklist of vernacular names of the Flora of the Central African Republic[169].

In the UK, the Darwin Initiative is a competitive grant scheme focused on preserving and increasing biodiversity - animal and plant species and their habitats - in developing countries. One example was a project in Guyana led by Royal Holloway University[170] which involved developing a participatory, transparent and evidence-based process for traditional knowledge integration that meets poverty alleviation and biodiversity goals. This will be reflected in national policy and can be replicated elsewhere.

RBG Kew works with partners to ensure that traditional knowledge, innovations and practices of IPLCs are respected. One such project involved the Yanomami of Brazil publishing their traditional medicinal knowledge[171] for the first time, in collaboration with Kew (Milliken 2015).

Target 13 – issues to consider

- Target 13 is currently difficult for countries to report against. Reporting would be facilitated through encouraging the establishment of baselines or more specific wording, with associated guidance (e.g. reporting on numbers of projects, workshops, publications, socioeconomic surveys).
- The use of accurate names for plants is important, although the MPNS has made great strides in helping to resolve this.
- A key issue is the protection of traditional knowledge from exploitation for profit by private companies that then may not fairly share the benefits of such knowledge, although the Nagoya Protocol covers this. However, continued monitoring and vigilance, and compliance with the Nagoya Protocol, are important.
- Another issue associated with traditional knowledge, especially when this is shared more broadly across society, is the potential for overharvesting in the wild of particularly useful plant species, as unsustainable practices could put at risk their conservation status. Associated with this, rarity in the wild of medicinally useful plants can result in the substitution of other plant species that could present risks to human health. Sustainable management and cultivation along with effective systems for traceability, authentication and quality control would help reduce such risks.
- In order to protect the traditional knowledge from biopiracy and misuse, the environmental agencies should make public and universally accessible the information on the traditional use of wild and cultivated plants, at least the already published information often spread in hundreds of articles but not joined in an official publication.

166 https://gadepam.com/
167 between the French Institute of Research for Sustainable Development (IRD), the Muséum National d'Histoire Naturelle, the CNRS (Centre National de la Recherche Scientifique) funded by the French Ministry of Ecological Transition and through a contract with the State and French Guiana (CPER-DOUCP)
168 https://www.bgci.org/files/Wuhan/PosterU&D/FLEURY2.pdf
169 https://www.gbif.org/dataset/a0b06e2e-287a-4687-8a6c-2c0cfb31c16d
170 https://www.darwininitiative.org.uk/project/24026/
171 https://www.kew.org/read-and-watch/medicinal-knowledge-amazong

References

Hovsepyan R., Stepanyan-Gandilyan N., Melkumyan H. and Harutyunyan L. 2016. Food as a marker for economy and part of identity: traditional vegetal food of Yezidis and Kurds in Armenia. *Journal of Ethnic Foods* 3(1): 32-41. file:///D:/Articles/Different/2016_Hovsepyanetal_Yezidifood_JEF.pdf

Hovsepyan R., Stepanyan-Gandilyan N. and Stollberg Ch. 2019. Phytomedicinal knowledge and "official" sources in Tatev (Armenia). Ethnobiology Letters 10 (1): 23-34. https://ojs.ethnobiology.org/index.php/ebl/article/view/1266

Milliken, W. 2015. Medicinal knowledge in the Amazon. https://www.kew.org/read-and-watch/medicinal-knowledge-amazong

Singh, R. and Singh, G. S. 2017. Traditional agriculture: a climate-smart approach for sustainable food production. E*nerg. Ecol. Environ.* 2(5):296–316. DOI 10.1007/s40974-017-0074-7

Willis, K.J. (ed.) 2017. State of the World's Plants 2017. Report. Royal Botanic Gardens, Kew.

World Health Organization 2014. WHO Traditional Medicine Strategy 2014–2023. http://apps.who.int/iris/bitstream/10665/92455/1/9789241506090_eng.pdf?ua=1

Wyse Jackson, P. 2014. Ireland's Generous Nature: The Past and Present Uses of Wild Plants in Ireland. Missouri Botanical Garden Press, St. Louis.

5.2.4. Objective IV: Education and awareness about plant diversity, its role in sustainable livelihoods and importance to all life on earth is promoted

Target 14: The importance of plant diversity and the need for its conservation incorporated into communication, education and public awareness programmes

As described in section 3.2, life on Earth as we currently know it could not be sustained in the absence of plants. Plants are the fundamental building blocks of food chains in practically all ecosystems and provide us with a wide range of services including food, shelter and medicine. Plants are also intrinsically valuable. Communication, education and public awareness of the critical role that plant diversity plays is essential to support their conservation and long-term sustainable management. A huge range of organisations, public and private, and individuals around the world contribute to this target.

Despite their fundamental importance, in some domains, plants appear to take a back seat to other taxa. For example, although many plant species are threatened by illegal wildlife trade they appear to receive little attention compared with threatened animals. Margulies *et al.* (2019) considered that plants (perhaps excepting timber) are overlooked in policy and research into IWT, they receive insufficient attention from funding agencies, and that this may partly result from 'plant blindness' in relation to the way that government laws define "wildlife" (see Target 11).

In some public domains, such as gardening, plants receive considerable attention. However, this is not usually focussed on the maintenance of native species, although more natural wildlife gardening is popular in some countries.

Plant identification course - Philippe Bardin

Digital technology has helped considerably with communication, education and public awareness about plants and their conservation. For example there has been a proliferation of apps for mobile devices in recent years for identifying plants and /or parts of plants, like leaves. Some of these apps have global coverage, and some national.

A widely used app is plantsnap[172] which identifies plants, flowers, cacti, succulents and mushrooms by taking a photo on a mobile device; 90% of species of all known plants and trees can apparently be identified.

Another example is Pl@ntNet[173], an app and a web-based tool that helps identify plants using photos, organised in different databases. It was initially supported by Agropolis Fondation and developed by a consortium of French research institutions[174]. It has had more than 12 million users since its launch in 2013[175]. Many other apps are available covering a wide range of plant taxa - crops, trees, mushrooms and plants in general.

172 https://www.plantsnap.com/
173 http://plantnet.org/en/
174 Including : the French National Research Institute for Agriculture, Food and Environment (INRAE), the French Agricultural Research Centre for International Development (CIRAD), the National Institute for Research in Computer Science and Control (INRIA) and the Research Institute for Development (IRD)
175 https://docs.google.com/document/d/15BtA1L5csp3paGvkBnaC2l4UU4kbkUEjfaHAVyZwmus/edit

European Progress

The key role that plant conservation and habitat creation or restoration can play in delivering many services to people, including clean water and air, flood risk reduction, climate regulation and others, has received considerable and increasing scientific and public attention over the last decade.

The application of 'green-infrastructure' to help to respond to a range of the negative impacts of unsustainable use of natural resources has been promoted in the EU, which has a Strategy on Green Infrastructure[176] aimed at helping stem biodiversity loss and supporting the delivery of ecosystem services (see Appendix V). In the EU, the backbone of green infrastructure is the Natura 2000 network, and outside of the Natura 2000 network it includes a wide range of natural and semi-natural features and spaces. Examples are parks and gardens (public and private), hedges and vegetated buffer strips along rivers, agricultural landscapes with certain beneficial features and practices, green roofs, green walls and ecobridges. Green infrastructure is increasingly present in urban setting, has attracted considerable publicity and public engagement.

An example of the value of green infrastructure is provided by Soares *et al.* (2011). These scientists investigated the benefits and costs of street trees in Lisbon, Portugal, using the computer programme i-Tree STRATUM (Street Tree Resource Analysis Tool for Urban forest Managers) which helps quantify urban tree structure and function and management needs and enables costs and benefits to be quantified. They found the annual value of services provided by Lisbon street trees to be $8.4 million, compared with $1.9 million spent on their maintenance. This provides an excellent example of the importance and value of plants that can readily be communicated to the public in urban areas.

Another growing area based on nature-based solutions for restoring biodiversity and supporting ecosystem services that has been widely communicated and received substantial interest across Europe in recent years is 'Rewilding[177]'. This involves the restoration of naturally functioning systems and wildlife at a landscapes scale.

Regarding research and the dissemination of scientific information on plants, the European Plant Science Organisation (EPSO[178]) is an independent academic organisation that aims to improve the impact and visibility of plant science in Europe. EPSO represents more than 220 research institutes, departments and universities from 31 countries in Europe and beyond. Every two years, EPSO coordinates 'The Fascination of Plants Day' (FoPD[179]), a global set of about 1,000 events carried out during May, peaking on the 18th May.

Seed sampling session to help the emergence of local nurseries in the field of Social Economy - Philippe Bardin

176 https://ec.europa.eu/environment/nature/ecosystems/strategy/index_en.htm
177 https://rewildingeurope.com/
178 https://epsoweb.org/
179 https://plantday18may.org/

The Federation of European Societies of Plant Biology (FESPB[180]) is a European society of Plant Scientists that aims to advance research, education, and information exchange among plant biologists within Europe and beyond. It supports the publication of research results through its affiliated international journals: Journal of Experimental Botany, Journal of Plant Physiology, Plant Physiology and Biochemistry, Physiologia Plantarum, and Plant Biology.

Since 2012 EPSO and FESPB have joined their conferences and held a major biannual conference.

National implementation

Target 14

All of the countries reporting on GSPC Target 14 consider that progress is being made but at an insufficient rate (7 countries) or that they are on track (6 countries) to meet this target. No countries reported no progress against this target.

A wide range of learning activities associated with botany and plant conservation take place in all of the countries that reported on this target – and probably in all countries. The nature of form of communication, education and public awareness has changed, in some places more than others, and while botany still plays a part in formal teaching in some countries, this may have decreased in others. Many national botanical clubs or NGOs set up for the study and conservation of plants, or specific plant taxa, also contribute to this target. Examples of activities that take place to promote plant and other biodiversity conservation are given in below:

- **Activities at botanic gardens and other types of visitor centre.** In **Belgium**, the importance of plant diversity is incorporated in a wide range of communication, education and public awareness programmes at visitor centres and elsewhere. The University Botanical Garden Ljubljana[181] in **Slovenia** carries out public lectures about the importance of plant biodiversity and native plant conservation. It also provides guided tours to introduce people to native plants and organizes international conferences on plant biodiversity. In the **UK**, RBG Kew and RBG Edinburgh teach a large number of children every year through site visits and other activities. A brochure on 'The World of Plants' (Lumea Plantelor) was issued in 2019 by the "Alexandru Ciubotaru" National Botanical Garden (Institute), Chisinau, **Republic of Moldova**.

- **Outdoor teaching involving organised educational field trips.** In **Serbia** summer camps for children and youth, 'eco-camps', provide informal education and increase awareness. Since 2014 PLANTA EUROPA has been developing the idea of "PlantRace" to make botanical knowledge more interesting especially for young people. PlantRace is a regional event of teams competing in finding most plant species in a given time and area. Since then several PlantRace-events have been successfully carried out in **Germany** and **Hungary**. Continuation and advertising of the idea in more European countries is planned for the next years.

- **TV and radio programmes and documentaries. Ireland** has many national radio and TV programmes and newspaper columns dedicated to biodiversity. In **the Netherlands** Nature Today[182] keeps people informed of topical developments in nature with biologists writing stories on a wide range of subjects.

- **Book or web-based publications on national flora.** The publication in 2017 of The Flora of Italy[183] represents an important learning opportunity.

- **Web-based training and information resources.** In **Spain**, the Biodiversia Platform[184] launched in 2011 is a virtual space providing information generated by the Spanish Inventory of Natural Heritage and Biodiversity to the public, promoting education and environmental awareness. In the **UK**, RBG Kew disseminates science through social media and the RBG Kew science blog. State of the World's Plants[185] report is published on their website.

- **Nature, biodiversity or plant festivals.** Throughout **France** every year more than 800,000 people experience nature by participating in one of 5,000 events as part of the Fête de la Nature[186]. In **Hungary**, botanic gardens and conservation organisations raise awareness through a range of activities including Botany Week, Biodiversity Day, Tree Day and the Fascination of Plants Day.

- **Plant and horticultural networks.** The Botanical Society of **Britain** and **Ireland** BSBI[187] run field meetings, training events and surveys throughout the year. A range of activities are undertaken by the **Norwegian** Botanical Society, the Norwegian Lichen Society, the Norwegian Bryophyte Society, the Norwegian Fungi and Useful Plants Society, and the umbrella organisation SABIMA.

- **Citizen science projects.** In **France**, Vigie-Nature organises a programme whereby people can learn about the plants that grow in their direct environment[188]. The French Conservatoires botaniques nationaux network provides a set of citizen science programmes, as well as the NGO Tela Botanica[189] through its vast network of more than 50,000 botanists. In **Switzerland**, the National Data and Information Center[190] on the Swiss Flora encourages and maintains a network of citizen scientists active in plant conservation. The Ukrainian Biodiversity Network Project[191] provides a hub for citizen science projects. In the **UK**, The National Plant Monitoring Scheme[192] is a habitat-based scheme carried out by volunteer surveyors nationwide, where data are collected to provide an indication of changes in plant abundance, diversity and ultimately to assess the health of habitats.

- **Plant reporting schemes**. In **Austria**, plant species diversity is recorded[193]. In **Finland**, the Finnish Biodiversity Information Facility[194] compiles information into a single open access site, as well as in **France** with the National Inventory of Natural Heritage[195] gateway. The State Nature Conservancy in **Slovakia** manages a website[196] open to the public, collecting occurrence data on plant species for monitoring, management and reporting.

180 https://www.fespb.org/
181 http://www.botanicni-vrt.si/autochthonous-plants-in-the-urban-environment; http://www.botanicni-vrt.si/pdf/books/botanic-gardens-in-the-year-of-european-green-capital.pdf; http://www.botanicni-vrt.si/botanic-gardens-and-biodiversity
182 https://www.naturetoday.com/intl/en/home
183 http://www.minambiente.it/sites/default/files/archivio/biblioteca/protezione_natura/LaFloraInItalia.pdf
184 http://www.biodiversia.es/
185 https://stateoftheworldsplants.org/
186 https://fetedelanature.com/edition-2019
187 https://bsbi.org/
188 http://www.vigienature.fr/fr/flore/sauvages-de-ma-rue
189 https://www.tela-botanica.org/
190 https://www.infoflora.ch/en/
191 http://www.ukrbin.com/
192 https://www.npms.org.uk/
193 https://www.naturbeobachtung.at/platform/mo/nabeat/index.do
194 https://laji.fi/en
195 https://inpn.mnhn.fr/accueil/index?lg=en
196 www.biomonitoring.sk

- **Formal teaching.** In **Bosnia and Herzegovina** plant diversity has always been recognised in national curricula[197]. In the Republic of **Moldova**, a variety of environmental skills are included in the national curriculum of teaching institutions.

It is difficult to measure progress against Target 14 unless baselines exist for different types of communication, education and public awareness. These can sometimes be established, for example uptake and use of new technology, like plant identification apps. In the UK, one of the biodiversity indicators[198] presents an index of the number of hours worked by volunteers for 13 UK conservation charities and public bodies. JNCC extracted the information relating to the two charities focussed exclusively on plant conservation activities (Figure T14). This shows a long term-increase since 2000.

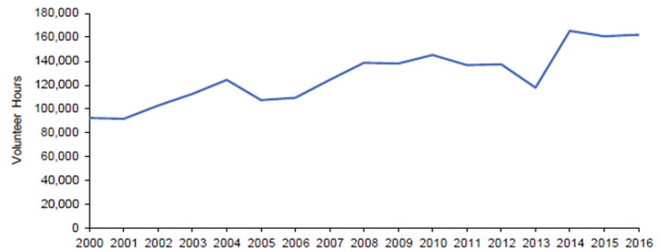


Figure T14. Total volunteer hours recorded by the Botanical Society of Britain and Ireland, and Plantlife from 2000 to 2017. Data for 2000 to 2006 for Plantlife are interpolated.
Source: Taken from Anon 2019. Sixth National Report to the United Nations Convention on Biological Diversity: United Kingdom of Great Britain and Northern Ireland. JNCC, Peterborough.

It is difficult to judge the extent to which **formal teaching** (primary, secondary and university levels) currently incorporates the study of plant ecology, uses and conservation, and how this has changed over time. As described above, the national reports highlight a considerable amount of public awareness activity and citizen science, and many organisations including botanic gardens and conservation charities incorporate biodiversity, including plant programmes in their educational activities. Some universities have developed teaching in specific areas, for example the Catholic University of Leuven (KULeuven) in **Belgium** has developed a European and intercontinental network on cryopreservation of many crops including research, training and applications for long-term use. **Slovakia** indicated that botany is regularly taught in elementary schools and some high schools, while in **France**, botany is reportedly tending to disappear from school, high school and university training programmes and several institutions are campaigning to reverse this. While results appear mixed, a long-term decrease in formal teaching is reflected in some responses to Target 15, which suggest that there may be an insufficient number of trained people working with appropriate facilities to achieve the GSPC targets. This seems to be partly due to decreased funding for formal education in biodiversity conservation.

197 http://www.fzofbih.org.ba/v3/vijest.php?akt_id=139
198 http://jncc.defra.gov.uk/page-4253

Target 14 – issues to consider

- A considerable amount of education, communication and public awareness is already underway highlighting the importance of plant conservation. It remains difficult though to know 'how much is enough' without measures in place to evaluate impact. Target 14 is complementary to, and integrated within the other GSPC targets, as knowledge gathering and transmission is a component of all of them. Although ultimately success will be measured by the diversity and conservation status of plants, their habitats, and the services they provide, the development of measures that enable the effectiveness of the contributions of education and communication channels would be very valuable. Education programmes frequently measure outputs, such as numbers of people trained, but do not always measure how this affects outcomes. Guidance for national reporting on the types of measures of outputs and outcomes would be of use.
- It appears that there may have been a general decline in botanical teaching as part of the formal education system, possibly resulting from a reduction in financial resources (see Target 15). While this gap may have been to some degree filled by other forms of less formal education, it may be a reason for the lack of trained people necessary to deliver the GSPC targets as highlighted in Target 15. This is of concern for the future delivery of effective plant conservation.
- The ability of plants to deliver natural solutions to sustainability problems, e.g. through green infrastructure, is a growing and important area, and better integration and communication across sectors (engineering, agriculture, environment, development etc.) would be beneficial.
- The apparent 'plant blindness' in the international wildlife trade area merits additional effort in communication and awareness.


Germination testing course - *Philippe Bardin*

References

Margulies, J.D., Bullough, L-A., Hinsley, A., Ingram, D.J., Cowell, C. *et al.* 2019. Illegal wildlife trade and the persistence of "plant blindness" Plants, People, Planet. 1:173–182. DOI: 10.1002/ppp3.10053

Soares, A.L., Rego, F.C., McPherson, E.G., Simpson, J.R., Peper, P.J. *et al.* 2011. Benefits and costs of street trees in Lisbon, Portugal. Urban Forestry & Urban Greening 10: 69–78.

5.2.5. Objective V: The capacities and public engagement necessary to implement the Strategy have been developed

Target 15: The number of trained people working with appropriate facilities sufficient according to national needs, to achieve the targets of this Strategy

Meeting Target 15 is essential for the delivery of the other GSPC Targets (although they may fail to be met for other reasons). It is important to note progress against this enabling target, but difficult for countries to quantify progress, so qualitative responses would be anticipated.

Capacity-building through sharing experiences among nations and regions (Target 16) will contribute to Target 15.

National implementation

Target 15

Most countries reporting against Target 15 consider that progress is being made but at an insufficient rate; three countries reported being on track to meet this target and one country reported that no progress had been made.

Half of the countries reported insufficient trained people working with appropriate facilities to achieve the GSPC Targets. This appears to have resulted from decreased funding in this area, e.g. for formal education in biodiversity in a number of countries, and also because multiple skills are required to tackle the many challenges facing plant conservation.

Reductions in funding are reported to have resulted in declines in formal teaching of botany and related subjects at school and university level, fewer people trained in plant taxonomy and systematics, and insufficient training for conservation management and monitoring specialists and protected area rangers. The impact of the financial crisis and budget cuts appear to have affected the availability of funding. Decreases in funding have happened despite stated commitments to biodiversity conservation.

For example, data are available for UK public sector funding[199]. Funding allocated to biodiversity in the UK decreased substantially between 2010/11 and 2017/18, but increased substantially for international biodiversity over the same period. Taken together however, there was a decrease in overall public sector funding for biodiversity. Spending on biodiversity in the UK by non-governmental organisations (NGOs) with a focus on biodiversity and/or nature conservation (net of government funding) showed a 24% increase in the 5 years to 2017-18. However, funding by NGOs is at a lower level than public sector funding so this increase does not compensate for the decrease in public sector funding.

Relevant international projects with capacity-building components funded under the UK Government's Darwin Initiative in the 2019 funding round are given in Table T15. Projects are usually of 3 years duration. NGOs also contribute significantly to international training and capacity building. For example, in 2018 BGCI led training[200] for 689 people from 220 institutions in 54 countries. Training topics include plant conservation policy, practice and education.

Other support for international capacity building includes that from France where number of activities have been undertaken to help supporting training and scientific and technical capacity building[201] for biodiversity conservation. Contributing to international solidarity and ensuring greater mainstreaming of biodiversity into French development assistance, the Sud Expert Plantes Developpement Durable (SEP2D), is a multilateral program supporting the implementation of the GSPC. Launched in 2015, it aims at sustaining the scientific communities in 22 francophone countries in western and central Africa, the Indian Ocean, and Southeast Asia. Financially supported by the French Development Agency, the French Global Environment Facility, the French Ministry of Europe and Foreign Affairs, the Research Institute for Development (IRD) and the MNHN, it seeks to strengthen interactions and partnerships in the field of plant biodiversity, supporting research projects on the knowledge and the valorization of plant biodiversity, establishing public-private partnership initiatives, enhancing the value of botanical collections, training professional and encouraging the involvement of scientists in advising national and international bodies.

Countries	Project Title and *UK project lead organisations*
Malawi, Tanzania, Zambia	Bridging agriculture and environment: Southern African crop-wild-relative regional network *University of Birmingham*
Malawi	Maximising Conservation and Community Benefits from Plants of Mount Mulanje *BGCI - Botanic Gardens Conservation International, TRAFFIC International*
Madagascar	Traditional African vegetables strengthen food and nutrition security in Madagascar *World Vegetable Centre*
Tajikistan	Know your onions: sustainable plant use in Tajikistan *RBGE - Royal Botanic Garden, Edinburgh, FFI - Fauna and Flora International*
Guatemala	Green Health: improving indigenous participation through the CBD's ABS mechanisms - *UCL School Of Pharmacy*
Sierra Leone	Linking food security and forest conservation under REDD+ - *RSPB*
Papua New Guinea	Integrating conservation and health in Papua New Guinea's vulnerable rainforests - *University of Sussex*
Bolivia, Brazil	Improving indigenous Bolivian Chiquitano people's livelihoods through sustainable forest management - *RBG Kew*
Nepal	Uprating community forest management in Nepal: enhancing biodiversity and livelihoods -*RBGE - Royal Botanic Garden, Edinburgh*
Kyrgyzstan	Securing wild tulips and pastoral communities in the Kyrgyz mountains *FFI - Fauna and Flora International, Cambridge University Botanic Garden*
Zambia	Lion Carbon: creating biodiversity value and sustainable management through REDD+ - *University of Oxford*
Nepal	Market-led approach to sustainable management of agrobiodiversity for livelihood outcomes *LI-BIRD - Local Initiatives for Biodiversity, Research and Development*

Table T15. Projects of particular relevance to the GSPC Targets and capacity building funded under the UK Government's Darwin Initiative in the 2019 funding round.

Target 15 – issues to consider

- The national reports suggest that in many countries capacity to tackle plant conservation has been eroded, largely due to lack of financial resources. This is of particular concern given the scale of the problems that plant conservation faces. Countries tend to report on the capacity associated with professionals, be they plant scientists, teachers, land managers or others associated with plant conservation, and also on capacity in the publicly-funded sector.
- Funding by plant-focussed NGOs appears to have increased, and while professional capacity has reportedly been eroded there is potential for the capacity of citizens and communities to contribute further to plant conservation. The report on progress with Target 14 illustrates a number of citizen science schemes that can help collect data, and new digital tools that facilitate plant identification. While it is important that professional capacity be maintained and enhanced, other capacity building avenues, for example voluntary, merit consideration.

199 https://jncc.gov.uk/our-work/ukbi-e2-biodiversity-expenditure/
200 https://www.bgci.org/resources/bgci-tools-and-resources/bgci-annual-reports/ BGCI Annual Report and Accounts 218
201 http://sep2d.org/actions-temps-forts/ecole-d-automne-apa

Target 16: Institutions, networks and partnerships for plant conservation established or strengthened at national, regional and international levels to achieve the targets of this Strategy

Some of the challenges facing plant conservation are local in nature, such as habitat loss and degradation resulting from local development, or locally unsustainable wild plant collection practices. Others are international, for example trade in wild plants, globalisation and the spread of invasive non-native species, and climate change. Tackling these challenges requires responses at different scales and from a wide range of different sectors ; farming and forestry, construction, transport, business, academia, development, finance, regulatory, non-governmental, citizens and others. Creating effective fora for information exchange and collaboration across these sectors will be critical to the development of integrated solutions and effective delivery of the GSPC targets.

Examples of international networks that focus on plant sciences and/or plant conservation are given in Table T16.

Working together for the conservation of Luronium natans, *France - Philippe Bardin*

GLOBAL NETWORKS		
Global Partnership for Plant Conservation - GPPC	63 partner organisations	www.plants2020.net/gppcpartners
The Global Partnership on Forest and Landscape Restoration - GPFLR	Launched in 2003 by IUCN, WWF and the Forestry Commission of Great Britain. Joined by 30 governments, international organisations and NGOs	http://www.forestlandscaperestoration.org/
The International Union for the Conservation of Nature Species Survival Commission - IUCN SSC **Specialist Groups**	43 taxon or geographical specialist groups for plants (38) and fungi (5)	https://www.iucn.org/ssc-groups/plants-fungi
Botanic Gardens Conservation International - BGCI	More than 600 institutional members in more than 100 countries.	https://www.bgci.org/
Global Trees Campaign - GTC	A joint initiative between Fauna & Flora International (FFI) and BGCI. Working with 26 project partners	https://globaltrees.org/about-global-trees-campaign/
International Network for Seed-Based Restoration	52 partner organisations	https://ser-insr.org/
The Global Plant Council	A coalition of 30 organisations raising awareness of plant research in science and society	https://globalplantcouncil.org/
EUROPEAN NETWORKS		
Planta Europa	A network of independent organisations and individuals working to conserve European wild plants and fungi. Secretariat provided by the National Museum of Natural History, Paris – FRANCE	https://www.plantaeuropa.com/
European Committee for Conservation of Bryophytes - ECCB	A European network of bryologists with members from universities, museums, conservation agencies and private individuals working for bryophyte conservation	https://eccbbryo.nhmus.hu/welcome
European Cooperative Programme for Plant Genetic Resources – ECPGR	29 member countries in the current Phase (2019-2023)	http://www.ecpgr.cgiar.org/
European Native Seed Conservation Network – ENSCONET	31 partners in 20 countries working together to preserve seeds for the future	http://enscobase.maich.gr/
European Mycological Association	Council representatives from 28 European countries (2015-2019)	http://www.euromould.org/
European Council for the Conservation of Fungi	80 representatives from almost all European countries	http://www.eccf.eu/welcome-en.ehtml
Federation of European Phycological Societies - FEPS	Full members include the national Phycological Societies/Algal Groups of: 12 countries representing more than 1000 scientists.	http://www.feps-algae.org/
The Federation of European Societies of Plant Biology - FESPB	25 affiliated scientific societies	https://www.fespb.org/
European Plant Science Organisation - EPSO	Independent academic organisation representing more than 220 research institutes, departments and universities	https://epsoweb.org/
The European Botanic Gardens Consortium - EBGC	32 countries as members, mainly representing national networks of botanic gardens. Convened by BGCI	http://www.botanicgardens.eu/index.html
The Business and Biodiversity Resource Centre	A resource centre for the EU, managed by Earthwatch (Europe)	http://www.businessandbiodiversity.org/index.html
Eurosite	Network of natural site managers bringing together non-governmental as well as governmental organisations, and individuals	https://www.eurosite.org/
ConservePlants	Network for the conservation of European threatened plants (38 countries), under the COST initiative	https://www.conserveplants.eu/en/

Table T16. Examples of networks for plant research and conservation. Many specialist networks are convened or coordinated by global networks.

European Progress

A number of regional plant science and/or conservation networks exist across Europe and some have been established or strengthened over the last ten years (Table T16). These networks primarily link plant scientists, botanical gardens, plant conservation organisations and those with a specialist interest in a particular taxon.

In terms of supporting networks that can contribute to plant conservation objectives, the EU Business @ Biodiversity Platform[202] provides a unique forum for dialogue and policy interface to discuss the links between business and biodiversity at EU level[203].

National implementation

Target 16

Half of the countries reporting against Target 16 consider that they are on track to meet this target. Most of the remainder consider that progress is being made but at an insufficient rate and one country reported that no progress had been made.

The reports on Target 3 (Box T3.2) and Targets 14 and 15 give examples of national networks and activities, e.g. connecting scientists and citizens and capacity building in Europe and internationally. Other plant conservation networks are mentioned throughout this report.

Activities, frameworks and partnerships exist at national level in many European countries incorporating different policy areas and government departments, often working with other sectors, to enhance biodiversity conservation. A good example is the "Trame verte et bleue[204]" in **France** supported by the Ministry of Ecological Transition and overseen by national and regional committees involving stakeholders from many governmental and non-governmental sectors (Box T16.1).

In **Spain**, the Spanish Society for Plant Conservation Biology (SEBiCoP[205], Box T16.2.) provides a forum for scientific and technical exchange between scientists, technicians, managers and to all those interested in the conservation of wild flora. It has acted, where appropriate, as a collaborator and advisor to the different public administrations on the development of conservation strategies or measures to protect plant diversity.

Many other types of network can support or interface with plant conservation, and numerous sector-specific national networks exists. One example, from the UK construction industry, is the UK Green Building Council[206], which has over 400 member organisations (including e.g. academics, architects, engineers, manufacturers, local government) aiming to improve the sustainability of the built environment. Their case studies include green infrastructure.

202 http://www.businessandbiodiversity.org/eu_Europe.html
203 https://ec.europa.eu/environment/biodiversity/business/index_en.htm
204 http://www.trameverteetbleue.fr/
205 https://www.conservacionvegetal.org/
206 https://www.ukgbc.org/

Box T16.1. "Trame Verte et Bleue" in France

The Green and Blue Framework (TVB) is a tool for helping conserve biodiversity through incorporating ecologically functional natural areas into planning tools and development projects. It aims to curb the biodiversity loss that has resulted from habitat fragmentation and urbanisation. A key aim is to preserve and restore ecological connectivity to enable favourable conditions for plants and animals to complete their life cycles and disperse.

The Green and Blue Framework is integrated into all other environmental policies. At a national scale, the "National guidelines for the preservation and restoration of ecological continuity" sets the framework for the Green and Blue Grid.

Regional Ecological Coherence Schemes (SRCE) define objectives and actions required to preserve and restore ecological continuity through a strategic action plan. Other regional level plans and programmes pay heed to the SRCE, especially development policies (transport or town planning) and sectoral policies (agriculture, forestry etc.).

The SRCE help achieve social and economic objectives by maintaining the services biodiversity provides (fuel from wood, pollination, benefits for agriculture, improved water quality, flood risk reduction etc.), by enhancing the landscape and culture and in other ways.

In the French Overseas Territories, regional development plans ensure the implementation of TVB.

Box T16.2. The Spanish Society of Plant Conservation Biology (SEBiCoP)

After the collaboration between different researchers from all over the country that led to the publication of a Red List of vascular flora in 2000, the need to create a forum for scientific and technical exchange between Spanish experts and managers emerged, giving way to SEBiCoP in 2003. Nowadays, the society has twenty institutional partners (mainly botanical gardens) and 250 ordinary members belonging to universities, research institutes, public administrations, consulting, etc. Its main achievement is the organization of biennial plant conservation congresses, nine so far, which not only bring together scientists, managers and conservationists, but has become the most important botanical meeting in Spain.

SEBiCoP often collaborates with different administrations, particularly on projects of the Spanish Ministry of the Environment. Among other results has been the updating of the Red List on 2008, and the edition and coordination of the Red Book (2004) and its subsequent appendices (2006, 2008, 2010 and 2017), totaling 700 red data sheets. In addition, four volumes have been published on demographic monitoring of threatened Spanish plants, totalizing 45 species distributed throughout the Iberian peninsula or the Balearic and Canary archipelagos.

The society also promotes the addition of species to the catalogs of protected species, both regional and national, and participates in the sexennial studies on the plants included in the annexes of the Habitats Directive.

https://www.conservacionvegetal.org

Target 16 – issues to consider

- There are many examples of functioning networks between plant-focussed organisations. In terms of supporting networks, resources such as the business and biodiversity resource centre[207], managed by Earthwatch Europe, exist at European level to link different sectors with biodiversity interests. Various networks exist promoting sustainability and environmentally responsible behaviour in Europe, e.g. CSR Europe[208] is a European business network for Corporate Sustainability and Responsibility that has a biodiversity and industry platform[209] that aims to explore how companies can have positive biodiversity impacts at their industrial sites and across their business models. Eurosif[210] promotes sustainability through European financial markets.

- Most plant organisations and networks are involved in specific projects that are collaborative in some way with other sectors including agriculture, forestry, business, industry or finance etc. Similarly, networks from, for example, the construction industry often collaborate with conservation organisations at an individual project level. However, plant science or conservation organisations are seldom members of other sectoral networks, and neither are organisations from other sectors often members of plant conservation networks. Strengthening such collaborations at a more strategic level and developing stronger networks between the plant science/conservation bodies and other sectors could be explored. This has the potential to contribute to the delivery of many of the GSPC targets and aid in the development of sustainable financing models.

- The conservation networks of the Mediterranean Region should also involve similar institutions from Northern Africa and the Middle East, as they are often sharing the same endangered species or habitats. Although some multi geographic platforms have been established, i.e. GENMEDA, the financial support from the European administrations is yet scarce and the bureaucratic burden slows down the inclusion of non-European countries.

Cirsium eriophorum – *Erika Penzesné Kónya*

207 http://www.businessandbiodiversity.org/eu_Europe.html
208 https://www.csreurope.org/
209 https://www.csreurope.org/biodiversity-and-industry-platform
210 http://www.eurosif.org/

Box T16.3. The French *Conservatoires botaniques nationaux* network

The French Conservatoires botaniques nationaux[211] is a network of independent organisations sharing the same specifications on behalf of the Ecology Ministry. The Conservatoires botaniques nationaux network covers the whole France territory including overseas. On their own agreement territory, each of the twelve Conservatoires implements a set of actions that aims at protecting plant biodiversity at the genetic, specific and ecosystemic level.

Field inventories have been carried out for several decades and feed an in-depth knowledge of plant and habitat distribution. More than 30 million floristic data have been computerized in the databases coupled to the main database of the network (SI-Flore[212]). The Conservatoires databases also centralise data collating at the regional level by their own networks of professional and amateur field botanists. Based on reliable and up-to-date distribution maps and multi-scale Red Lists, the botanists of the Conservatoires network work closely with land managers to restore the natural habitats and associated species and if necessary, population reinforcements or introductions are undertaken for the species on the verge of extinction. This is achieved through seed-banking genetic resources of the most endangered species and growing these species in their conservatory gardens. Networking also implies interoperability and sharing protocols and thus leads to regular workshops within the network. The network conducts expertise for public policies and is involved in public awareness through a large panel of activities (publication of atlases, academic courses, programmes of Citizen Sciences…). The network can also rely on a steering body at the Office Français de la Biodiversité that allows the Conservatoires botaniques nationaux to have an effective impact on the biodiversity sectoral policies in France.

The Conservatoires botaniques nationaux network can be consider as an inspiring success-story skilled to implement most of the Global and European Plant Conservation Strategy targets.

211 http://www.fcbn.fr/
212 http://siflore.fcbn.fr/?cd_ref=&r=metro

6. Discussion

Key points from the 'issues to consider' sections of the GSPC Targets have been summarised under the five GSPC Objectives in Appendix VI. Comments on the Targets themselves can be found in Appendix VII. The discussion below highlights some of the main issues that need to be considered for the better conservation and restoration of plant diversity, as highlighted in this report. The areas covered are not comprehensive, but they will provide a useful contribution to the dialogues and preparations underway to develop a new global plant conservation framework and targets to 2030.

Biodiversity is in crisis. The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) regional assessment report on biodiversity and ecosystem services for Europe and Central Asia[213] (IPBES 2018) highlights the continuous strong regional decline of biodiversity in the region (Box 2.1). The European Environment Agency's 6th report on the European Environment - state and outlook 2020 (SOER 2020) gives evidence-based insights into the state of the European Environment and how we need to respond to the challenges faced, including the biodiversity and climate crises. Key messages from this report (Box 6.1) are as relevant for plants as for other taxa, and highlight that although the EU's biodiversity policy framework is fit for purpose, and Europe has performed well in terms of designating protected areas (the Emerald Network including Natura 2000 sites), this has not effectively protected species and habitats.

Box 6.1. From: European Environment Agency 2019.

Key messages

- Biodiversity and nature sustain life on Earth, delivering numerous essential ecosystem services. They are a vital element of our cultural heritage and treasured for their recreational, spiritual and aesthetic values. As a result, biodiversity loss has fundamental consequences for our society, economy and for human health and well-being.
- Despite ambitious targets, Europe continues to lose biodiversity at an alarming rate and many agreed policy targets will not be achieved. Assessments of species and habitats protected under the Habitats Directive show predominantly unfavourable conservation status at 60 % for species and 77 % for habitats. Biodiversity loss is not confined to rare or threatened species. Long-term monitoring shows a continuing downward trend in populations of common birds and butterflies, with the most pronounced declines in farmland birds (32 %) and grassland butterflies (39 %).
- There has been progress in some areas, such as the designation of protected areas: the EU Natura 2000 network now covers 18 % of the EU's land area and almost 9 % of marine waters, making it the world's largest network of protected areas.
- Europe's biodiversity and ecosystems face cumulative pressures from land use change, natural resource extraction, pollution, climate change and invasive alien species. These have a severe impact on ecosystem services — nature's benefits to people — as illustrated by the recent alarming loss of insects, especially pollinators.
- The broad framework of EU biodiversity policy remains highly relevant and is fit for purpose but the challenge is urgent and interlinked with the climate crisis. Targets will not be met without more effective implementation and funding of existing measures in all European environmental policies, as well as greater policy coherence with respect to biodiversity in agricultural and other sectoral policies. The wider application of ecosystem-based and adaptive management in combination with increased public awareness of society's dependency on biodiversity and nature are important steps forward.

The European environment —state and outlook 2020. Knowledge for transition to a sustainable Europe. ISBN 978-92-9480-090-9 doi: 10.2800/96749

213 This region covers the 47 countries of the Council of Europe and Belarus, plus Israel and Central Asia: Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, Uzbekistan

Gentiana clusii – *Erika Penzesné Kónya*

Transformational change is now needed, both in what is done and how it is done, to deliver a sustainable future for biodiversity, ecosystem functioning and human livelihoods.

A wide range of relevant biodiversity agreements and policies exist across Europe. Appendix V describes a wide selection of the European or EU agreements, Directives, Regulations, Action plans and other policy instruments of relevance to plant conservation. These are extensive and considered to be largely fit for purpose.

Updating of some policies could be considered. Although the policy framework is relatively comprehensive and robust, some agreements may benefit from revision or updating. Examples that merit consideration are the development of legally binding forestry policy (see Appendix V, section on Forestry and Plant Conservation in Europe) and an exploration of whether the interactions between governments, private companies and NGOs in voluntary certification standards could be adjusted to increase the coverage of and compliance with sustainable management techniques.

The Habitats Directive is one of the strongest legal tools in nature conservation and the Natura 2000 network is one of the largest protected area networks in the world, even if the Natura2000 sites are not placed under national Protection Act or environmental regulations by EU Members States. However, the species Annexes cover only a proportion of threatened plant species and are not updated to take account of recent scientific knowledge, i.e. species added to the IUCN Red List or other considerations. Consequently, there have been calls for changes including greater flexibility and updating of the Annexes (Cardoso 2012), implementation of local action plans, and an improved monitoring system (Hochkirch *et al.* 2013). However, it has also been noted that the extensive Natura 2000 network protects a wide range of species, habitats and functions not specifically mentioned within the Annexes, and the Habitats Directive already calls for broader landscape measures above and beyond site designation and management to improve the coherence of the network (Box T4.1). It has additionally been argued that amending the Directives' Annexes could be a substantial undertaking and detract from the urgent need for effective action to ensure that favourable conservation status of Natura 2000 sites is achieved (Maes *et al.* 2013). Other measures designed to protect those threatened species not included in the Directive's Annexes are undoubtedly needed and should be supplementary, with mechanisms provided for making available European Union and other funding to support their conservation (see also Hermoso. *et al.* 2019).

Threatened species require additional measures. Action/recovery plans have only been produced for a relatively small number of threatened plant species. An assessment is needed of the number of additional threatened plant species requiring *in situ* species recovery plans. These should be developed collaboratively with all stakeholders and consider measures needed within and outside pro-

tected areas, and requirements for *ex situ* collections. An additional consideration, relevant to several GSPC objectives, is ensuring that the needs of individual species are not overlooked in broader approaches to conservation or policies that affect the environment, such as agri-environmental policies under the EU CAP, and that species, site and landscape approaches are well integrated, with special attention given to the microhabitats many threatened plants require. For example, while large and functionally connected networks are essential for plant conservation, as described below, at the other end of the size scale micro-reserves (Box T5.1) help conserve those threatened and often endemic plant species that occur in very small and specific habitat patches.

Protected areas will continue to play a key role in plant conservation. Protected areas have been the cornerstone of much conservation work across Europe and should remain critical components of future conservation strategies. However, it is highly probable that climate change and other factors will cause changes in the populations and distributions of habitats and species in at least some protected areas, with both local extinctions and continental-scale shifts in species distributions. However, while the composition of protected areas may change, their role in providing resilience is paramount and they will continue to support the maintenance of plant diversity over time in a way that is unlikely to happen outside protected areas. Protected areas are key refuges for a wide range of species that have been lost from or severely affected by threats in the wider landscape, and this is likely to remain the case. Increased protected area connectivity through restoring and enhancing relevant features and the ecological value of the landscapes around and between them is undoubtedly essential. Such strengthening of the functionality of the protected area network will allow species to migrate to areas with suitable climatic conditions and specific conservation policies and support mechanisms will be needed to facilitate this.

Juniperus polycarpos *in woodland in Herher Sparse Woodland state sanctuary - Anna Asatryan*

There is an urgent need for habitat restoration and green infrastructure beyond protected areas. Large, ecologically functional and connected networks of protected sites help conserve plant species and their habitats today, but also help protect against the future effects of climate change, invasive species and other potential drivers of species decline. Such connection requires corridors of suitable habitat managed in ways that accommodate the requirements of plants and other biodiversity, along with wider landscape measures. This is discussed in section 3.3.1 on the impacts of habitat fragmentation on plants. The European Greenbelt Initiative[214] and the EU Strategy on Green Infrastructure[215] support these broader measures along with national schemes described in this report (like Trame Verte et Bleue in France – Box T16.1.). Supplementary initiatives also help increase connectivity and reduce fragmentation. For example Rewilding[216] (Box T4.3) occurs at a sufficiently large scale to potentially sustain movements and populations of many species. Effective functional networks of sites should improve the conservation status of the habitats and plant species in protected areas (like Natura 2000 sites) and measures beyond site protection, many of which contribute to this connectivity, will benefit plants more broadly. This is important as a high proportion of plants are found beyond protected areas. Increased emphasis is needed on the development of national and regional frameworks to promote habitat restoration and green infrastructure. Tree planting, and the restoration of habitats that can provide carbon sinks, can help mitigate climate change. However, it is essential that the right species are planted in the right places, and that such measures (like Végétal local in France and NASSTEC leaded by Italy – Box T12.3.) contribute to both biodiversity and climate objectives.

Although fit for purpose, European policies have so far failed to conserve plants and other biodiversity: the GSPC targets have not been met in Europe. This is despite the framework for plant (biodiversity) conservation in Europe being among the best developed in the world. Reasons for missing the 2010-2020 GSPC targets, as well as for missing previous biodiversity targets (e.g. in 2010) appear to lie partly in *insufficient sectoral integration*, as well as *inadequate compliance* with and *poor implementation* of existing policies and regulations. Resources have also been an important constraint in many cases. Examples of these are given throughout this report. Good sectoral integration is required to ensure that the drivers of decline in plant diversity are dealt with effectively. Some drivers affect particular sites (e.g. fragmentation as a result of urbanisation or transport infrastructure) but many (e.g. climate change, invasive non-native species) threaten plants in ways that are not site specific.

Also, the GSPC targets do not always neatly align with other biodiversity targets, especially the Aïchi targets, and this can hamper reporting on progress. This may be, at least in part, because although the GSPC targets were updated for the 2011-2020 period, they were initially developed as part of the first GSPC strategy (2002-2007 – Appendix III) which predates the 2011-2020 Aichi targets and EU biodiversity strategy targets. In December 2018, the Global Partnership for Plant Conservation (GPPC) submitted to the CBD a vision for long-term plant conservation and views on plant conservation and the GSPC in the post-2020 biodiversity framework[217].

The GPPC proposed that plant specific milestones (or quantifiable targets) and supporting indicators be included and clearly nested within the post 2020 biodiversity framework. They also provided examples of how these could be developed for a number of the existing Aichi targets, and how progress could be measured. Such harmonisation would facilitate future reporting on progress.

Inadequate compliance and implementation are additional reason for policy failure. A variety of examples exist for different policy areas but one that is relevant to the GSPC targets is that of CITES. CITES is an important legally binding international law that provides the framework for sustainable trade, and while there have been some positive examples of outcomes from its implementation there have also been failures. These appear to result from a combination of lack of data on species' status, the sway of political influence over decision making, slow response times for CITES listing following IUCN assessment, noncompliance by some countries and lack of accountability and enforcement. Risks to valuable plants (especially forests) are compounded by serious risks to the safety of people that protect them. These issues all require stronger governance of CITES (see discussion under GSPC

214 https://www.europeangreenbelt.org/
215 https://ec.europa.eu/environment/nature/ecosystems/strategy/index_en.htm

216 https://rewildingeurope.com/areas/
217 https://www.cbd.int/doc/strategic-plan/Post2020/postsbi/gppc.pdf

Target 11). The European Union has been called to take action to halt deforestation and human rights abuses caused by forest risk commodities.

Lack of sectoral integration is a key reason for policy failure. Better integration is needed between environmental and all relevant sectors (e.g. climate, agriculture, forestry, energy, transport and communications). The EU's Common Agricultural Policy (CAP) provides a key example. Agricultural intensification has caused substantial biodiversity loss across Europe and the abandonment of certain types of farmland, especially High Nature Value grassland, has also put plant diversity at risk (see 3.3.1). Successive reforms of the CAP over the last 20 years have failed to sufficiently integrate environmental requirements and stem the loss of biodiversity associated with agriculture (even for CWR, section 5.2 T9). An analysis of the agricultural sector and environmental impacts and outlooks is given by EEA (EEA 2019). At the end of 2019, the post 2020 proposals for a reformed CAP were based around economic, environmental and social objectives. The environmental objectives included: climate change action; environmental care; preserve landscapes and biodiversity. How well these will deliver will depend upon national implementation. As there is likely to be increased flexibility in implementation, this may result in lower environmental ambitions. EEA (2019) suggest that, for the CAP as for other sectors, the climate and biodiversity outcomes desired could be more effectively delivered were there to be *quantitative and enforceable targets* (including, e.g., trends in indicator species of biodiversity, and soil and water quality), beyond the assessment of budget spend on such measures. Those measures that have worked best so far have been specific scientific evidence-based measures, closely linked to the ecological requirements of the species that they aim to support (see section 5.2 T6). Delivery of the climate and biodiversity aims of the reformed CAP is critical as it influences such a large proportion of land across Europe, and is essential for ensuring that networks are functional and ecosystem services can be sustained. The reformed CAP needs to be fully aligned with the SDGs and the EU must have clearly defined 2030 targets as to where agriculture and forestry must make a measurable contribution (e.g. see Meredith 2019).

While a key European policy, the CAP only covers EU countries, and broader European collaboration is needed across all sectors to ensure effective and coordinated Europe-wide initiatives that facilitate movement and conservation of plant species across the entirety of their distributions. Examples of relevant European processes and networks including The Bern Convention[218], the Emerald Network[219] (incorporating Natura 2000), The Environment for Europe[220] are described in Appendix V.

All sectors need to recognise their links to biodiversity and mitigate impacts. Almost all businesses, for example, will use plant resources in some way, more or less directly. The example in Box 6.3 illustrates that while biodiversity reporting by businesses can be or has been poor, new initiatives and fora are helping to promote the links.

218 https://www.coe.int/en/web/bern-convention/presentation
219 https://www.coe.int/en/web/bern-convention/emerald-network
220 https://www.unece.org/env/efe/welcome.html

Box 6.3. Mainstreaming Biodiversity Concerns into Business

Liempd and Jacob (2013) reviewed biodiversity reporting in Denmark and found that (at the time) Danish companies scored poorly, quantitatively and qualitatively, on biodiversity reporting. Biodiversity preservation and reporting was found to be an ethical issue, even if the intrinsic value of biodiversity is not considered. These authors considered that the relative lack of biodiversity reporting in Denmark illustrated the need for this issue to be addressed by State and accounting standard setters together with business and other stakeholders.

The Global Partnership for Business and Biodiversity[221] comprises 21 national and regional initiatives, all working towards greater business engagement on biodiversity-related issues. The Partnership is a 'network of networks' linking initiatives to facilitate sharing of information and good practice, and help mainstream biodiversity concerns into businesses.

In Europe, the European Business and Biodiversity Campaign (EBBC[222]) helps businesses recognise how they are connected to biodiversity and the innovative opportunities they have to conserve it, and the EU Business @ Biodiversity Platform[223] provides a forum for dialogue and policy interface to explore the links between business and biodiversity at EU level.

Ornithogalum gabrielianae – *Anna Asatryan*

Data gaps hinder the delivery of plant conservation targets and research needs remain. While an online flora database now exists (The World Flora Online), effort to populate this is needed for regions with sparse data and for certain groups that are taxonomically difficult to describe (e.g. certain vascular plants) or underrepresented (e.g. lichens and fungi). Data are also lacking on the conservation status of most of Europe's plants, although status has now been assessed for all trees, lycopods and ferns and bryophytes, and for many threatened plants listed in policy instruments. Assessing conservation status is resource intensive and slow, so additional efforts to investigate predictors of extinction risk based upon species' traits would be valuable (see Willis 2017).

Data are similarly lacking on the geographical locations of many species and this limits the ability of countries to identify IPAs. Similarly, not everywhere has maps of habitats or ecological regions. The collection and analysis of such data can be very resource intensive and costly, but several new techniques could help, including the use of automated plant recording, remote sensing, and indicators or surrogate species.

Many research needs remain concerning the most effective ways of conserving plants and a few examples have been highlighted in this report. A key challenge is developing sufficient understanding of how a changing environment, particularly with respect to climate change, affects species and hab-

221 https://www.cbd.int/business/gp.shtml
222 https://www.iucn.org/regions/europe/projects/completed-projects/european-business-and-biodiversity-campaign
223 https://ec.europa.eu/environment/biodiversity/business/index_en.htm

itats in the wider environment. Better understanding of plant responses to climate change will help to predict resulting threats and opportunities and develop appropriate conservation management plans. Some work in this area is already underway (e.g. see Willis, 2017). Especially important is knowledge of how to prevent irreversible damage to landscape permeability, and an identification of the essential measures required to adapt to and mitigate changes that are happening in the wider environment (see section 3.3.1).

Other needs include research into invasive alien species and how best to eliminate them, or manage them in cases where this proves impossible. This requires research agendas to be both anticipatory and responsive, and international collaboration is required as the challenges from IAS are substantial and many have the potential to be Europe-wide. Work is also needed on the most effective ways of adapting and transferring information that has been developed on how to grow threatened plants *ex situ* to their conservation *in situ*.

Additional research challenges highlighted in this report relate to recently identified or emerging threats. These include developing a better understanding of the impacts of pollinator losses on both wild and crop plant populations (Box 3.3.4), and understanding and developing measures to avert impacts associated with emerging threats, such as increased demand for wood and the declines in kelp forests (Section 3.3.4). Another emerging threat is the increasing demand for plant products for traditional medicine (Sutherland *et al.* 2020) and it will be important to develop mechanisms to ensure that demands for plant-based products currently sourced from wild populations do not threaten the conservation status of the species concerned

Civil society, volunteers and new technologies provide huge potential for plant conservation. Civil society and volunteer networks already contribute a substantial amount to plant monitoring as illustrated by the discussions under GSPC Targets 3 (Box 3.2), T7, T14, T15 and T16, with potential for this to be increased, especially as digital technology develops further. Automated technologies are already being used for plant identification and are becoming increasingly sophisticated. Widespread remote access to databases, ownership of mobile devices that can take digital photographs and the availability of a number of apps has substantially increased the potential for non-experts and experts alike to contribute to the identification and monitoring of plants and their locations (Box 3.2; section5.2 T14; Wäldchen *et al.* 2018). Coordination of volunteer networks and increasingly sophisticated and networked databases should substantially reduce the costs involved in describing and monitoring flora, and assessing their conservation status.

Remote sensing for the mapping and monitoring of habitat extent and condition is a long-explored option that could increase automation. High resolution imagery is able to distinguish accurately a wide range of habitat types (e.g. Corbane *et al.* 2015) and it could be used more widely. Both formatting data so that it can be easily combined with other monitoring and assessment data, and tailoring data to the needs of managers and decision makers would help. Direct detection of vegetation at the species level is unlikely to be an option in the majority of cases, but it may be possible to identify groups of species having similar functionality -"plant functional types"- as plant groups with similar functions may have similar physiology and therefore spectral similarities (reviewed in Geller *et al.* 2017).

Good monitoring data will be needed to facilitate adaptive management. Comprehensive monitoring of pressures on plant diversity and populations (climate change, environmental quality, plant diseases etc.), the status, distributions and trends of native species (and IAS), and their responses to conservation interventions is essential. Such data will enable and facilitate the adaptive management that will inevitably be needed in our fast-changing environment where climate change will interact with a variety of other drivers of change.

European botanic gardens make a key contribution to plant conservation globally, and their expertise could be used more broadly. Botanic gardens play a vital role in plant conservation, as illustrated throughout this report (see descriptions especially under Targets 1, T3, T6, T8, T9, T10, T12 and T13). This primarily encompasses *ex situ* conservation through the banking of viable plant material and genetic diversity (e.g. Table T8.1), the collation and standardisation of information on plants through various online databases and sharing of information (e.g. Box T3.1), training, public engagement and awareness and a certain amount of *in situ* conservation including restoration. Despite the immense potential, only a small proportion of the capacity of botanic gardens overall appears to be devoted to *in situ* conservation of threatened species and to collaborating in *in situ* restoration programmes. Increasing the representation of threatened species, and associated genetic diversity with multiple accessions across the network, would be an enabling step towards delivering greater *in situ* conservation outcomes for threatened species. Greater involvement in direct *in situ* conservation and associated public awareness would be very beneficial and is being encouraged by different networks among which BGCI. For example, the BGCI accreditation scheme is a 3-tier system putting light on achievements in plant conservation within the botanic gardens community. The BGCI Conservation Practitioner Accreditation recognises botanic gardens with a conservation-oriented approach and the Advanced Conservation Practitioner Accreditation recognises botanic gardens with a focus on conservation actions that support local, national or global conservation goals. A wide range of databases are now available thanks to the work of botanic gardens but increased functionality could further improve their utility. For example, some do not have a geographical search function. PlantSearch is limited to taxon-level data, but effective *ex situ* conservation depends on high intra-specific diversity, and for this, individual accession-level data are needed (Mounce *et al.* 2017).

A range of organisations in many European countries contribute substantially to plant conservation beyond Europe. Throughout this report, the significant international contributions that European organisations make beyond the region have been highlighted (e.g. see Box 8.2, Box 9.3, Box 11.2 Table T15). These contributions are by governments, botanic gardens and others and contribute significantly to the GSPC Targets beyond the European region. It is important that such international contributions continue as the requirements beyond the European region are substantial and the geographical concentrations of plant diversity needs and botanic gardens and other relevant organisations are mismatched.

Better resourcing for plant conservation measures is essential. The CBD 6th National Reports on GSPC Targets suggest that professional capacity to tackle plant conservation has been eroded in recent years largely due to lack of financial resources and this is of particular concern given the scale of the problems that plant conservation faces.

Biodiversity policies need to be better funded across Europe as a whole if we are to stem biodiversity loss. The costs of effectively implementing existing policies might initially appear high, but these costs are generally substantially outweighed, in the medium to long term, by the costs of inaction. An example is implementation of EU Regulation 1143/2014 on Invasive Alien Species[224]. IAS have a major impact on plants and animals across Europe, and cost the European economy billions of Euros every year (see GSPC Target 10, this report).

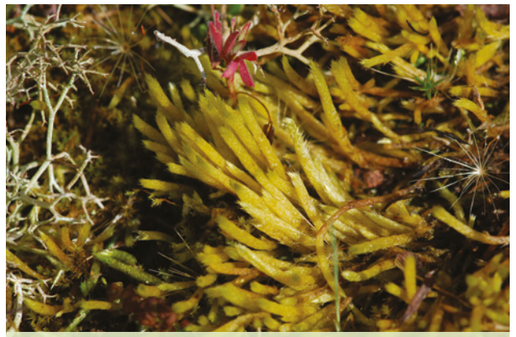
224 https://ec.europa.eu/environment/nature/invasivealien/index_en.htm

Strengthening policy implementation, integration and coherence: Full implementation of existing policies would take Europe a long way to achieving its environmental goals up to 2030. Achieving full implementation will require increased funding and capacity building; engagement of business and citizens; better coordination of local, regional and national authorities; and a stronger knowledge base. Source: EEA 2019 - SOER 2020

While professional capacity for plant conservation has decreased, opportunities for citizens to understand and contribute to plant conservation have increased, as described by the volunteer and citizen science programmes in this report. Although professional capacity needs to be maintained and enhanced, other capacity building avenues merit exploration. While many networks for plant conservation exist, facilitated by digital technology, there are few inter-sectoral strategic networks for plant conservation. Such networks could potentially contribute to the delivery of many GSPC objectives and aid in the development of sustainable financing models.

The EEA (2019 – SOEP 2020) discusses the types of responses needed to meet the sustainability challenge. One of the areas highlighted is that the transitions required will need to include the development and upscaling of diverse innovations, and that there is a need for more emphasis on social innovation, behavioural change and nature-based solutions. The use of nature-based solutions and green infrastructure can provide effective alternatives to human-engineered solutions ('grey infrastructure'). For example, in addition to storing carbon, forests can filter water, sustainable drainage systems (SuDS) using plants can manage and clean surface water while providing biodiversity and amenity benefits . In addition, nature-based solutions can also be cost effective compared to grey infrastructure (see examples under GSPC Target 14, this report). While the initial costs of some new nature-based solutions can be high, as with most new technologies or systems, their wider use is likely to provide economies of scale and as they are refined costs are likely to reduce. Nature-based solutions can also provide many additional non-market co-benefits (see EEA 2019).

"Investments in green infrastructure and nature-based solutions enhance ecological resilience and society's capacity to transform and adapt, often delivering benefits that far exceed their costs." EEA 2019



Brachythecium albicans - *Sébastien Filoche*

Transformational change is needed to conserve biodiversity. Our world is changing rapidly, biodiversity is in crisis, threats are increasing, and many interact. While we may be able to predict some impacts with reasonable confidence, we will simply need to respond to others. This presents a wide range of challenges for plant conservation; existing conservation approaches alone will be insufficient to tackle these and efforts need to be significantly scaled up, imaginative and transformational. While Europe, like many regions, has been good at designating protected areas, it has been less good at conserving them, and many are in poor ecological condition. Much biodiversity occurs outside of these areas, and is needed for the ecosystem services upon which we depend. It has been acknowledged for some time that habitat conservation alone is insufficient and that restoration is essential (Aichi targets 14 and 15, SDG Target 15), both within and outside of protected areas. Protected areas must be restored to good ecological condition, expanded, functionally connected and within a permeable landscape, the management of which is sympathetic to the ecological needs of plants and supports ecosystem services. We will need to develop ways of delivering such an environment while incorporating projected climate change impacts and taking account of the population dynamics of threatened plant species. How best to achieve this requires creative thinking, objective evaluation of conservation approaches and better resourcing. Additional approaches to consider may, as examples, include the potential for species introductions outside of their historic ranges, exploring the possibilities presented by land sharing vs land sparing, rewilding and other relatively new options for enhancing overall biodiversity conservation. Conservation policies and practices are not independent of the socio-political context in which they are made, and different solutions will be appropriate for different situations. However, if they are supported by scientific evidence, and driven by the desired outcomes, then we have the best possible chance of achieving them.

Transformation change requires public support. Effective plant and biodiversity conservation will require changes to the way we think about and manage large parts of our environment, and how we live our lives as individual citizens. These changes will require robust international agreements and effective national policies, and public support will be needed for these to be readily accepted to society. Communication, education and engagement are an essential part of this. It will be important to highlight the role that plant conservation plays in delivering the environmental services upon which we all depend. This includes how plant conservation and habitat restoration can provide sustainable solutions to the impacts of climate change, both in terms of adaptive management and mitigation. Volunteers and civil society groups already play a key role in collecting plant data and organising or contributing to conservation initiatives, and digital technology, including social media, presents an unrivalled opportunity for communicating the actions that need to be taken. The more involved citizens are in collecting the data that highlights the issues to be tackled the more engaged and supportive they will be of the solutions. Having effective messengers and ambassadors, from all socio-economic and cultural groups, will play an important part in societal acceptance of the changes needed.

Iris elegantissima – Anna Asatryan

7. Appendices

Appendix I

Global Strategy for Plant Conservation. Updated Strategy 2011-2020 Targets

https://www.cbd.int/gspc/targets.shtml

Objective I: Plant diversity is well understood, documented and recognized

- Target 1: An online flora of all known plants.
- Target 2: An assessment of the conservation status of all known plant species, as far as possible, to guide conservation action.
- Target 3: Information, research and associated outputs, and methods necessary to implement the Strategy developed and shared.

Objective II: Plant diversity is urgently and effectively conserved

- Target 4: At least 15 per cent of each ecological region or vegetation type secured through effective management and/or restoration.
- Target 5: At least 75 per cent of the most important areas for plant diversity of each ecological region protected with effective management in place for conserving plants and their genetic diversity.
- Target 6: At least 75 per cent of production lands in each sector managed sustainably, consistent with the conservation of plant diversity.
- Target 7: At least 75 per cent of known threatened plant species conserved *in situ*.
- Target 8: At least 75 per cent of threatened plant species in *ex situ* collections, preferably in the country of origin, and at least 20 per cent available for recovery and restoration programmes.
- Target 9: 70 per cent of the genetic diversity of crops including their wild relatives and other socio-economically valuable plant species conserved, while respecting, preserving and maintaining associated indigenous and local knowledge.
- Target 10: Effective management plans in place to prevent new biological invasions and to manage important areas for plant diversity that are invaded.

Objective III: Plant diversity is used in a sustainable and equitable manner

- Target 11: No species of wild flora endangered by international trade.
- Target 12: All wild harvested plant-based products sourced sustainably.
- Target 13: Indigenous and local knowledge innovations and practices associated with plant resources maintained or increased, as appropriate, to support customary use, sustainable livelihoods, local food security and health care.

Objective IV: Education and awareness about plant diversity, its role in sustainable livelihoods and importance to all life on earth is promoted

- Target 14: The importance of plant diversity and the need for its conservation incorporated into communication, education and public awareness programmes.

Objective V: The capacities and public engagement necessary to implement the Strategy have been developed

- Target 15: The number of trained people working with appropriate facilities sufficient according to national needs, to achieve the targets of this Strategy.
- Target 16: Institutions, networks and partnerships for plant conservation established or strengthened at national, regional and international levels to achieve the targets of this Strategy.

Appendix II

European Strategy for Plant Conservation Targets (2008-2014)

ESPC contributions to GSPC target 1:

ESPC 1.1 A widely accessible dynamic working list of all known plant and fungi species (including bryophytes, lichen, algae and cultivated plants) available by 2010 for vascular plants and bryophytes and 2014 for other groups, as a part of a world list, and including country distributions.

ESPC 1.2 Alien plants annotated within the working list of plant species with a risk category (low risk, spreading but weedy, damaging ecosystems 'transformers').

ESPC contributions to GSPC target 2:

ESPC 2.1 European Red Lists produced by 2014 (review of progress in 2011), vascular plants completed by 2010, Red Lists updated periodically for vascular plants and bryophytes, and at least a preliminary assessment produced for fungi, lichens, and algae.

ESPC contributions to GSPC target 3:

ESPC 3.1 Proven methods that enable delivery of each target in the European Strategy, collected and made available in one place *via* an online facility linked with the Planta Europa website.

ESPC 3.2 European plant distribution data (national/regional datasets) published electronically and regularly updated to facilitate conservation activities including comprehensive conservation assessments, invasive plants and climate change research, through cross-border projects and using the GBIF standards and facilities.

ESPC contributions to GSPC target 4:

ESPC 4.1 Landscape-scale conservation of Europe's ecological regions must support the maintenance of plant diversity.

ESPC 4.1a IPA data – including digital boundary data (or data from equivalent programmes with a focus on plants and fungi) and micro-reserve data are used to support the following biodiversity initiatives: Natura 2000; the Emerald Network; National Protected Areas; High Nature Value farmland; the Pan-European Ecological Network; Ramsar; Protected Area Networks, Invasive species programmes.

ESPC 4.1b The negative impacts of habitat fragmentation and climate change on plant diversity reduced by implementing article 10 of the EC Habitats and Species Directive, the Pan-European Ecological Network and other measures such as creating buffers and corridors or identifying Zones of Opportunity for habitat restoration around IPAs.

ESPC contributions to GSPC target 5:

ESPC 5.1 All countries implement a national strategy (action framework) by 2014 for the conservation of IPAs (or equivalent programme with a focus on site-based conservation on plants, fungi and their habitats, including genetic reserves for crop wild relatives).

ESPC 5.1a IPA identification programmes (or equivalent programmes with a focus on plants and fungi and their habitats) completed in 100% of European countries by 2014.

ESPC 5.1b At least 50% of IPAs legally protected through national protected area systems, and regional systems such as EU Natura 2000 AND at least 50% under appropriate management (which could be passive or active depending on conservation need).

ESPC contributions to GSPC target 6:

ESPC 6.1 80% of Europe's remaining high biodiversity production lands (e.g. old growth forest, natural/semi-natural grasslands, arable plant-rich areas, High Nature Value farmland) managed consistent with conservation of plant diversity through traditional management and other mechanisms. (High Nature Value Farmland 15–25% of total agricultural area; primary forest c.7% of total forest area (excluding the area of old growth forest in the Russian Federation)

ESPC 6.2 20%* of production lands managed to maintain and restore plant diversity, reduce fragmentation, and mitigate effects of climate change within the wider landscape (20% of those production lands not already included in target 6.1).

ESPC 6.3 100% of East European countries have mechanisms (lobbying information, case studies, biodiversity/economic benefit studies) to promote the urgent need for and the benefits of plant conservation in production lands.

ESPC 6.4 Ensure biodiversity risk assessments are a mandatory element of national and EU biofuel/biomass and development plans. (to ensure that conversion of land to new uses such as urban development, infrastructure and biofuel production should only occur on low biodiversity land and should not impact connectivity functions)

ESPC contributions to GSPC target 7:

ESPC 7.1 60% of species of European conservation priority*plant and fungal species, including crop wild relatives, conserved *in situ* by 2014 through the implementation of national strategies for conserving priority species (*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)

ESPC 7.1a Prepare information on plants (including vascular plants, bryophytes, algae, fungi) in readiness to contribute to any scientific update of the 2010 Biodiversity target in relation to:

- Annexes (II, IV and V) of the EU Habitats and Species Directive
- Appendix I of the Bern Convention
- Priority species lists associated with of relevant national biodiversity legislation

ESPC 7.1b Promote the development of 20 trans-boundary or multi-country species recovery projects (including cryptogamic species and fungi) to develop Pan-European cooperation and to develop methods for coping with climate change and connectivity issues.

ESPC 7.2 Develop database of plant micro-reserves, genetic reserves for crop wild relatives, and where relevant other small *in situ* protected areas.

ESPC contributions to GSPC target 8:

ESPC 8.1 Store in gene banks 60% of European threatened species, or species and populations of particular interest (e.g. populations under extreme conditions, or at the edge of their distribution area, species potentially at risk from the effects of climate change, including species with a trans-European distribution) and implement restoration programmes for 50 species.

ESPC 8.2 At least 10 priority species in each country held in conservation gardens or research institutes active in that country, and research initiated into storage methods, recalcitrant seeds, autecology, propagation methods including germination and cultivation techniques, and re-introduction methods.

ESPC contributions to GSPC target 9:

ESPC 9.1 Establishment of 25 European crop wild relative genetic reserves covering the major hotspots of species and genetic diversity.

ESPC contributions to GSPC target 10:

ESPC 10.1 Action Frameworks developed and implemented for controlling and monitoring the15 most problematic* invasive alien plants in each European region (Mediterranean, Baltic, Alps, South East Europe, East Europe, Atlantic etc). (*as defined by the latest scientific information, and with reference to the EPPO, the DAISIE Information service, NEOBIOTA and other relevant organisations)

ESPC 10.2 Action Frameworks developed and implemented for controlling and monitoring 10* problematic invasive alien species in each country, with reference to information from other countries and regional initiatives. (*This number may be less for the smallest countries in Europe, i.e. those countries with an area of less than 1,000 km²)

ESPC 10.3 The existing EU web-based information system (DAISIE) to include at least 80% of European countries.

ESPC 10.4 The Code of Conduct on Horticultural and Invasive Alien Plants adopted and implemented in at least 10 European states.

ESPC contributions to GSPC target 11:

ESPC 11.1 Action plans implemented and methods disseminated to ensure that 15 priority wild medicinal and aromatic plant and fungus taxa traded within Europe are not endangered by trade (based on recommendations in Lange 1998*) * Lange, D. 1998, Europe's Medicinal and Aromatic Plants: Their use, trade and conservation (A TRAFFIC Species in Danger Report, June 1998).

ESPC 11.2 Ensure that CITES and the EC Habitats and Species Directive are effective in protecting wild plant species from trade through updating of the annexes and appendices of CITES and the EC Habitats and Species Directive Annex V and providing recommendations for effective implementation.

ESPC contributions to GSPC target 12:

ESPC 12.1 30% of plant-based products derived from sources that are sustainably managed.

ESPC contributions to GSPC target 13:

ESPC 13.1 Projects in place in four European sub regions demonstrating sustainable methods of conserving plant resources (crop wild relatives, land races, medicinal plants) whilst supporting European livelihoods (see also target 9 and associated activities).

ESPC 13.2 Develop a handbook/series of case studies, in local languages, to provide training in methods and demonstrate the value of ethnobotanical projects to individuals, communities, researchers and children, in order to halt the loss of plant resources and local knowledge in Europe.

ESPC contributions to GSPC target 14:

ESPC 14.1 6 year sequence of targeted campaigns at the Pan-European and regional level (within the EU, within accession countries and in non-EU countries), that aim to ensure biodiversity initiatives, actions and incentives deliver sufficient plant conservation (including campaigns on climate change, agriculture, forestry and invasive species). At least 1 regional campaign for each of the following audience groups at regional level: Policy makers; Children and young people; Land managers; General public; Trade and business. This target can also be implemented at the national level with national lead organisations

ESPC 14.2 Initiate a Wake Up Call for European Plant Conservation in all European countries.

ESPC 14.3 Develop a high quality touring photographic exhibition, with a legacy of permanent exhibitions in public gardens and arboreta. These should be produced in local languages to highlight the plight of plants in Europe.

ESPC 14.4 50% of botanic gardens in Europe to display information on the GSPC and ESPC by 2010.

ESPC contributions to GSPC target 15:

ESPC 15.1 A measurable increase in government resourcing of skill training for plant conservation at national and regional level. Priority skill areas must include taxonomy, field botany, ecology, policy and advocacy, all-age education, marketing and volunteer development.

ESPC 15.2 Identify and engage key partners to resource production of priority tools for building the capacity to deliver plant conservation at a national level. Priority tools are field guides in national languages, national Red Books or Red Lists, habitat and vegetation type maps.

ESPC contributions to GSPC target 16:

ESPC 16.1 Ensure ESPC targets are communicated, understood and promoted through network partnerships at national, regional and international levels.

ESPC 16.2 Identify national plant focal points to develop/support development of plant conservation networks that facilitate sharing of skills and information at the national level.

ESPC 16.2a Network of national coordinators (or focal points) for Eastern Europe for realization of the new European Strategy for Plant Conservation.

ESPC 16.3 Increase the number of ESPC projects which engage organisations from *in situ* and *ex situ* conservation, plant genetic research, wildlife conservation and sustainable use.

From: Planta Europa (2008) A Sustainable Future for Europe; the European Strategy for Plant Conservation 2008–2014. Plantlife International (Salisbury, UK) and the Council of Europe (Strasbourg, France) ISBN: 1-904749-91-7

Appendix III

History and milestones in the development of the Global Strategy for Plant Conservation and the European contribution

Milestone	Date	Details
Establishment of the Gran Canaria Group and its Gran Canaria Declaration	1999	Declaration[225] calls for a Global Programme for Plant Conservation
Decision taken to consider, at CBD CoP 6, the establishment of a Global Strategy for Plant Conservation (GSPC) to halt the current and continuing unacceptable loss of plant diversity	CBD CoP 5 May 2000 Nairobi, Kenya	Decision V/10
First European Plant Conservation Strategy (EPCS) 2002-2007 developed	Third Planta Europa European conference on the conservation of wild plants June 2001 Průhonice, Czech Republic	Developed by Planta Europa and the Council of Europe as a contribution to, and part of, the proposed Global Strategy for Plant Conservation, submitted to COP 6 (UNEP/CBD/COP/6/INF/22).
First GSPC Adopted	CBD CoP 6 April 2002 The Hague, The Netherlands	Decision VI/9[226]. The GSPC was adopted to provide a framework for activities, some of which were already under way or envisaged in existing initiatives (such as in the EPCS). The GSPC included 16 outcome-orientated targets aimed at achieving measurable goals by 2010. It was envisaged that the activities necessary to reach those targets could be developed within the GSPC framework.

225 https://www.cbd.int/doc/meetings/cop/cop-05/information/cop-05-inf-32-en.pdf
226 https://www.cbd.int/decision/cop/?id=7183

Milestone	Date	Details
Global Partnership for Plant Conservation (GPPC) and coordination mechanism established	CBD CoP 7 February 2004 Kuala Lumpur, Malaysia	Coordination mechanism established to support national implementation of the GSPC. As of 2019, the GPPC included >60[227] partners . The Subsidiary Body for Scientific, Technical and Technological Advice, in its recommendation VII/8, recognized regional initiatives such as the European Plant Conservation Strategy as valuable contributions to global plant conservation[228].
	CBD CoP8 March 2006 Curitiba, Brazil	The GSPC was identified as an issue for in-depth review or consideration at CoP 9 (Annex II)
Second European Strategy for Plant Conservation Published: A Sustainable Future for Europe: the European Strategy for Plant Conservation 2008–2014	CBD CoP 9 May 2008 Bonn, Germany	Circulated to participants of the 9th CBD CoP as a regional contribution to the implementation of the GSPC
GSPC and targets updated	CBD COP 10 October 2010 Nagoya, Aichi Prefecture, Japan	Adopted the consolidated update of the Global Strategy for Plant Conservation[229], including the outcome-oriented global targets for the period 2011-2020, and decided that implementation of the Strategy should be part of the broader framework of the Strategic Plan for Biodiversity 2011-2020
Publication of Global Biodiversity Outlook 4: A mid-term assessment of progress towards the implementation of the Strategic Plan for Biodiversity 2011-2020	CBD COP 12 September - October 2014 Pyeongchang Republic of Korea	Officially launched[230] on the opening day of CBD COP 12 Accompanied by Plant Conservation Report 2014[231]: a review of progress towards the Global Strategy for Plant Conservation 2011-2020

227 https://plants2020.net/gppcpartners/
228 https://www.cbd.int/doc/meetings/cop/cop-06/information/cop-06-inf-22-en.doc
229 https://www.cbd.int/doc/decisions/cop-10/cop-10-dec-17-en.pdf
230 https://www.cbd.int/gbo/gbo4/publication/gbo4-en.pdf
231 https://www.cbd.int/doc/publications/cbd-ts-81-en.pdf

Milestone	Date	Details
Guidance provided on reporting against GSPC for 6th National Reports	CBD CoP13 December 2016 Cancun, Mexico	6th National Reports by CBD Parties on measures taken to implement the CBD and their effectiveness in meeting its objectives (as required by Article 26) are due by 31 December 2018. COP 13 covered guidance for the structure and format of the 6th Report to the *CBD Section V. Description of the national contribution to the achievement of the targets of the Global Strategy for Plant Conservation*. Some of the areas may have been previously reported on in sections II, III or IV of the report, and completion of section V is optional.
Conference of the Global Partnership for Plant Conservation	August 2018 Cape Town, South Africa	CBD Meeting #5768, supporting the worldwide implementation of the Global Strategy for Plant Conservation[232]
Draft set of GSPC targets for 2021-2030 prepared by GPPC	Requested at 6th meeting of the GSPC Liaison Group Cape Town, South Africa, 2018	Consultation underway (as of December 2019)
World Forum on GSPC	Held in October 2019 in China	Discussed: • Plant conservation progress (towards GSPC 2011-2020) • Lessons learnt • Possible post 2020 GSPC framework • Draft GSPC targets for 2021-2030 discussed
Declaration on Plant Conservation	10 Jan 2019 Xishuangbanna International Symposium, "Saving All the Plants in a Changing World", China	Xishuangbanna Declaration on Plant Conservation Unanimously approved by the participants

232 https://www.cbd.int/kb/record/meeting/5768?FreeText=global%20strategy%20for%20plant%20conservation

Appendix IV

List of priority pests in the European Union

Appendix X List of priority pests in the European Union	
Bronze birch borer *Agrilus anxius*	
Emerald ash borer *Agrilus planipennis*	
Mexican fruit fly *Anastrepha ludens*	
Citrus long-horned beetle *Anoplophora chinensis*	
Asian long-horned beetle *Anoplophora glabripennis*	
Pepper weevil *Anthonomus eugenii*	
Red-Necked Longhorn Beetle *Aromia bungii*	
Potato psyllid *Bactericera cockerelli*	
Oriental fruit fly *Bactrocera dorsalis*	
Peach fruit fly *Bactrocera zonata*	
Pine wood nematode *Bursaphelenchus xylophilus*	
Candidatus Liberibacter spp	Causal agent of Huanglongbing disease of citrus/citrus greening
Plum curculio *Conotrachelus nenuphar*	
White-lined silk moth *Dendrolimus sibiricus*	
Phyllosticta citricarpa	Causal agent of Citrus Black Spot disease
Japanese beetle *Popillia japonica*	
Apple maggot *Rhagoletis pomonella*	
Fall armyworm *Spodoptera frugiperda*	
False codling moth *Thaumatotibia leucotreta*	
Xylella fastidiosa	Causal agent of Pierce's disease in grapevine
Reference: From https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32019R1702 with common names added. These are listed as priority pests because they are not known to be present in the Union territory or are known to be present either in a limited part of that territory or for scarce, irregular, isolated and infrequent presences in it, and their potential economic, environmental or social impact is the most severe in respect of the Union territory	

Appendix V

Relevant European environmental agreements and policies

The Convention on Biological Diversity (CBD)[233] entered into force on 29 December 1993. It has three main objectives:

- The conservation of biological diversity
- The sustainable use of the components of biological diversity
- The fair and equitable sharing of the benefits arising out of the utilization of genetic resources

A Strategic Plan for Biodiversity 2011-2020 including Aichi Biodiversity Targets was adopted at the tenth meeting of the Conference of the Parties, held from 18 to 29 October 2010, in Nagoya, Aichi Prefecture, Japan. The CBD also has a Global Strategy for Plant Conservation[234] 2011-2020 with associated targets[235].

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)[236]. CITES is an international agreement between governments that entered in force on 1 July 1975. CITES aims to ensure that international trade in specimens of wild animals and plants does not threaten their survival.

Pan-European

The Bern Convention[237] is a binding international legal instrument covering most of the natural heritage of the European continent and extending to some States of Africa. It aims to conserve wild flora and fauna and their natural habitats, and to promote European co-operation in this field. Fifty countries and the European Union have signed up to the Convention and committed to promoting national conservation policies, considering the impact of planning and development on the natural environment, promoting education and information on conservation, and coordinating research.

The Emerald Network[238] is an ecological network made up of Areas of Special Conservation Interest. The Council of Europe launched the implementation of the Network as part of its work under the Bern Convention, with the adoption of Recommendation No. 16 (1989) of the Standing Committee to the Bern Convention. Establishment of Emerald Network sites at national level is one of the main tools by which Contracting Parties to the Bern Convention can comply with their obligations to ensure the long term survival of those habitats and species listed by the Convention (under Resolution No. 4 (1996) and Resolution No. 6 (1998) of the Standing Committee) as requiring specific protection measures. Proposed candidate sites are thoroughly assessed at biogeographical level to ensure that they can contribute sufficiently to the objectives of the Network before they are formally adopted.

233 https://www.cbd.int/
234 https://www.cbd.int/gspc/strategy.shtml
235 https://www.cbd.int/gspc/targets.shtml
236 https://www.cites.org/
237 https://www.coe.int/en/web/bern-convention/presentation
238 https://www.coe.int/en/web/bern-convention/emerald-network

All Contracting Parties or observer States to the Bern Convention are to contribute to the Network, which thus involves all European Union Member States, some non-Community States and a number of African States. The European Union fulfils its obligations en bloc through the Natura 2000 Network of sites, set up under the EU Habitats Directive (see below).

Since 6 December 2019, seven countries[239] have officially adopted Emerald sites[240] on their territories, and a number of "Candidate Emerald sites" have been nominated officially[241] by the Standing Committee from those proposed by countries currently working on the establishment of the Emerald Network.

Environment for Europe Process[242]
This is a partnership of Member States of all European countries within the UN Economic Commission for Europe (UNECE) region along with organisations of the United Nations system represented in the region, other intergovernmental organisations, regional environmental centres, non-governmental organisations, the private sector and other major groups. The Secretariat is held by UNECE. There have been eight conferences (Dobris 1991, Lucerne 1993, Sofia 1995, Aarhus 1998, Kiev 2003, Belgrade 2007, Astana 2011, Batumi 2016) and several Pan-European conservation initiatives including: the Pan-European Biological and Landscape Diversity Strategy (PEBLDS), the Pan-European Ecological Network (PEEN), the identification and conservation of High Nature Value Farmland across Europe, and the Aarhus Convention on public access to environmental information and justice, and participation in environmental decision making.

The pan European biological and landscape diversity strategy (PEBLDS)[243]
PEBLS (1996) was developed under the auspices of the Council of Europe as a European response to support implementation of the Convention on Biological Diversity. A key element of PEBLDS has been the development of the Pan European Ecological Network (PEEN) to promote the development of national networks and the development of an international network, ensuring coherence in biodiversity conservation.

The European Greenbelt Initiative[244]
This initiative was set up to ensure the conservation and restoration of the shared natural heritage along the line of the former Iron Curtain. The initiative intends for this shared heritage to function as an ecological network that connects high-value natural and cultural landscapes while respecting the economic, social and cultural needs of local communities. It connects 16 countries with opportunities for transboundary cooperation.

The European Strategy for Plant Conservation[245]
The European Strategy for Plant Conservation (ESPC) is the regional response of plant and fungi conservation specialists across Europe to the implementation of the CBD Global Strategy for Plant Conservation. The first European Plant Conservation Strategy was developed by the Planta Europa Network and the Council of Europe in 2002 and ran until 2007. After a review of the first strategy, a second strategy (2008—2014) was developed at the Fifth Planta Europa Conference in Romania in 2007 and published in 2008. The second European strategy is based on the structure of the GSPC with five objectives (understanding plant diversity; conserving plant diversity; using plant diversity sustainably; increasing awareness of plant diversity; increasing capacity for plant diversity) and 16 targets. However, it also contains sub-targets specific to the European region and actions to mitigate the effects of climate change under each target. The second ESPC has been extended until 2020 to correspond with the timeframes of relevant International Agendas.

The European Cooperative Programme for Plant Genetic Resources (ECPGR)[246]
ECPGR is a collaborative Programme among most European countries that aims to ensure the long-term conservation and facilitate the use of plant genetic resources in Europe. As of November 2019, 29 countries had signed the agreement for the ECPGR Membership during Phase X:

The European Union (EU)

EU Biodiversity Strategy[247]
As signatory to the CBD the European Union has set itself targets to tackle biodiversity loss. The 2010 target to halt biodiversity loss had not been achieved due to inadequate: implementation of legal measures, integration with other EU sectors, funding, data and communication. Although the 2010 target was not achieved many important projects and frameworks were implemented under this strategy and the EU renewed its commitment to biodiversity. The EU Biodiversity Strategy, adopted in 2011, sets 6 targets and 20 actions with the aims of halting the loss of biodiversity and ecosystem services in the EU and helping stop global biodiversity loss by 2020. The mid-term review of the strategy[248] showed that although progress had been made in many areas, much greater effort was needed to meet the targets. The headline target for 2020 is "Halting the loss of biodiversity and the degradation of ecosystem services in the EU by 2020, and restoring them in so far as feasible, while stepping up the EU contribution to averting global biodiversity loss."

EU Birds and Habitats Directives & Natura 2000 Network[249]
As part of its commitment to biodiversity conservation, the EU has developed binding legal instruments which include the Birds and Habitats Directives. These Directives form the cornerstones of Europe's legislation on nature conservation. Adopted in 1992, The Habitats Directive, protects around 1000 rare, threatened or endemic species of wild animals (in addition to birds covered by The Birds Directive) and plants – often collectively referred to as species of European importance, along with some 230 rare habitat types, protected in their own right. The Habitats Directive includes species protection provisions for all naturally occurring wild species listed in Annex IV and a network of sites across Europe (the Natura 2000 Network) to conserve them. The Natura 2000 Network is key to both Directives and all EU Member States have designated Natura 2000 sites to help conserve the rare habitats and species present in their territory. Over 27,000 sites are included in the network covering almost a fifth of Europe's land area and an important part of the surrounding seas, making it, globally, the largest coordinated network of conservation areas.

239 At the time of writing in May 2020
240 https://rm.coe.int/updated-list-of-officially-adopted-emerald-sites-december-2019-/168098ef51
241 https://rm.coe.int/updated-list-of-officially-nominated-candidate-emerald-sites-december-/168098ef50
242 https://www.unece.org/env/efe/welcome.html
243 https://www.cbd.int/doc/nbsap/rbsap/pebld s-rbsap.pdf
244 https://www.europeangreenbelt.org/
245 http://www.plantlife.org.uk/download_file/force/853/1157
246 https://www.ecpgr.cgiar.org/
247 https://ec.europa.eu/environment/nature/biodiversity/strategy/index_en.htm
248 https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:52015DC0478
249 https://ec.europa.eu/environment/nature/info/pubs/docs/brochures/nat2000/en.pdf

Policies and Strategies relating to Agriculture and Forestry

Common Agricultural Policy[250]

The EU's common agricultural policy (CAP) has existed since 1962 and aims, in the EU, to support farmers and improve agricultural productivity to ensure a stable supply of affordable food while safeguarding farmers to make a reasonable living. It also aims to help tackle climate change and the sustainable management of natural resources, maintain rural areas and landscapes and keep the rural economy alive.

Land used for agriculture covers over 40% of the EU's land area. Farming methods are one of the most important routes towards supporting the conservation of or destroying Europe's diversity of plant species. The rapid and widespread decline of arable plant species under intensive farming methods is a major conservation concern for wild plants and the birds and insects they support. Similarly, the abandonment or conversion of grassland areas that have been managed in a low-intensity fashion (High Nature Value areas) is an important threat to the diversity of wild plants in Europe. Tackling these issues within the reformed EU Common Agricultural Policy (CAP) and through initiatives such as the Pan-European High Nature Value Farmland programmes will be a key arena where the EU and European nations succeed or fail in their target to halt biodiversity loss.

EU CAP Reform

Management of the agriculture and forestry sectors has been heavily influenced by the financial support provided through the European Union's Common Agricultural Policy. This funding support mechanism has historically played a significant part in the wide scale biodiversity loss across European farmland. The CAP is also the key EU funding mechanism for providing support for environmental and climate action in the EU agricultural and forest sectors. However, previous efforts to 'green' the CAP have fallen far short of stopping the degradation of biodiversity, water quality, soils and air quality associated with the activity of these sectors. In future, CAP support needs to change fundamentally to deliver environmental and climate outcomes while also securing long-term food production in a sustainable way. On 1 June 2018, the European Commission presented legislative proposals on the common agricultural policy (CAP) beyond 2020 that aim to make the CAP more responsive to current and future challenges such as climate change or generational renewal, while continuing to support European farmers for a sustainable and competitive agricultural sector.

There are 9 objectives of the future CAP, i.e.:

- to ensure a fair income to farmers
- to increase competitiveness
- to rebalance the power in the food chain
- climate change action
- environmental care
- to preserve landscapes and biodiversity
- to support generational renewal
- vibrant rural areas
- to protect food and health quality

250 https://ec.europa.eu/info/food-farming-fisheries/key-policies/common-agricultural-policy/cap-glance_en

These proposals have far greater environmental and climate ambition than before and could facilitate the scaling up of environmental and climate action across the agriculture and forest sectors helping to meet EU and national targets and priorities. However, it is essential that these proposals translate into action so that no Member States can maintain the status quo (see Hart & Bas-Defossez 2018).

High Nature Value (HNV) Farmland

Across the centuries various landscapes have been managed for agricultural production in a low intensity fashion, and are of value culturally and for plants and other wildlife. Such land is described as 'High Nature Value' (HNV) farmland. The management of HNV farmland tends to be labour intensive and use livestock breeds and crop types that are well adapted to local soils, vegetation and climate. HNV farmland can support rich plant diversity, especially in grasslands, and its maintenance depends upon the continuation of these traditional low-intensity farming practices.

HNV farmland has been mapped across Europe (Paracchini et al. 2008[251]) to help target CAP funding and to monitor changes in its extent. IEEP (2014)[252] give more detail of HNV farming throughout EU-27 and its financial support under the CAP. An Agri-environmental indicator - High Nature Value farmland[253] is still subject to development.

Forestry and plant conservation in Europe

Forest policy across Europe is mainly based at the national level. There is an EU Forestry Strategy, but no binding forestry legislation at the European level, although discussions are underway on the possibility of this route. Analysis of the Important Plant Areas (IPA) programme in 11 countries across Europe found that poor forestry practices (intensified forest management, deforestation and afforestation) was the single most widespread threat to IPAs, affecting 47% of sites. Old growth or 'virgin' forests are particularly important for plant, fungi, lichen and bryophyte conservation but they form a tiny proportion of overall forest cover in Europe. These remaining areas need to be targeted urgently for increased protection. Afforestation of other habitats, such as grassland and heath, is also a key threat which could increase if various demands for increased tree-planting are applied without thought to wider biodiversity concerns.

There are processes in place to aid in the sustainable management of forestry, and regulations that control the trade in forest products, mainly aimed at ensuring that illegal trade does not take place.

EU Forestry Strategy COM (2013) 659 final[254]

A new framework for forestry management was developed in 2013. As well as to satisfy the growing demand for forestry material and new products and related production aims, there are several objectives relevant to plant conservation in the strategy. These include ensuring sustainable management, enabling the functioning of ecosystem services and protecting forests and biodiversity from the significant effects of factors that do no respect national boundaries such as storms and fires, increasingly scarce water resources, and pests.

251 see also https://www.eea.europa.eu/data-and-maps/data/high-nature-value-farmland
252 IEEP (2014). High Nature Value farming throughout EU-27 and its financial support under the CAP.https://ieep.eu/uploads/articles/attachments/d76c1aec-14df-4bcb-8a4a-d7deab2e7a34/HNV_and_CAP_Executive_Summary.pdf?v=63664509849
253 https://ec.europa.eu/eurostat/statistics-explained/index.php/Agri-environmental_indicator_-_High_Nature_Value_farmland
254 https://eur-lex.europa.eu/resource.html?uri=cellar:21b27c38-21fb-11e3-8d1c-01aa75ed71a1.0022.01/DOC_1&format=PDF

Forest Europe[255]
Forest Europe is the brand name of the Ministerial Conference on the Protection of Forests in Europe. It is a voluntary high level forum for the forestry ministers from 46 European countries and the European Union and observer organisations which sets guidelines and standards for sustainable forest management and protection. It is involved in discussions on the potential for legally binding European forestry policy.

The EU Timber Regulation (EUTR) ((EU) No 995/2010 (Target 11)[256]
The EU Timber Regulation aims to counter illegal trade in timber by laying down three main obligations: it prohibits the placing on the EU market for the first time of illegally harvested timber and products derived from such timber; it requires EU traders who place timber products on the EU market for the first time to exercise 'due diligence'; it requires traders to keep records of their suppliers and customers.

EU's Forest Law Enforcement, Governance and Trade (FLEGT) Action Plan[257]
The FLEGT action plan sets out a series of seven measures that together prevent the importation of illegal timber into the EU, improve the supply of legal timber and increase demand for timber from responsibly managed forests. This action plan, published in 2003, is necessary because the EU is one of the largest consumers of timber products in the world and has a responsibility to ensure that timber is legally purchased and that efforts to enforce forest law in timber-exporting countries are not undermined.

Water and marine issues

Key areas of policy regarding water and marine issues in Europe include:

EU Marine Strategy Framework Directive2008/56/EC[258]
The Marine Strategy Framework Directive aims to achieve Good Environmental Status (GES) of EU marine waters by 2020. The maintenance of biodiversity by 2020 is an explicit regulatory objective of the Directive. Projects such as the UK's Important Plant Areas (IPAs) for algae provide essential data for making sure all available ecological data is considered.

EU Water Framework Directive 200/60/EC[259]
This has provided a powerful framework that compels Member States to ensure good ecological condition for all rivers, lakes and coastal water by 2015, including the development of River Basin Management Plans. The potential for conserving and restoring key habitats for wild plants and algae is immense but as with all legislation the benefits for wild plants and their habitats depend on how the law is implemented on the ground.

Invasive Species

EU Regulation 1143/2014 on Invasive Alien Species[260]
This Regulation covers plant and animal species that are introduced to the natural environment in countries where they do not normally occur and where they are invasive and have serious negative consequences for that environment. IAS can have negative impacts on native plant and animal species, and cost the European economy billions of Euros annually. This Regulation includes a list of Invasive Alien Species (IAS) of Union concern and provides for certain measures to be taken regarding species on the list, including to prevent their introduction, detect early their introduction (early warning) and eradicate them, and to manage those that are already established to minimise their impacts. By their very nature most IAS have considerable potential to spread and so coordinated action at the European level is needed to tackle them.

Wildlife Trade

EU Wildlife Trade Regulations[261]
Systematic border controls do not exist within the EU due to the Single Market. Consequently, CITES provisions have to be implemented uniformly in all EU Member States, and this is delivered thorough a set of Regulations known as the EU Wildlife Trade Regulations. In a number of respects EU Wildlife Trade Regulations go beyond CITES provisions, for example by adopting stricter domestic measures[262] for some species.

The EU Action Plan against Wildlife Trafficking[263]
Recognition that implementing CITES was insufficient to halt the substantial impacts of wildlife crime on the environment and the economy resulted in the production in 2016 of the EU Action Plan against Wildlife Trafficking. This plan includes measures of enforcement, prevention and cooperation and forms part of the EU's response to the United Nations 2030 Agenda for Sustainable Development, particularly Sustainable Development Goal (SDG) 15, which calls for urgent action to end poaching and trafficking of protected species of flora and fauna and address both demand and supply of illegal wildlife products.

Plant Health

'Plant Health Law' - Regulation (EU) 2016/2031[264]
The introduction of certain plant pests and diseases has had particularly devastating consequences for native European flora. The circulation of plant material around the world, for whatever purpose, brings attendant risks associated with the spread of plant pests and diseases. These risks have accelerated as a result of globalisation including increases in global trade and changes in agricultural production systems, and climate change may increase the favourability of new environments for some pathogens. This trend is having a substantial impact upon plants across Europe, including those in both more natural and managed environments. Consequently, EU Plant Health legislation was revised to adopt the Plant Health Law, applicable from December 2019. As part of this legislation a list of the most dangerous, 'priority', pests[265] was established, including those non-native plant pests with the potential to have the most severe economic, environmental or social impacts across the EU. EU Members States must act to protect the environment and agriculture from these pests by carrying out surveys, communicating with the public and adopting eradication plans for them if they are detected.

255 https://foresteurope.org/
256 https://ec.europa.eu/environment/forests/timber_regulation.htm
257 http://www.euflegt.efi.int/flegt-action-plan
258 https://ec.europa.eu/environment/marine/eu-coast-and-marine-policy/marine-strategy-framework-directive/index_en.htm
259 https://ec.europa.eu/environment/water/water-framework/index_en.html
260 https://ec.europa.eu/environment/nature/invasivealien/index_en.htm
261 https://ec.europa.eu/environment/cites/legislation_en.htm
262 https://ec.europa.eu/environment/cites/pdf/differences_b_eu_and_cites.pdf
263 https://ec.europa.eu/environment/cites/pdf/WAP_EN_WEB.PDF
264 https://ec.europa.eu/food/plant/plant_health_biosecurity/legislation/new_eu_rules_en
265 https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1570789349853&uri=CELEX:32019R1702

Green Infrastructure

The EU Strategy on Green Infrastructure[266]
Coherence and connectivity of protected areas and other sites of importance for biodiversity is critical to the conservation of biodiversity, the functioning of ecosystem services and therefore the delivery of the CBD Aichi targets - and the GSPC. The EU strategy on green infrastructure aims to promote investments in and the deployment of green infrastructure across Europe. It also promotes the development of a Trans-European Network for Green Infrastructure in Europe, a so-called TEN-G. This is along the lines of existing networks for transport, energy and information and communications technology.

Text expanded and updated from:

https://www.plantlife.org.uk/international/our-work/policies-and-strategies

266 https://ec.europa.eu/environment/nature/ecosystems/strategy/index_en.htm

Appendix VI

Key issues to consider from the GSPC Objectives

Objectives I: Plant diversity is well understood, documented and recognized (Targets 1-3)
Considerable effort has gone into the targets under this objective. While an online flora database exists, effort to populate this is needed from regions with sparse data and research needs remain for taxonomically difficult plant species. The conservation status of most of Europe's plants has not been assessed, although it has for all trees, bryophytes and probably for a disproportionate number of threatened plants, such as those listed in policy instruments.

A key research need involves ensuring that the role individual plant species and plant communities play in ecosystem services are evidenced, to ensure plant diversity is properly integrated policies such as agri-environmental policies, and site and landscape conservation approaches.

Objective II: Plant diversity is urgently and effectively conserved (Targets 4-10)
While good mechanisms exist for site designation, data issues exist regarding site identification. Where threatened plant species are present within protected areas, only a limited number of management/action plans have been produced, even though active conservation measures are frequently necessary. Ecological condition, representativeness and connectedness of the network, especially with respect to future impacts of climate change, including interactions with invasive species, are significant issues. The management of the matrix between protected areas needs to be sustainable to enable plant dispersal, and this is not generally the case. Within the EU, the post 2020 CAP needs to be fully aligned with the Sustainable Development Goals and the EU must have clearly defined 2030 targets for the contributions of agriculture and forestry to sustainability and biodiversity conservation.

Analysis of the Important Plant Areas (IPA) programme in 11 countries across Europe found that poor forestry practices (intensified forest management, deforestation and afforestation) was the single most widespread threat to IPAs, affecting 47% of sites. Old growth or 'virgin' forests are particularly important for plant, fungi, lichen and bryophyte conservation but they form a tiny proportion of overall forest cover in Europe. These remaining areas need to be targeted urgently for increased protection. Afforestation of other habitats, such as grassland and heath, is also a key threat which looks set to increase if climate change targets are applied without thought to wider biodiversity concerns.

Botanic gardens already play an important role in ex situ conservation but have considerable potential to aid *in situ* conservation. However, currently only a small proportion of their capacity is devoted to *in situ* conservation of threatened species and to collaborating in *in situ* restoration programmes. Increasing the representation of threatened species, and associated genetic diversity with multiple accessions across the network, would be a first enabling step towards delivering *in situ* conservation outcomes for threatened species, followed by involvement in *in situ* conservation on the ground and public awareness. The role of botanic gardens in ex situ conservation of plant material from other global regions was apparent. The need for better integration between conservation and agricultural sectors would help enable the conservation of Crop Wild Relatives.

Objective III: Plant diversity is used in a sustainable and equitable manner (Targets 11-13)
CITES is key to ensuring that trade does not endanger threatened plant species but stronger governance is needed to improve listing response times and ensure accountability and enforcement in cases

of noncompliance. Risks to valuable plants (especially forests species) are compounded by serious risks to the safety of people that protect them.

In Europe, sustainable management of forests and other wild plants currently depends upon voluntary certification schemes. Although these are not perfect, they are currently one of the few tools available to help ensure sustainable management and product traceability. An expansion of the area of forest, and the species of non-forest plants, covered by certification would be beneficial, as would an exploration of whether the interactions between governments, private companies and NGOs in sustainability standards could be adjusted to increase the coverage of and compliance with sustainable management techniques.

Objective IV: Education and awareness about plant diversity, its role in sustainable livelihoods and importance to all life on earth is promoted (Target 14)

The ability of plants to deliver natural solutions to sustainability problems, for example through green infrastructure and agro-ecology, is a growing and important area, and better integration and communication across sectors (engineering, agriculture, environment, development, tourism etc.) would be beneficial.

The apparent 'plant blindness' in the international wildlife trade area merits additional effort in communication and awareness.

The development of measures that enable the effectiveness of education and communication channels at delivering conservation outcomes would be valuable.

Objective V: The capacities and public engagement necessary to implement the Strategy have been developed (Targets 15 and 16)

In many countries professional capacity to tackle plant conservation has been eroded, largely due to lack of financial resources. This is of particular concern given the scale of the problems that plant conservation faces. In parallel, opportunities for citizens to understand and contribute to plant conservation have increased. While it is important that professional capacity be maintained and enhanced, other capacity building avenues merit consideration.

Many networks for plant conservation exist, facilitated by digital technology, but there are few inter-sectoral strategic networks for plant conservation. Such networks could potentially contribute to the delivery of many GSPC objectives and aid in the development of sustainable financing models.

Appendix VII

Comments on GSPC Objectives and Targets

The GSPC Targets are not sufficiently well aligned with the Aichi Targets, and this potentially places an additional reporting burden on countries; reporting on GSPC targets is currently optional. If, as has been proposed (see GPPC[267], described in Section 6 of this report), the GSPC targets are more closely 'nested' within the higher level biodiversity targets post-2020, reporting on plant conservation targets would clearly be part of overall biodiversity reporting.

The rationale for some of the targets required additional clarification (e.g. Target 8), and some of the targets have been difficult for countries to report on (e.g. Targets 13 and 14). Setting targets where baselines are, or can readily be, established would facilitate the evaluation of progress, as would the provision of technical guidance for reporting on the targets, perhaps using examples.

GSPC Target		Comments
7	At least 75 per cent of known threatened plant species conserved *in situ*	This target tends to be interpreted to mean the presence of threatened species in protected areas. However, presence is not a guarantee of persistence, and the conservation of threatened plant species often requires active management. It would be helpful for this target to specify this in some way (e.g. through the production and implementation of action plans). The need for this is clear given that many protected habitats and areas across Europe are not in favourable conservation status.
8	At least 75 per cent of threatened plant species in ex situ collections, preferably in the country of origin, and at least 20 per cent available for recovery and restoration programmes	Botanic gardens play a key role in plant conservation but only 10% of network capacity is devoted to threatened species (Mounce et al. 2017). Ideally ex situ material needs to be available for *in situ* actions for all species that need recovery or reintroduction programmes.
9	70 per cent of the genetic diversity of crops including their wild relatives and other socio-economically valuable plant species conserved, while respecting, preserving and maintaining associated indigenous and local knowledge	Maintenance and reporting on such knowledge present a particularly significant problem as few tested methodologies and assessments of such knowledge are associated with plant genetic diversity (Sharrock 2019).
13	Indigenous and local knowledge innovations and practices associated with plant resources maintained or increased, as appropriate, to support customary use, sustainable livelihoods, local food security and health care	Target 13 is currently difficult for countries to report against. Reporting would be facilitated through encouraging the establishment of baselines or more specific wording, with associated guidance (e.g. reporting on numbers of projects, workshops, publications, socioeconomic surveys).
14	The importance of plant diversity and the need for its conservation incorporated into communication, education and public awareness programmes	It is difficult to define 'how much education and awareness is enough'. The development of measures that enable the effectiveness of education and communication channels at delivering conservation outcomes (rather than outputs, such as number of people trained) would be valuable

These comments should be considered in the context of recommendations by the GPPC.

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8. References

'et al.' is used to denote additional authors after the first five.

Albrecht, H., Prestele, J., Altenfelder, S., Wiesinger, K. and Kollmann, J. 2014. New approaches to the conservation of rare arable plants in Germany. Deutsche Arbeitsbesprechung über Fragen der Unkrautbiologie und -bekämpfung, 11.-13. März 2014 in Braunschweig. Julius-Kühn-Archiv, 443: 180-189. 2014. DOI 10.5073/jka.2014.443.021

Allen, D., Bilz, M., Leaman, D.J., Miller, R.M., Timoshyna, A. *et al.* 2014. European Red List of Medicinal Plants. Luxembourg: Publications Office of the European Union.

Allkin, B. 2016. Kew's Plant Names Services adopted by global health. 26 January 2016. https://www.kew.org/read-and-watch/plant-names-services-used-by-global-health

Angelstam, P. Manton, M., Green, M., Gunnar Jonsson, B., Mikusinski, G. *et al.* 2020. Sweden does not meet agreed national and international forest biodiversity targets: a call for adaptive landscape planning. Landscape and Urban Planning, in press.

Antonelli, A., Smith, R.J. and Simmonds, M. S. J. 2019. Unlocking the properties of plants and fungi for sustainable development. *Nature Plants* VOL 5 NOVEMBER 2019: 1100–1102 www.nature.com/natureplants Published online: 11 November 2019 https://doi.org/10.1038/s41477-019-0554-1

Batáry, P. Dicks, L.V., Kleijn, D. and Sutherland, W.J. 2015. The role of agri-environment schemes in conservation and environmental management. *Conserv. Biol.* 29 (4): 1006–1016.

BGCI 2018. Annual Reports and Accounts. https://www.bgci.org/resources/bgci-tools-and-resources/bgci-annual-reports/

Bennie, J., Davies, T.W., Cruse, D. and Gaston, K.J. 2016. Ecological effects of artificial light at night on wild plants. *J. Ecol.* 104: 611–620.

Bilz, M., Kell, S. P., Maxted, N. and Lansdown, R. V. 2011. European Red List of vascular plants. IUCN Luxembourg: Publications Office of the European Union. https://portals.iucn.org/library/sites/library/files/styles/publication/public/book_covers/BC-RL-4-016.jpg

Brosi, B.J. and Briggs, H.M. 2013. Single pollinator species losses reduce floral fidelity and plant reproductive function *PNAS* 110 (32): 13044-13048 https://doi.org/10.1073/pnas.1307438110

Byfield,A.J. & Wilson, P. J. 2005. Important Arable Plant Areas: identifying priority sites for arable plant conservation in the United Kingdom. Plantlife International, Salisbury, UK.

Cardoso, P. 2012. Habitats Directive species lists: urgent need of revision. Insect Conserv. Divers. 5: 169-174.

Castañeda-Álvarez, N., Khoury, C., Achicanoy, H., Bernau, V., Dempewolf, H. *et al.* 2016 Global conservation priorities for crop wild relatives. *Nature Plants* 2, 16022 (2016). https://doi.org/10.1038/nplants.2016.22

Chapman, T., Miles, S. and Trivedi, C. 2018. Capturing, protecting and restoring plant diversity in the UK: RBG Kew and the Millennium Seed Bank. *Plant Diversity* 41: 124-131

Cogoni, D., Fenu, G., Concas, E., and Bacchetta, G. 2013. The effectiveness of plant conservation measures: The Dianthus morisianus reintroduction. *Oryx* 47(2): 203-206. doi:10.1017/S003060531200169X

Corbane, C., Lang, S., Pipkins, K., Alleaume, S., Deshayes, M., García Millán, V.E., Strasser, T., Vanden Borre, J., Toon, S., & Michael, F. 2015. Remote sensing for mapping natural habitats and their conservation status – New opportunities and challenges. *International Journal of Applied Earth Observation and Geoinformation.* 37: 7–16. DOI: 10.1016/j.jag.2014.11.005

Dahlberg, A. and Croneborg, H. 2003. 33 threatened fungi in Europe. Complementary and revised information on candidates for listing in Appendix I of the Bern Convention. A document compiled for EU DG Environment and the Secretariat of the Bern Convention by Anders Dahlberg and Hjalmar Croneborg at the Swedish Species Information Centre on behalf of the Swedish Environmental Protection Agency (EPA) and the European Council for Conservation of Fungi (ECCF). https://www.researchgate.net/publication/248581348_33_Threatened_Fungi_in_Europe

Darbyshire, I., Anderson, S., Asatryan, A., Byfield, A., Cheek, M. *et al.* 2017. Important Plant Areas: revised selection criteria for a global approach to plant conservation. *Biodivers. Conserv.* 26:1767–1800. DOI 10.1007/s10531-017-1336-6

Dhanda, S., Williams, C. and Cowell, C. (eds) 2019. Kew and the Global Strategy for Plant Conservation. Royal Botanic Gardens, Kew

DLA Piper 2015. Empty threat 2015: does the law combat illegal wildlife trade? A review of legislative and judicial approaches in fifteen jurisdictions. pp 498. https://www.dlapiper.com/~/media/Files/News/2015/05/IllegalWildlifeTradeReport2015.pdf

Frank, E.J. and Wilcove, D.S. 2019. Long delays in banning trade in threatened species. Science: 363 (6428):686-688. DOI:10.1126/science.aav4013

de Rigo, D., Libertà, G., Houston Durrant, T., Artés Vivancos, T., San-Miguel-Ayanz, J. 2017. Forest fire danger extremes in Europe under climate change: variability and uncertainty, EUR 28926 EN, Publications Office of the European Union, Luxembourg, 2017, ISBN: 978-92-79-77046-3, doi:10.2760/13180, JRC108974 https://publications.jrc.ec.europa.eu/repository/bitstream/JRC108974/jrc108974_final.pdf

ECPGR. 2017. ECPGR Concept for on-farm conservation and management of plant genetic resources for food and agriculture. European Cooperative Programme for Plant Genetic Resources, Rome, Italy. http://www.ecpgr.cgiar.org/fileadmin/bioversity/publications/pdfs/ECPGR_Concept_for_on_farm_final__05_05_2017_bis.pdf

EEA 2012. The impacts of invasive alien species in Europe. European Environment Agency (EEA) Technical report No 16/2012. ISBN 978-92-9213-345-0 ISSN 1725-2237 doi:10.2800/65864

EEA 2018. 'Land recycling and densification (LSI 008)'. European Environment Agency (https://www.eea.europa.eu/data-and-maps/indicators/land-recycling-and-densification/assessment-1) Cited in EEA 2019 as accessed 29 May 2019.

EEA 2019 (SOER 2020). The European environment — state and outlook 2020. Knowledge for transition to a sustainable Europe. European Environment Agency. ISBN 978-92-9480-090-9 doi: 10.2800/96749

Elbakidze, M., Ražauskaitė, R., Manton, M., Angelstam, P. Mozgeris, G. *et al.* 2016. The role of forest certification for biodiversity conservation: Lithuania as a case study. *Eur J Forest Res* 135, 361–376 (2016). https://doi.org/10.1007/s10342-016-0940-4

EU NEWS 18 November 2019 (Brussels Environment) First EU action plan for restoring a key habitat for wild pollinators. https://ec.europa.eu/info/news/first-eu-action-plan-restoring-key-habitat-wild-pollinators-2019-nov-18_en

Euro+Med. 2006-2014. Euro+Med PlantBase – the information resource for Euro-Mediterranean plant diversity. Accessed on 12 August 2014 by Allen *et al* 2014: http://ww2.bgbm.org/EuroPlusMed/.

Eurostat 2017. Statistics Explained. Agri-environmental indicator – commitments. Data from June 2017. https://ec.europa.eu/eurostat/statistics-explained/index.php/Agri-environmental_indicator_-_commitments

Eurostat 2020. Statistics Explained. Organic farming statistics. Data from January 2020. https://ec.europa.eu/eurostat/statistics-explained/index.php/Organic_farming_statistics

Evstatieva, L.N. and Alipieva, K.I. 2012. Conservation and sustainable use of threatened medicinal plant Sideritis scardica in Bulgaria. *Acta Hortic.* 955, 89-92mDOI: 10.17660/ActaHortic.2012.955.10

Ferrando, I., Ferrer-Gallego, P.P. & E. Laguna. 2016. Assessing the conservation value of ex situ seed bank collections of endangered wild plants. Israel Journal of Plant Sciences 63(4): 333-346.

Forest Europe undated. FOREST EUROPE FACTS. European Forests Resources FOREST EUROPE Ministerial Conference on the Protection of Forests in Europe. Liaison Unit Madrid. https://www.foresteurope.org/sites/default/files/EuropeanForestResourcesFINAL.pdf

FOREST EUROPE, 2015: State of Europe's Forests 2015. 119https://www.foresteurope.org/docs/fullsoef2015.pdf

EC 2016. European Commission 2016. EU action plan against wildlife trafficking. ISBN 978-92-79-55076-8 doi:10.2779/016138 https://ec.europa.eu/environment/cites/pdf/WAP_EN_WEB.PDF

Fos, S., Laguna. E., Jiménez, J. & Gómez-Serrano, M-A. 2017.-Plant micro-reserves in Valencia (E. Spain): A model to preserve threatened flora in China?. *Plant Diversity* 39: 383e389.

García Criado, M., Väre, H., Nieto, A., Bento Elias, R., Dyer, R. *et al.* 2017. European Red List of Lycopods and Ferns. Brussels, Belgium: IUCN.

Geller G.N., Halpin, P.N., Helmuth, B., Hestir, E.L., Skidmore, A. *et al.* 2017. Remote Sensing for Biodiversity. In: Walters M., Scholes R. (eds) The GEO Handbook on Biodiversity Observation Networks. Springer, Cham

Goettsch, B., Hilton-Taylor, C., Cruz-Piñón, G., Duffy, J.P., Frances, A. *et al.* 2015. High proportion of cactus species threatened with extinction. *Nature Plants* 1: 15142. https://doi.org/10.1038/nplants.2015.142

Graham, A., Day, J., Bray, B. and Mackenzie, S. 2012. Sustainable drainage. Maximising the potential for people and wildlife. A guide for local authorities and developers. RSPB & WWT. https://www.wwt.org.uk/uploads/documents/2019-07-22/1563785657-wwt-rspb-sustainable-drainage-systems-guide.pdf

Gubbay, S., Sanders, N., Haynes, T., Janssen, J.A.M., Rodwell, J.R. *et al.* 2016. European Red List of Habitats. Part 1. Marine habitats. European Union 2016. ISBN 978-92-79-61586-3. doi: 10.2779/032638.

Halalisan, A.F., Ioras, F., Korjus, H., Avdibegovic, M., Maric, B. *et al.* 2016.An Analysis of Forest Management Non-Conformities to FSC Standards in Different European Countries. *Not. Bot. Horti. Agrobo.* 44(2):634-639. DOI:10.15835/nbha44210263

Hart, K. and Bas-Defossez, F. 2018. CAP 2021-27: Proposals for increasing its environmental and climate ambition, report for NABU by IEEP. The Institute for European Environmental Policy.https://ieep.eu/uploads/articles/attachments/63db952e-0825-4eb8-80fe-f88708cfd62f/NABU%20CAP%20Report%20-%20FINAL%20.pdf?v=63710723894

Heath, A. 2016. Spotlight on CITES. https://www.synchronicityearth.org/spotlight-on-cites/

Hermoso, V., Morán-Ordóñez, A., Canessa, S. and Brotons, L. 2019. Realising the potential of Natura 2000 to achieve EU conservation goals as 2020 approaches. *Scientific Reports Nature Research* 9:16087 https://doi.org/10.1038/s41598-019-52625-4

Heywood, V.H. 2014. An overview of *in situ* conservation of plant species in the Mediterranean. *Fl. Medit.* 24: 5-24. ISSN: 1120-4052 printed, 2240-4538 online.

Heywood, V.H. 2019. Conserving plants within and beyond protected areas – still problematic and future uncertain. *Plant Diversity* 41:36-49 https://doi.org/10.1016/j.pld.2018.10.001

Hill, L., Jones, G., Atkinson, N., Hector, A., Hemery *et al.*. 2019. The £15 billion cost of ash dieback in Britain. *Current Biology*, 29(9), R315-R316.

Hochkirch, A., Schmitt, T., Beninde, J., Marietta, H., Kinitz, T. *et al.* 2013. Europe needs a new vision for a Natura 2020 network. *Conserv. Lett.* 6, 462-467.

Hodgetts, N., Cálix, M., Englefield, E., Fettes, N., García Criado, M. *et al.* 2019. A miniature world in decline: European Red List of Mosses, Liverworts and Hornworts. Brussels, Belgium: IUCN.2019. https://portals.iucn.org/library/node/48520

Hovsepyan R., Stepanyan-Gandilyan N., Melkumyan H. and Harutyunyan L. 2016. Food as a marker for economy and part of identity: traditional vegetal food of Yezidis and Kurds in Armenia. Journal of Ethnic Foods 3(1): 32-41. file:///D:/Articles/Different/2016_Hovsepyanetal_Yezidifood_JEF.pdf

Hovsepyan R., Stepanyan-Gandilyan N. and Stollberg Ch. 2019. Phytomedicinal knowledge and "official" sources in Tatev (Armenia). Ethnobiology Letters 10 (1): 23-34. https://ojs.ethnobiology.org/index.php/ebl/article/view/1266

Humphreys, A. M., Govaerts, R.H.A., Ficinski, S.Z., Lughadha, E.M.N. and Vorontsova, M. 2019. Global dataset shows geography and life form predict modern plant extinction and rediscovery. *Nature Ecol. Evol.* 3(7):1-5 https://doi.org/10.1038/s41559-019-0906-2.

Hungate, B. A., Barbier, E. B., Ando, A. W., Marks, S. P. and Reich, P. B. *et al.* The economic value of grassland species for carbon storage. *Sci. Adv.* 3: e1601880 (2017).

IPBES (2018): Summary for policymakers of the regional assessment report on biodiversity and ecosystem services for Europe and Central Asia of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. M. Fischer, M. Rounsevell, A. Torre-Marin Rando, A. Mader, A. Church, M. Elbakidze, V. Elias, T. Hahn, P.A. Harrison, J. Hauck, B. Martín-López, I. Ring, C. Sandström, I. Sousa Pinto, P. Visconti, N.E. Zimmermann and M. Christie (eds.). IPBES secretariat, Bonn, Germany. 48 pages. Janssen, J.A.M., Rodwell, J.S., García Criado, M., Gubbay, S., Haynes T. *et al.* 2016. European Red List of Habitats. Part 2. Terrestrial and freshwater habitats. European Union 2016. ISBN 978-92-79-61588-7. doi: 10.2779/091372.

IUCN 2010. The IUCN Red List of Threatened Species™ October 2010 update. Cycad Facts https://www.iucn.org/downloads/cycad_factsheet_final.pdf

IUCN 2019. The IUCN Red List of Threatened Species. Versions 2019-3 and 2020-1 as cited. http://www.iucnredlist.org. Downloaded on 10 January 2020. Also see Summary Statistics. https://www.iucnredlist.org/

resources/summary-statistics

IUCN & UNEP-WCMC 2016. The World Database on Protected Areas (WDPA). Available: www.protectedplanet.net

Ivanova, N.V. and Shashkov, .P. 2017. Biodiversity databases in Russia: towards a national portal. *Arctic Science* 3: 560-576 https://www.nrcresearchpress.com/doi/10.1139/as-2016-0050#.Xk5YXjL7TIU

Jenkins, M., Timoshyna, A. and Cornthwaite, M. 2018. Wild at Home: Exploring the global harvest, trade and use of wild plant ingredients. TRAFFIC International, Cambridge, United Kingdom. https://www.traffic.org/site/assets/files/7339/wild-at-home.pdf

Jongman, R.H.G., Bouwma, I.M., Griffioen, A., Jones-Walters, L., Van Doorn, A.M. 2011. The Pan European Ecological Network: PEEN. Landscape Ecol. 26 (3):311-326. DOI 10.1007/s10980-010-9567-x

Kadis, C., Thanos, C. & Laguna, E. (eds.). 2013. Plant micro-reserves: From theory to practice. Utopia Publishing. Athens.

Kettunen, M., Genovesi, P., Gollasch, S., Pagad, S., Starfinger, U. *et al.* 2008. Technical support to EU strategy on invasive species (IAS) - Assessment of the impacts of IAS in Europe and the EU (final module report for the European Commission). Institute for European Environmental Policy (IEEP), Brussels, Belgium. 44 pp. + Annexes.

Knop, E., Zoller, L., Ryser, R., Gerpe, C., Hörler, M. *et al.* 2017. Artificial light at night as a new threat to pollination. *Nature* 548: 206–209. https://doi.org/10.1038/nature23288

Kovats, R.S., R. Valentini, L.M. Bouwer, E. Georgopoulou, D. Jacob, E. *et al.* 2014: Europe. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Barros, V.R., C.B. Field, D.J. Dokken, M.D. Mastrandrea, K.J. Mach, *et al.* (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1267-1326. https://www.ipcc.ch/site/assets/uploads/2018/02/WGIIAR5-Chap23_FINAL.pdf

Krauss, J., Bommarco, R., Guardiola, M., Heikkinen, R.K., Helm, A. *et al.* 2010. Habitat fragmentation causes immediate and time-delayed biodiversity loss at different trophic levels *Ecol Lett.* 2010 May; 13(5): 597–605. doi: 10.1111/j.1461-0248.2010.01457.x

Kreziou, A., De Boer, H. and Gravendeel, B. 2016. Harvesting of salep orchids in north-western Greece continues to threaten natural populations. Oryx, 50(3), 393-396. doi:10.1017/S0030605315000265

Krigas, N., Menteli, V. and Vokou, D. 2016. Analysis of the ex situ conservation of the Greek endemic flora at national European and global scales and of its effectiveness in meeting GSPC Target 8, *Plant Biosystems* - An International Journal Dealing with all Aspects of Plant Biology 150(3): 573-582, DOI: 10.1080/11263504.2014.988194

Kuzemko, A. A., Didukh, Y., Onyshchenko, V., Borsukevych, L., Moysiyenko, I. *et al.* 2018. National Habitat Catalogue of Ukraine. Раритетне фіторізноманіття Нижньодніпровських пісків. ISBN: 978-966-7775-63-6. https://www.researchgate.net/publication/331935396_NATIONAL_HABITAT_CATALOGUE_OF_UKRAINE

Laguna, E., Fos, S., Jiménez, J. & Volis, S. 2016. Role of micro-reserves in conservation of endemic, rare and endangered plants of the Valencian region (Eastern Spain). *Israel J. Plant Sci.* 63 (4): 320e332. https://doi.org/10.1080/07929978.2016.1256131.

Lambin, E.F. and Thorlakson, T. 2018. Sustainability Standards: Interactions Between Private Actors, Civil Society, and Governments. *Ann. Rev. Environ. Resources* 43:369-393.

Liempd, D.van and Jacob, B. 2013. Biodiversity reporting in Denmark. Accounting, Auditing & Accountability Journal 26 (5): 833-872 DOI: https://doi.org/10.1108/AAAJ:02-2013-1232

Lockhart, N. Hodgetts, N and Hollyoak, D. 2012. Rare and threatened Bryophytes of Ireland. National Museums Northern Ireland.

Maes, D. Collins, S., Munguira, M.L., Martina Sašić, M., Settele, J. *et al.* 2013. Not the right time to amend the annexes of the European Habitats Directive. *Conserv. Lett.* 6: 468–469.

Maesano, M., Ottaviano, M., Lidestav, G., Lasserre, B., Matteucci, G. *et al.* 2018. Forest certification map of Europe. *iForest* 11: 526-533. – doi:

10.3832/ifor2668-011 [online 2018-08-01]

Malovrh, S.P., Bećirović, D., Marić, D., Nedeljković, J., Posavec, S. *et al.* 2019.Contribution of Forest Stewardship Council Certification to Sustainable Forest Management of State Forests in Selected Southeast European Countries. *Forests* 10: 648. doi:10.3390/f10080648

Margulies, J.D., Bullough, L-A., Hinsley, A., Ingram, D.J., Cowell, C. *et al.* 2019. Illegal wildlife trade and the persistence of "plant blindness" *Plants, People, Planet.* 1:173–182. DOI: 10.1002/ppp3.10053

Menteli, V., Krigas, N., Avramakis, M., Turland, N. and Vokou, D. 2019. Endemic plants of Crete in electronic trade and wildlife tourism: current patterns and implications for conservation. *J of Biol Res-Thessaloniki* 26:10 https://doi.org/10.1186/s40709-019-0104-z

Milliken, W. 2015. Medicinal knowledge in the Amazon. https://www.kew.org/read-and-watch/medicinal-knowledge-amazong

Maxted, N., Ford-Lloyd, B.V., Kell, S.P., Iriondo, J.M., Dulloo, M.E. & Turok, J. (eds.). 2008. Crop Wild Relative Conservation and Use. CABI. Wallingford

Maxted, N., Dulloo, M.E., Ford-Lloyd, B.B., Frese, L., Iriondo, J. *et al.* 2013. Agrobiodiversity Conservation: Securing the Diversity of Crop Wild Relatives and Landraces. CABI International 2012.

Maxted, N., Avagyan, A., Frese, L., Iriondo, J.M., Magos Brehm, J. *et al.* 2015. ECPGR Concept for *in situ* conservation of crop wild relatives in Europe. Wild Species Conservation in Genetic Reserves Working Group, European Cooperative Programme for Plant Genetic Resources, Rome, Italy. http://www.cropwildrelatives.org/fileadmin/templates/cropwildrelatives.org/upload/documents/Portal_Content/ECPGR_Concept_for_in__situ_conservation_of_CWR_in_Europe_Maxtedetal_2015.pdf

Meredith, S. 2019. Getting to the roots of sustainable land management: A briefing on the Common Agricultural Policy in the EU Post-2020, Briefing for iSQAPER by IEEP. https://ieep.eu/uploads/articles/attachments/0f3a7514-3c95-4e10-aba5-012624caedc1/Getting%20to%20the%20roots%20of%20sustainable%20land%20management%20(IEEP,%20December%202019).pdf?v=63742773501

Mounce R., Smith P. and Brockington S. 2017. Ex situ conservation of plant diversity in the world's botanic gardens. *Nat. Plants.* 3: 795-802. DOI:10.1038/s41477-017-0019-3

Muñoz Rodríguez, P., Draper Munt, D. and Moreno Saiz, J.C. 2016. Global strategy for plant conservation: inadequate *in situ* conservation of threatened flora in Spain. *Israel J. Plant Sci.* 63(4):1-12. DOI: 10.1080/07929978.2016.1257105

O'Donnell, K & Sharrock, S. 2017. The contribution of botanic gardens to ex situ conservation through seed

banking[J]. Plant Diversity, 2017, 39(6): 373-378.

Ollerton J, Winfree R and Tarrant S. 2011. How many flowering plants are pollinated by animals? *Oikos*. 120(3):321–326.

Olmeda C., Šefferová V., Underwood E., Millan L., Gil T. *et al.* (compilers). 2019. EU Action plan to maintain and restore to favourable conservation status the habitat type 6210 Semi-natural dry grasslands and scrubland facies on calcareous substrates (Festuco Brometalia) (*important orchid sites). European Commission Technical Report XXXX-2019. https://ec.europa.eu/environment/nature/natura2000/management/pdf/EUHabitat_ap6210.pdf

Ozinga, W.A., Römermann, C., Bekker, R.M., Prinzing, A., Tamis, W.L.M. *et al.* 2009. Dispersal failure contributes to plant losses in NW Europe *Ecology Letters* 12: 66–74 doi: 10.1111/j.1461-0248.2008.01261.x

Paracchini, M-L., Petersen, J-E., Hoogeveen, Y., Bamps, C., Burfield, I. *et al.* 2008. High nature value farmland in Europe — an estimate of the distribution patterns on the basis of land cover and biodiversity data, EUR - Scientific and Technical Research Report https://publications.jrc.ec.europa.eu/repository/handle/JRC47063

PEBLS 1976. Pan-European Biological and Landscape Diversity Strategy. Nature and Environment, No. 74. Council of Europe Press, 1996. https://www.cbd.int/doc/nbsap/rbsap/peblds-rbsap.pdf

Phalan, B.T. 2018. What Have We Learned from the Land Sparing-sharing Model? *Sustainability* 10: 1760; doi:10.3390/su10061760

Phelps, J., Hinsley, A and Maguiles, J. 2018. Illegal wildlife trade endangers plants — but few are listening Blog on : https://www.iucn.org/news/species/201810/illegal-wildlife-trade-endangers-plants-few-are-listening

Phillips, J., Asdal, A., Brehm, J.M., Rasmussen, M. and Maxted, N. 2016. In situ and ex situ diversity analysis of priority crop wild relatives in Norway. *Diversity and Distributions* 22: 1112–1126

Planta Europa and the Council of Europe 2002. Saving the Plants of Europe; the European Plant Conservation Strategy. Plantlife International, London.

Planta Europa 2008.A Sustainable Future for Europe; the European Strategy for Plant Conservation 2008 – 2014. Plantlife International, Salisbury.

Planta Europa and Plantlife International 2005. Mid-term review of the European Plant Conservation Strategy. ISBN: 1 904749-14-3 https://www.plantlife.org.uk/application/files/4614/8234/0470/MID_TERM_review_of_EPCS.pdf

Plantlife 2014. Global Strategy for Plant Conservation 2020: A review of the UK's progress towards 2020. Plantlife Salisbury.

Pywell, R.F., Heard, M.S., Bradbury< R.B., Hinsley, S., Nowakowski, M. *et al.* 2012. Wildlife-friendly farming benefits rare birds, bees and plants. *Biol. Lett.* 8: 772–775. doi:10.1098/rsbl.2012.0367

RBG Kew (2016). The State of the World's Plants Report – 2016. Royal Botanic Gardens, Kew.

Research Centre for Agrobiodiversity 2014. Pannon Seedbank. Laymans Report. Establishment of the Pannon Seedbank for the long-term ex situ conservation of Hungarian vascular wild plants. http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=home.showFile&rep=file&fil=LIFE08_NAT_H_000288_LAYMAN.pdf

Rivers, M.C., Beech, E., Bazos, I., Bogunić, F., Buira, A. *et al.* 2019. European Red List of Trees. Cambridge, UK and Brussels, Belgium: IUCN. viii + 60pp.

Rivière, S., Carta, A., Breman, E., Müller, J.V. and Kiehn, M. 2018. How to meet the 2020 GSPC target 8 in Europe priority-setting for seed banking of native threatened plants *Biodivers. Conserv.* 27(8): 1873-1890. DOI 10.1007/s10531-018-1513-2

Sabatini, F. M., Burrascano, S., Keeton, W.S., Levers, C., Lindner, M. *et al.* 2018, 'Where are Europe's last primary forests?. *Diversity and Distributions* 24(10): 1426-1439 (DOI: 10.1111/ddi.12778).

Sánchez-Bayoa, F. and Wyckhuysbcd, K. A.G. 2019. Worldwide decline of the entomofauna: A review of its drivers. *Biol. Conserv.* 232: 8-27. https://doi.org/10.1016/j.biocon.2019.01.020

Senn-Irlet, B., Heilmann-Clausen, J., Genney, D. and Dahlberg, A. 2007. Guidance for Conservation of Macrofungi in Europe. Prepared for the European Council for Conservation of Fungi (ECCF) within the European Mycological Association (EMA). http://www.eccf.eu/Guidance_Fungi.pdf

SEP 2014. Science for Environment Policy. Thematic Issue: Invasive Alien Species. September 2013, Issue 4 https://ec.europa.eu/environment/integration/research/newsalert/pdf/41si_en.pdf

Sharrock, S., Oldfield, S. & Wilson, O. 2014. Plant Conservation Report 2014: A review of progress in implementing the Global Strategy for Plant Conservation 2011–2020. Secretariat of the Convention on Biological Diversity, Montreal, Canada, and Botanic Gardens Conservation International, Richmond, U.K. Technical Series No. 81.

Sharrock, 2019. A review of progress towards the Global Strategy for Plant Conservation 2011-2020 Draft 3 November 2019.

Singh, R. and Singh, G. S. 2017. Traditional agriculture: a climate-smart approach for sustainable food production. *Energ. Ecol. Environ.* 2(5):296–316. DOI 10.1007/s40974-017-0074-7

Soares, A.L., Rego, F.C., McPherson, E.G., Simpson, J.R., Peper, P.J. *et al.* 2011. Benefits and costs of street trees in Lisbon, Portugal. *Urban Forestry & Urban Greening* 10: 69–78.

Sparrius, L.B. Odé B. and Beringen R., 2014. Basisrapport Rode Lijst Vaatplanten 2012 volgens Nederlandse en IUCN-criteria. FLORON Rapport 57. FLORON, Nijmegen. DOI: 10.13140/RG.2.2.19320.96006

Sutherland, W.J., Dias, M.O., Dicks, L.V., Doran, H., Entwistle, A.C. *et al.* 2020. A Horizon Scan of Emerging Global Biological Conservation Issues for 2020. *TREE.* 35 (1):81-90. https://doi.org/10.1016/j.tree.2019.10.010

Tamanyan, K., Fayvush, G., Nanagyulyan, S. & Danielyan, T. (eds.) 2010. The Red Book of Plants of the Republic of Armenia. Higher Plants and Fungi. Yerevan: Zangak-97 Publishing House. 591 pp

Thuiller, W., Lavorel, S., Araújo, M.B., Sykes, M.T. and Prentice, C. 2015.Climate change threats to plant diversity in Europe. *Proc. Nat. Acad. Sci.* Jun 2005, 102 (23): 8245-8250; DOI: 10.1073/pnas.0409902102

Uludağ, A., Aksoy, N., Yazlık, A., Arslan, Z.F., Yazmış, E. *et al.* 2017. Alien flora of Turkey: checklist, taxonomic composition and ecological attributes. NeoBiota 35: 61–85. https://doi.org/10.3897/neobiota.35.12460.

UN Economic and Social Council 2019. Report of the Secretary-General 8 May 2019. Special edition: progress towards the Sustainable Development Goals https://undocs.org/E/2019/68

UNEP WCMC 2019. Briefing Note for the Competent Authorities (CA) implementing the EU Timber Regulation September - November 2019. https://ec.europa.eu/environment/forests/pdf/EUTR%20Briefing%20note%20Sept-Nov%202019.pdf

Vanbergen, A.J., Heard, M.S., Breeze, T. ,. Potts, S.G. and Hanley, N. 2014. A report to the Department for Environment, Food and Rural Affairs (Defra) ID PH0514 July 2014 ver. 3 file:///C:/Users/Debbie.Pain/Down-

loads/12316_finalreportph0514%20(2).pdf

Vincent, H., Wiersema, J., Kell, S., Fielder, H., Dobbie, S. *et al.* 2013. A prioritized crop wild relative inventory to help underpin global food security. *Biol. Conserv.* 167: 265-275 https://doi.org/10.1016/j.biocon.2013.08.011

Walsh, A., Finn, J., Jebb, M. Waldren, S. and Sullivan, C. 2015. The distribution of vascular plant species of conservation concern in Ireland, and their coincidence with designated areas. *J. Nature Conserv.* 24: 56-62.

Wäldchen, J., Rzanny, M., Seeland, M., Mäder, P. 2018. Automated plant species identification—Trends and future directions. *PLoS Comput.* Biol. 14(4): e1005993. https://doi.org/ 10.1371/journal.pcbi.1005993

Willis, K.J. (ed.) 2017. State of the World's Plants 2017. Report. Royal Botanic Gardens, Kew. https://stateoftheworldsplants.org/2017/report/SOTWP_2017.pdf

Willis, K. J. (ed.) 2018. State of the World's Fungi 2018. Report. Royal Botanic Gardens, Kew. https://stateoftheworldsfungi.org/2018/reports/SOTWFungi_2018_Full_Report.pdf

Wilmé, L., Innes, J.L., Schuurman, D., Ramamonjisoa, B., Langrand, M. *et al.* 2019. Management options for addressing the persistent and unresolved CITES issue of Madagascar's rosewood stocks and stockpile. PeerJ Preprints 7:e27889v1 https://doi.org/10.7287/peerj.preprints.27889v1

Wilson, B., Beech, E., Window, J., Allen, D.J. and Rivers, M. 2019. European Red List of selected endemic shrubs. Brussels and Cambridge: IUCN. Available at: https://portals.iucn.org/library/node/48438

Wolf, D., Oldfield, T.E.E. and McGough, N. 2018. CITES Non-detriment Findings for Timber: A nine-step process to support CITES Scientific Authorities making science-based non-detriment findings (NDFs) for timber / tree species listed in CITES Appendix II. Version 3.0 BfN-Skripten 504 https://d-nb.info/1168761131/34 Accessed 27.01.20

World Health Organization 2014. WHO Traditional Medicine Strategy 2014–2023. http://apps.who.int/iris/bitstream/10665/92455/1/9789241506090_eng.pdf?ua=1

Wyse Jackson, P. 2014. Ireland's Generous Nature: The Past and Present Uses of Wild Plants in Ireland. Missouri Botanical Garden Press, St. Louis.

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