European Red List of Medicinal Plants

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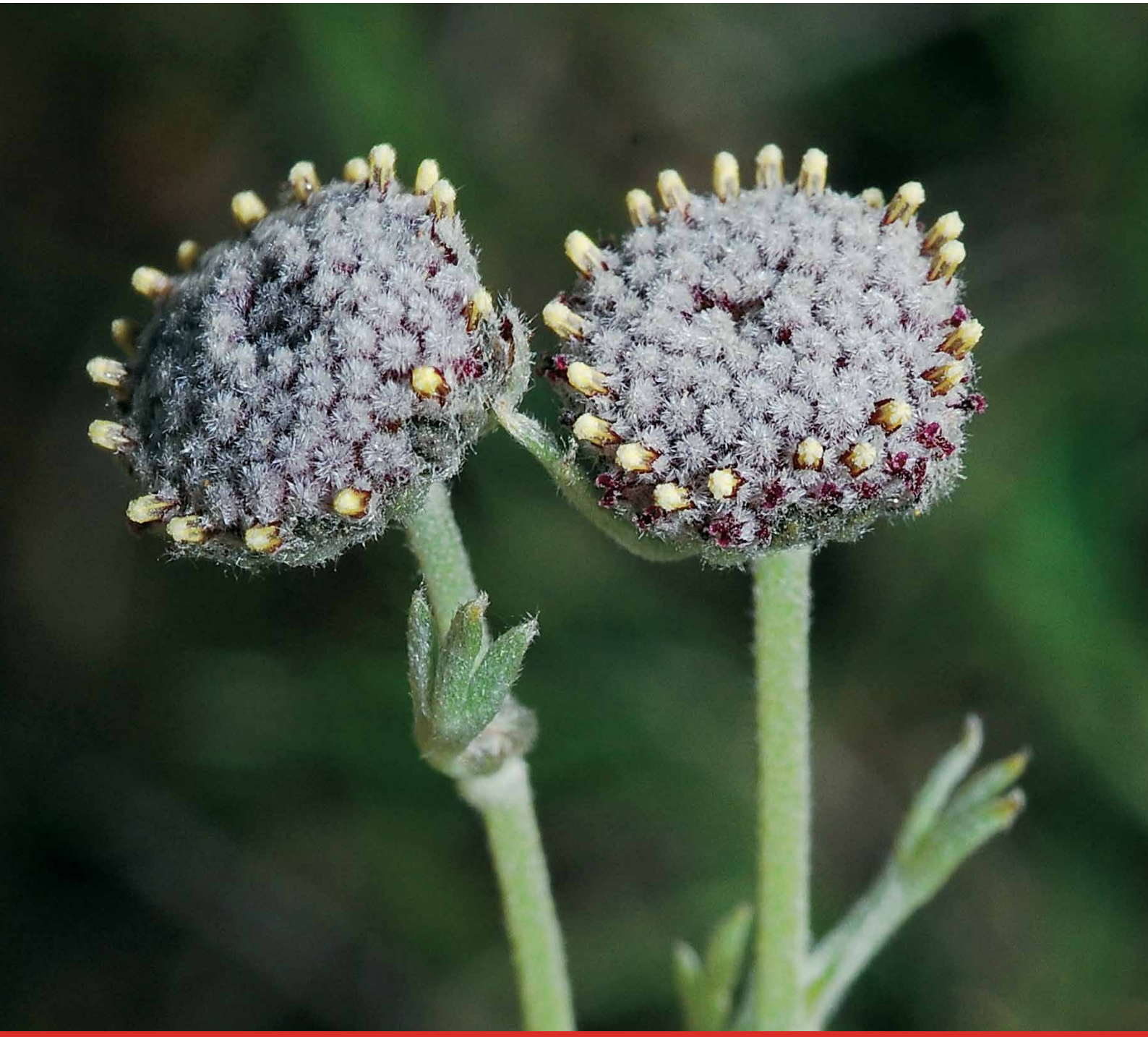

European Commission
IUCN
SSC Species Survival Commission
RED LIST
Medicinal Plant Specialist Group
BGCI Plants for the Planet

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IUCN Global Species Programme
IUCN European Union Representative Office
IUCN Species Survival Commission

Published by the European Commission.

Citation:	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.
Design and layout:	Imre Sebestyén jr. / UNITgraphics.com
Printed by:	Rosseels Printing
Picture credits on cover page:	*Artemisia granatensis* is endemic to the mountains of Sierra Nevada, southern Spain. The plant is considered Endangered as a result of population decline and range contraction. ©José Quiles Hoyo / www.florasilvestre.es
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Available from:	Luxembourg: Publications Office of the European Union http://bookshop.europa.eu IUCN EU Representative Office: brussels@iucn.org A catalogue of IUCN publications is available www.iucn.org/publications

Luxembourg: Publications Office of the European Union, 2014

ISBN 978-92-79-44513-2

DOI 10.2779/907382

Printed in Belgium

The text of this book is printed on 130 gsm 100% recycled paper (CyclusPrint, FSC and EU Ecolabel certified)

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Foreword

Europe's landscape has been shaped by centuries of diverse farming and forestry traditions. This has resulted in a wide range of agricultural and woodland landscapes and significantly contributed to the continent's biodiversity. In addition, the EU's Outermost Regions and Europe's Overseas Countries and Territories are situated in five biodiversity hotspots, including areas that host over 20% of the world's coral reefs and lagoons, and 70% of the EU's biodiversity.

Biodiversity loss is an enormous challenge in the EU, with Europe's species richness currently highly threatened by human activities. Progress has been made on a number of fronts: certain populations and distributions of wildlife species are showing positive trends, with some species that were once at risk of extinction now stabilising or even increasing. The Birds and Habitats Directives, the cornerstone of the EU's nature policies, have clearly helped bird species and some large carnivore species to recover in Europe, which is encouraging.

However, many of Europe's ecosystems are now so heavily degraded that their ability to deliver valuable ecosystem services has been drastically reduced. The EU Biodiversity Strategy adopted in 2011 is part of a 2050 vision aiming to protect, value and restore biodiversity and the services it provides – its natural capital. This is important not only to protect nature's intrinsic value, but also for its essential contribution to human wellbeing and economic prosperity, and to avert catastrophic changes caused by the loss of biodiversity. In recent years, the vital role of goods and services provided by nature to sustaining our well-being and future socio-economic developments, has gained increased political attention. For instance, naturally occurring substances from plant species form the basis of more than 50% of prescription medicines.

As part of the EU Biodiversity Strategy to 2020, the EU is supporting the development of assessments and indicators to improve the knowledge and evidence base on the services provided by nature to society.

The European Red List of Medicinal Plants is providing for the first time factual information on the status of medicinal plants in Europe. This assessment includes 400 vascular plants from ninety families, including large trees, aquatic plants and epiphytes, and occupying a wide range of habitats.

The good news is that this new assessment shows that only 2.4% (nine plants) of medicinal plants are threatened (it is important to note however that there was insufficient information available for 25 species and as a result the proportion of threatened species lies between 2.3% and 8.5%). The collection of plants from the wild was identified as the prime threat and highlights the need to engage in monitoring of harvest and trade of these highly utilised species. Impacts from agriculture (livestock farming, annual and perennial non-timber crops, and plantation forestry) were identified as another important threat.

The value of natural capital to our economies and societies, and the interdependencies of nature with other societal objectives, are often not reflected in private and public decisions, indicators and accounting systems in the same way as economic and human capital. By improving our knowledge, we want to contribute to the protection of nature and ensure that far-reaching actions are taken to bring huge benefits not only to nature and the countryside, but also to our long-term well-being.

Pia Bucella
Director
Directorate B: Natural Capital
European Commission

Acknowledgements

All of IUCN's Red List assessment projects rely on the willingness of scientists who are often, but not always, members of the IUCN Species Survival Commission (SSC), to pool and contribute their collective knowledge to make the most reliable estimates of a species conservation status. Without their enthusiastic commitment to species conservation, this kind of assessment project would not be possible. These experts are either contributors to the IUCN Red List species assessments that have been completed through this project and earlier projects, or provided their time and expertise to review species assessments.

Botanic Gardens Conservation International (BGCI) played a key role in the project, and we would like to express our thanks to Sonia Khela who undertook the majority of the assessments in the first and second years of the project, and to Sara Oldfield, Secretary General of BGCI, who in addition to reviewing assessments, provided guidance and made BGCI resources available to the project. Helen Chadburn, Eglantine Chappuis, and Fabian Schweizer undertook the majority of the assessments in the final year of the project. We would also like to thank Helen Chadburn for the species case studies that illustrate this report.

A very large number of people have provided invaluable assistance to this project throughout its duration, as well as to assessments included in here that were compiled under other projects, and we would like to express our sincere thanks to all who have contributed as assessment Assessors, Reviewers and Contributors, and our apologies if they are omitted here in error. Those experts who contributed to this work through assessing, compiling or reviewing the species assessments included in this report are as follows;

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Antun Alegro
Alessandro Alessandrini
Badarau Alexandru
José Antonio Algarra Ávila
Jose Alberto Castillo Almagro
Jana Ambrožič-Dolinšek
Marios Andreou
Tomás Martín Arévalo
Åsmund Asdal
Michael Avishai
Steven Bachman
Giuseppina Barberis
Ioannis Bazos
Alexandra Bell
Imtinen Ben Haj Jilani
Semia Ben Saad
Erwin Bergmeier
Karl-Georg Bernhardt
Alessio Bertolli
Gabriel Blanca
Mauro Bovio
Zofia Bulińska
Stephane Buord
Francisco Barreto Caldas
Robert Cantley
Lothar Frese
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Zeineb Gammar-Ghrabi
Nieves García
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Antonio Rivas Rangel
Diego Rivera
Francisco Rodríguez Vicarío
Llorenç Sáez Goñalons
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Silvia Strajeru
Maria do Carmo Tavares
Philip Thomas
Dana Turonova
Katya Uzundzhalieva
Benito Valdés
Klaus van de Weyer
Errol Vela
Gema Villa
Rudolf Vögel
Gabor Vörösváry
Murphy Westwood
Thomas Wilhalm
Lindsay Williams
Rainer Woschée
Robert Zintl

Product processing at a FairWild certified operator in Hungary. © Anastasiya Timoshyna / Traffic International

Spring Pasque flower *Pulsatilla vernalis* is common in most Alpine areas of Europe, as well as at lower altitudes in central Europe and in southern Scandinavia.

A number of IUCN SSC Specialist Groups have assisted in the compilation and review of assessments. These include: the Carnivorous Plant Specialist Group, the Conifer Specialist Group, the Crop Wild Relative Specialist Group, the Freshwater Plant Specialist Group, the Global Tree Specialist Group, the Macaronesian Island Plant Specialist Group, the Mediterranean Plant Specialist Group, and the Orchid Specialist Group. We would like to especially thank Danna Leaman and Uwe Schippmann from the IUCN SSC Medicinal Plant Specialist Group (MPSG), who compiled the list of species for inclusion in the project, provided invaluable assistance throughout, and made their own data available. Danna has also reviewed the great majority of the assessments undertaken through this project in her role as MPSG Red List Authority Coordinator.

We thank the *Atlas Florae Europaeae* (Alexander Sennikov) for making plant distribution data available for a significant number of species included in this assessment.

Colleagues from the IUCN Global Species Programme (Barbara Goettsch, Diego Juffe Bignoli, Annabelle Cuttelod, Maiko Lutz, Ana Nieto, Jean-Christophe Vié) have provided assistance throughout the project, and Red List Unit staff (Craig Hilton-Taylor, Caroline Pollock, Janet Scott) provided training and support. The following provided invaluable assistance with GIS mapping and assessment review in a voluntary capacity; Lindsay Davidson, Richard Douglas, Kate Saunders, and Andrew Ladle, with support from Ackbar Joolia, Adrian Hughes and Jemma Window from the IUCN Global Species Programme; Jemma provided extensive assistance with mapping and analyses.

We would like to thank IUCN colleagues in Cambridge (Maureen Martindell and Amy Burden), Gland (Anna Rosenberg) and Brussels (Seifu Habtemichael) who have worked tirelessly with all project reporting and financial issues. Angelika Pullen (Communications, IUCN Brussels) provided invaluable assistance in the production of the final report.

We are indebted to the European Commission who funded the European Medicinal Plant Assessment and this report through Service Contracts (070307/2011/603880/SER/B.2, 070307/2012/632606/SER/B.2, and 070307/2013/661306/SER/B.2). We would like to thank Anne Teller for ensuring the smooth coordination between the project and the European Commission. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors and do not necessarily reflect the views of the European Commission, the International Union for Conservation of Nature (IUCN), or the IUCN Species Survival Commission.

Executive summary

Aim

The European Red List is a review of the Red List status of European species according to IUCN regional Red Listing guidelines. It identifies those species that are threatened with extinction at the regional level – in order that appropriate conservation action can be taken to improve their status. This Red List publication summarises results for the selected European medicinal plants.

Scope

In Europe, there are more than 30,000 vascular plant taxa (Euro+Med 2006-2014), however, only a small proportion of these have an identified medicinal use. A wide range of sources were reviewed to identify medicinal plants that are considered native or naturalised prior to AD 1500, a process that arrived at a final number of 400 assessed taxa.

The term 'medicinal plant' has been understood here in a wider sense to include overlapping uses as herbal teas, spices, food, dietary supplements, and cosmetics. This inclusive approach is widely accepted and avoids a narrow focus on plants with a modern pharmaceutical application.

The geographical scope of the assessment was continent-wide, extending from Iceland in the west to the Urals in the east, and from Franz Josef Land in the north to the Canary Islands in the south. Red List assessments were made at two regional levels: for geographical Europe, and for the 27 Member States of the European Union (prior to the accession of the Republic of Croatia in 2013).

Status assessment

The status of all species was assessed using the *IUCN Red List Categories and Criteria* (IUCN 2012a), which is the world's most widely accepted system for measuring extinction risk. All assessments followed the *Guidelines for Application of IUCN Red List Criteria at Regional Levels* (IUCN 2012b). Assessments were compiled through an extensive literature review, and with contributions from a large network of experts from almost every country in the region. The assessments were reviewed by relevant SSC Specialist Groups, especially the Medicinal Plant Specialist Group, and through email correspondence with relevant experts. Assessments are available on the European Red List website and data portal: http://ec.europa.eu/environment/nature/conservation/species/redlist and http://www.iucnredlist.org/europe.

Results

This assessment includes 400 vascular plants from ninety families, including large trees, aquatic plants and epiphytes, and occupying a wide range of habitats. The assessment found that 2.4% (nine plants) of extant medicinal plants included in the assessment for which sufficient data are available are threatened. Twenty five species were considered Data Deficient (i.e., for which there was insufficient information available to assess against the Red List criteria) and as a result the precise proportion of threatened species is uncertain and could lie between 2.3% (if all Data Deficient species are not threatened) and 8.5% (if all Data Deficient species are threatened).

The main current threats emerging from the analysis include, in descending order of importance: wild plant collection, livestock farming, general ecosystem modifications, agriculture (other than livestock), silviculture, invasive alien species, transport infrastructure, and energy production and mining. For the selected medicinal plants, 164 (41%) were assessed as having a stable population trend, whilst 125 (31%) were considered to be declining in population size in Europe. More than one quarter (101, 25%) have an unknown population trend and a small part of the group (2.5%) have increasing populations.

Recommendations

Expand the state of knowledge of European medicinal plants

- Undertake further research on threatened and Near Threatened European species and ensure the adequate identification and management of their critical habitats to inform conservation programmes and identify gaps in conservation actions.

- Reassess threatened plants at least every five years and when new information becomes available. It is recommended that Data Deficient species should also be reassessed every five years.
- Prioritise fieldwork and data collection for Data Deficient species to determine whether they are in need of conservation action.
- Promote data access through the development of national and regional data portals.
- Integrate the outcomes of this assessment and any follow-up research into the European Strategy for Plant Conservation, and showcase in the Global Strategy for Plant Conservation.

Localise and apply the assessment results

- Promote awareness of medicinal plant conservation status and the drivers of population declines, as well as the tools available to develop conservation actions through regional and national workshops and other relevant awareness-raising activities.
- Use the outcomes of assessment for further sub-regional assessments, to update national Red List assessments or develop if not already in place, and to inform national-level conservation priority-setting and conservation measures, including sustainable use.
- Build capacity and resources at the national level to undertake national assessments.

Capacity-building and awareness

- Tools and resources for building the capacity of resource managers and relevant agencies should be developed and disseminated, including; undertaking Red List assessments at national scales; producing resource inventories; in the development of species and area management plans; and in population and habitat monitoring.
- Strengthen the network of European plant experts by providing training and improving communication, including the mobilisation of financial resources.
- Promote expert engagement in relevant SSC Specialist Groups, especially the Medicinal Plant Specialist Group, in order to build expertise, share knowledge and develop links between national experts.
- Effective government regulations and policies can create an enabling environment for the conservation, sustainable use and trade in wild medicinal plants in Europe. Tools such as the FairWild Standard can be applied to improve existing wild harvesting management practices and provide a framework for such policies.
- Prioritize conservation measures based on the findings of this assessment.
- Integrate medicinal plant conservation measures into National Biodiversity Strategies and Action Plans (NBSAPs), and where relevant develop specific plant conservation strategies at the national or sub-national level.
- Cooperation between government ministries is important for the development and implementation of effective medicinal plant conservation and sustainable use strategies. Such cooperation should extend across all government sectors, including environmental protection, agriculture, forestry, economic and rural development, and health.
- Encourage the uptake of the FairWild Standard and certification scheme for sustainable wild-harvesting and equitable trade to prevent further population decline of species impacted by wild collection.
- Engagement of multiple stakeholder groups, including research institutions, NGOs, communities and private sector in the discussions of the assessment outcomes and the design of the follow-up measures is of critical importance to the successful implementation of the activities.

Common Poppy *Papaver rhoeas* is widespread and common across much of Europe. © Jörg Hempel / Creative Commons via Wikimedia Commons

1. Background

This study had two geographical foci; the 27 European Union Member States (as of 2011 when the project commenced) and continental Europe (termed here 'pan Europe'), defined below (and see Figure 1).

1.1 The European context

Continental Europe is physically and geologically the westernmost peninsula of Eurasia. Europe is bounded to the north by the Arctic Ocean, to the west by the Atlantic Ocean, to the south by the Mediterranean Sea, to the east by the Ural Mountains and the Caspian Sea, which separate Europe from Asia, and to the southeast by the Black Sea and the Caucasus Mountains (see Figure 1). It is the worlds' second smallest continent in terms of area, covering approximately 10,400,000 km^2 (or 2% of the Earth's surface). In terms of human population, Europe is the third-largest continent (after Asia and Africa) with a population of some 740 million in 2010 (UN DESA 2012) – about 11% of the world's population. Europe has the most highly urbanised population and, together with Asia, is the most densely populated continent in the world.

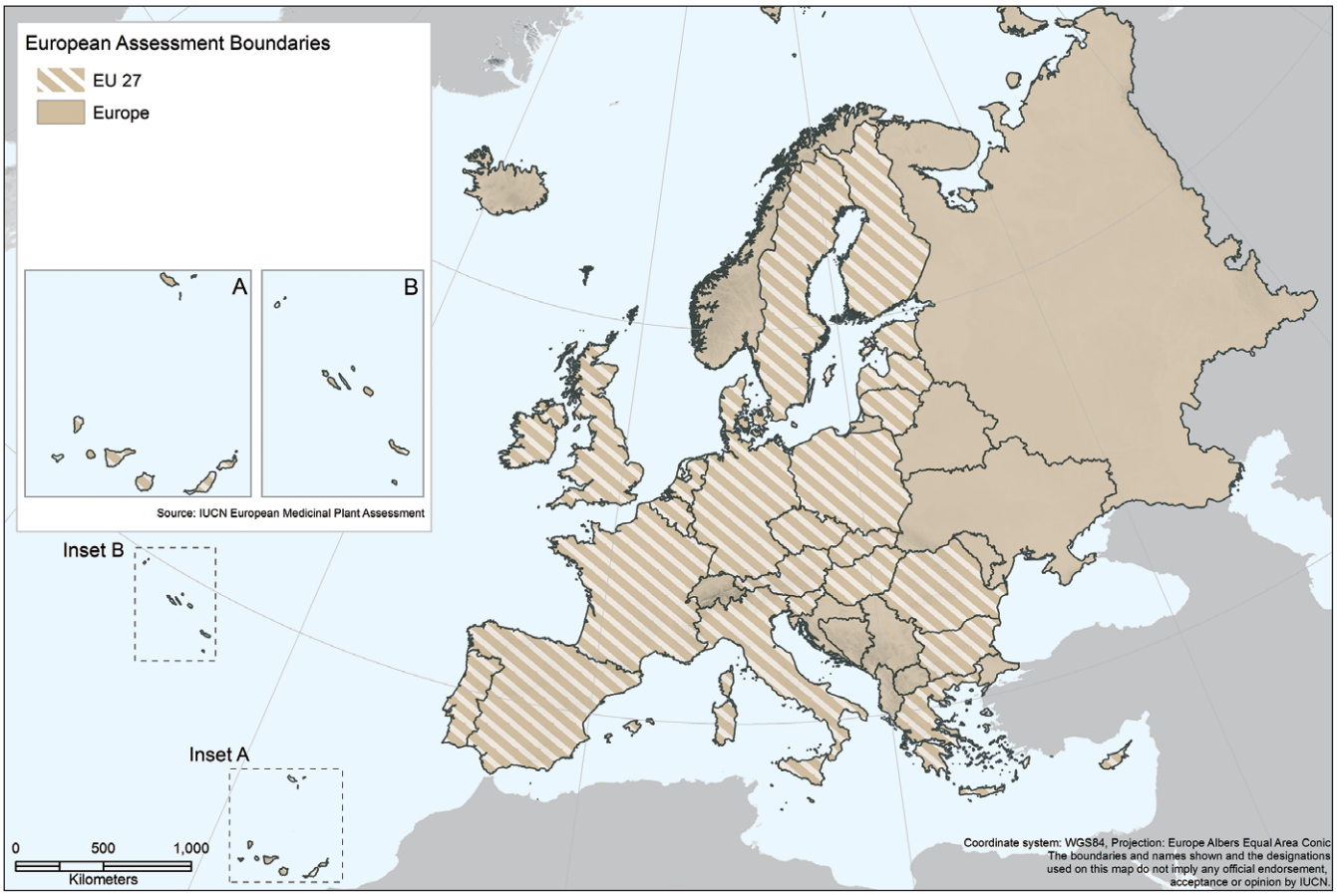
The European Union (EU), comprising 27 Member States (prior to the accession of Croatia in 2013), is Europe's largest political and economic entity. It is the world's largest economic block with an estimated gross domestic product (GDP) in 2013 of 13,025,473 million Euros for the EU 27 Member States (Eurostat 2014). Per-capita GDP in many EU states is among the highest in the world, and rates of resource consumption and waste production are correspondingly high – the EU 27's "ecological footprint" has been estimated to exceed the region's biological capacity (the total area of cropland, pasture, forest, and fishing grounds available to produce food, fibre and timber, and absorb waste) by 2.6 times (WWF 2007).

The EU's Member States stretch from the Arctic Circle in the north to the Mediterranean in the south, and from the Atlantic coast in the west to the Pannonian Basin in the east. Continental Europe ('pan Europe') extends to the Ural Mountains, and includes non-EU Member States such as Switzerland – an area containing a great diversity of landscapes and habitats and a wealth of flora and fauna. The biodiversity of pan Europe includes more than 520 species of birds (Birdlife In prep.), 138 species of Odonata (Kalkman *et al.* 2010), 260 species of mammals (Temple and Terry 2007, 2009), 151 species of reptiles (Cox and Temple 2009), 85 species of amphibians (Temple and Cox 2009), 546 species of freshwater fishes (Kottelat and Freyhof 2007, Freyhof and Brooks 2011), 20-25,000 species of vascular plants (Euro+Med 2006-2011) and well over 100,000 species of invertebrates (de Jong 2013). The Mediterranean part of Europe, which is especially rich in plant and animal species, has been recognised as a global biodiversity hotspot (Mittermeier *et al.* 2004, Cuttelod *et al.* 2008).

Pan Europe has arguably the most highly disturbed and fragmented landscape of all continents, and only a small fraction of its land surface can be considered as wilderness. For centuries, most of Europe's land has been used by humans to produce food, timber and fuel and to provide living space. Currently in western Europe, more than 80% of land is under some form of direct management (EEA 2007), although approximately twenty five percent of the EU 27 terrestrial land area is within the Natura 2000 protected areas network (EEA 2014). Consequently, European species are to a large extent dependent upon semi-natural habitats created and maintained by human activity, particularly traditional, non-intensive forms of land management. These habitats are under pressure from agricultural intensification, urban sprawl, infrastructure development, tourism pressure, land abandonment, acidification, eutrophication and

Seafennel *Crithmum maritimum* (LC), Akrotiri, Cyprus. The plant is widespread in the European and Mediterranean regions, and has a range of medicinal applications ascribed to it. © G.N. Hadjikyriakou / Flora of Cyprus

Figure 1. Regional assessments were made for two areas – continental Europe and the EU 27 Member States.



desertification. Many species, especially utilised plants such as those used for medicinal purposes, are directly affected by overexploitation, persecution and impacts of invasive alien species, as well as climate change which is set to become an increasingly serious threat in the future. Although considerable efforts have been made to protect and conserve European habitats and species, biodiversity decline and the associated loss of vital ecosystem services (such as water purification, crop pollination and carbon sequestration) continues to be a major concern in the region.

1.2 European medicinal plants: diversity and endemism

Plants are a fundamental part of ecosystems, forming their physical structure, and are of essential importance to the functioning of the planet's atmosphere. The majority of plants conduct photosynthesis, a process that by using sunlight energy, converts carbon dioxide and water into organic compounds (such as sugar), water and most importantly into oxygen. Plant species provide habitat, enable the life of animal species and are primary producers for the food web. Plant cover significantly influences the climate, water resources and soil stability and composition (Hamilton and Hamilton 2006). People have relied on plants for thousands of years for food, shelter, fuel, fibre, clothing, for medicinal purposes and for their ornamental and cultural value.

The market for medicinal plant products, such as these herbal teas, is large. © Anastasiya Timoshyna / TRAFFIC International

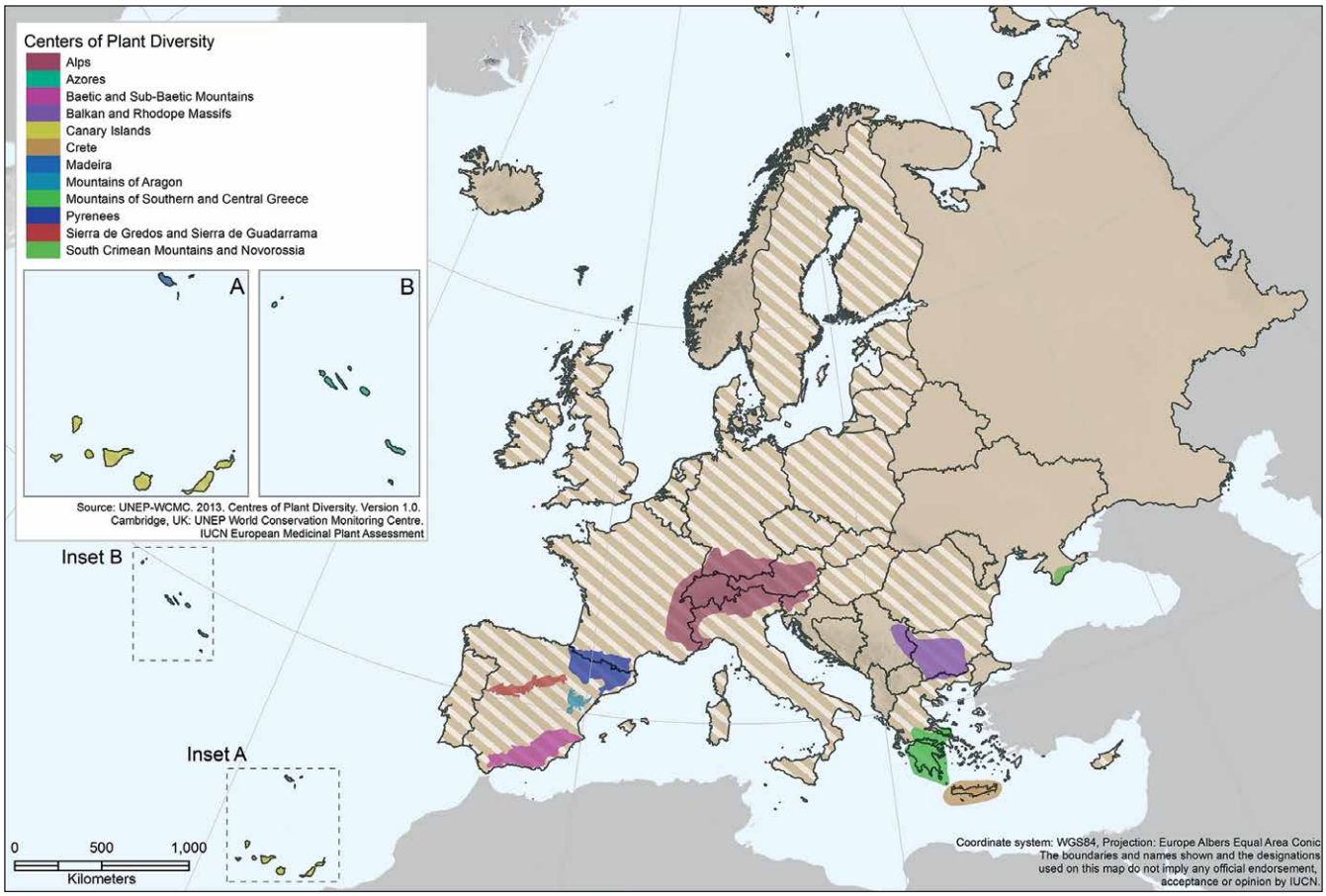
Within Continental Europe, 25 Centres for Plant Diversity (CPDs) have been identified (Heywood and Davis 1994, UNEP-WCMC 2013; Figure 2). All are in the southern parts of the European region; the Alps (nine sites), the Baetic and Sub-Baetic Mountains (southern

and eastern Spain), the Balkan and Rhodope Massifs (three sites), Crete (single site), Macaronesia (Azores, Canary Islands, and Madeira), the Mountains of Aragon (single site), Mountains of southern and central Greece (single site), the Pyrenees (four sites), the Sierra de Gredos and Sierra de Guadarrama (single site), and the South Crimean Mountains and Novorossia (single site). The primary natural vegetation was mixed forest across large areas of continental Europe, however agricultural expansion, human settlement, and other anthropogenic impacts have reduced the forest cover to 30% in Europe (Sharrock and Jones 2009).

Plants have long been used by humans for a very wide range of purposes (Lange 1983), with medicinal and associated applications recorded in Europe from the Hittite period of Turkey (c.1900-1200 BC) and extensively in early Greek cultures (Lange 1983, Petrovska 2012). Plant use has formed the basis of European Traditional Medicine since at least the Middle Ages (fifth to fifteenth centuries AD) (Firenzuoli and Gori 2007), with more specialised use of plants, such as homeopathy and the extraction of alkaloids, emerging from the nineteenth Century onwards (Lange 1983, Petrovska 2012). Herbal medicine (phytotherapy) is among the major "complementary" treatments in current use by doctors and other therapists throughout Europe (Fisher and Ward 1994).

The Global Checklist of Medicinal Plants (GCL-MP; U. Schippmann pers. comm. 2014) recorded 21,524 taxa globally in 2010 (Biodiversity Indicators Partnership 2010), a number that constantly increases as further research records novel uses and additional species. It has been suggested that one in six species of higher plants (around 50,000 taxa) have been used medicinally (Schippmann *et al.* 2006), although the majority of these have been used in folk medicine, with fewer used in formal traditional medicine systems (e.g., Ayurveda or traditional Chinese medicine). There were 119 drugs derived from plants identified on the market in 1990 (Farnsworth 1990) and an additional 16 new pharmaceutical compounds were available by 2002 (Newman *et al.* 2003). Miller (2011) proposes that these studies conservatively estimate the current reliance of commercial drugs on plant sources since they exclude semi-synthetic and synthetic medicines based on naturally occurring compounds and estimates the future potential for 540 to 23,490 new drugs discovered

Figure 2. The pan Europe region encompasses 25 Centres for Plant Diversity, all within the southern part of the region.



from the world's flora, based on the current rate of drug discovery and development from plants and given the range of estimates of global plant species diversity.

Many plant species used in medicine are also used for other purposes. In compiling the GCL-MP and the species list used in this European assessment, the term 'medicinal plant' has been understood in a wide sense to include overlapping uses as herbal teas, spices, food, dietary supplements, and cosmetics, and it is this wider definition that is used in this report.

Contemporary European use and trade in medicinal and aromatic plants (MAPs) is extensive, with eight countries in the pan Europe region (Germany, Spain, France, Netherlands, Italy, United Kingdom, Russian Federation (not disaggregated by Russia-in-Europe), and Poland) amongst the top twenty global importers by volume of MAPs (MAP material classified as pharmaceutical plants, in 2013), and six of the top twenty exporters (Germany, Poland, Spain, Bulgaria, Albania, France) (Lange (2006), updated from UN (2014); UN COMTRADE Database, commodity group HS 1211). Lange (2006) observed that:

- The majority of internationally traded MAPs are raw or semi-processed and of wild origin
- Source countries export mainly raw plant material, often of wild origin
- Processing (value-added) primarily occurs in consumer countries and trade centres

Just three percent of the world's well-documented medicinal flora has been evaluated for global conservation status by 2010, and the proportion of medicinal plants flora considered to be threatened appeared to have remained relatively stable (c.40% to 45%) between 1997 and 2008 (Biodiversity Indicators Partnership 2010). This high level of threat (in contrast to the low level of threat found in this assessment) and apparent stability may however be an artefact of a number of variables, not least that prior to 2008 (Temple and Terry 2007, with the majority of assessments published on the Red List the following year), the taxa assessed for the IUCN Red List were biased towards known-to-be-threatened species, whereas current global and regional assessments undertaken by IUCN and Red List partners are providing a more balanced evaluation of whole groups of taxa or regional floras.

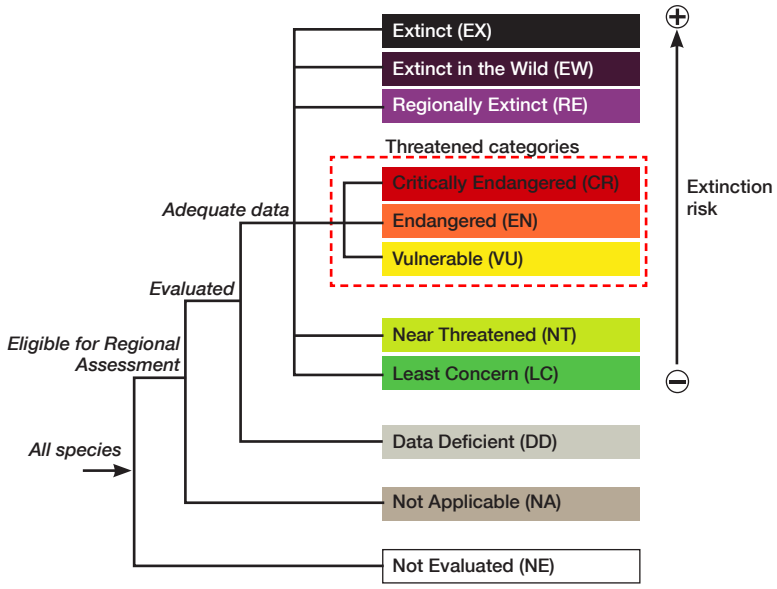
1.3 Species threat status

The Red List status of taxa is one of the most widely used indicators for assessing the condition of ecosystems and their biodiversity. It also provides an important tool in establishing priorities for species conservation. At the global scale, the primary source of information on the conservation status of plants and animals is The IUCN Red List of Threatened Species™ (www.iucnredlist.org) (hereafter referred to as the IUCN Red List), whilst numerous national Red List initiatives within the European region include many more plant species and often contain a wealth of additional information. The IUCN Red List Categories and Criteria are designed to determine a taxon's relative risk of extinction, with the main purpose of cataloguing and highlighting those taxa that are facing a higher risk of extinction. The IUCN Red List provides taxonomic, distribution, ecological, threat and conservation status information on taxa that have been evaluated using the *IUCN Red List Categories and Criteria* (IUCN 2012a). The IUCN Red List Categories (Figure 3) are based on a set of quantitative criteria linked to population trends, population size and structure, and geographic range. There are nine categories, ranging from Not Evaluated (NE), where a species has not been evaluated against the Red List Criteria, Least Concern (LC), for species that are not threatened, and to Extinct (EX), for species that have disappeared from the planet[1]. Species classified as Vulnerable (VU), Endangered (EN) and Critically Endangered (CR) are classed as 'threatened'. 'Near Threatened' (NT) species are considered to be close to meeting the threshold for a threatened category, and they may be considered 'conservation dependent', reliant on specific conservation actions to maintain, for example, sub-populations.

When conducting regional or national assessments, applying the Red List Regional Guidelines (IUCN 2012b) two additional categories are used: Regionally Extinct (extinct within the geographical region of the assessment), and Not Applicable (NA), for non-native species or omitted for other predefined reasons. For further information on the application of the global and regional criteria see section 2.1: Assessment methodology.

1 For a description of each of the global IUCN Red List Categories go to: http://www.iucnredlist.org/technical-documents/categories-and-criteria/2001-categories-criteria#categories

Figure 3. The IUCN Red List Categories at the regional scale (IUCN 2012b).



The extinction risk of a taxon may be assessed at any scale from global, to regional, national or even sub-national level. A taxon can have a different category in the global IUCN Red List than in a regional Red List. For example, a taxon that is common worldwide and assessed as Least Concern (LC) in the Global Red List could face a high level of threat and meet the threshold for the Endangered (EN) category in a particular region (see Figure 1 for the IUCN categories). In order to avoid an over- or under-estimation of the regional extinction risk of a taxon, the *Guidelines for Application of IUCN Red List Criteria at Regional and National Levels* (IUCN 2012b) should be applied. Logically, a taxon that is endemic to a particular sub-global region should have the same category at regional and at global level, as it is not present in any other part of the world.

1.4 Objectives of the assessment

This European regional assessment had five main objectives:

- To contribute to regional conservation planning through the provision of a baseline dataset reporting the status of selected European medicinal plants.
- To identify those geographic areas and habitats needing to be conserved to prevent extinctions and to ensure that European medicinal plants reach and maintain a Favourable Conservation Status.
- To identify the major threats and to propose mitigating measures and conservation actions to address them.
- To support efforts to conserve plant diversity through illustrating the value of plants to people.
- To strengthen the network of experts focused on conservation of medicinal plants in Europe so that the assessment information can be kept current and expertise can be targeted to address the highest conservation priorities.

The assessment provides three main outputs:

- This summary report on the status and distribution of selected European medicinal plants; their main threats and recommendations for conservation measures, as well as a poster on their status.
- A freely available database holding the baseline data for monitoring the status and distribution of European medicinal plants.
- A website and data portal showcasing these data in the form of species factsheets for all European plants that were assessed, along with background and other interpretative material. (http://ec.europa.eu/environment/nature/conservation/species/redlist and http://www.iucnredlist.org/initiatives/europe).

The data presented in this report provide a snapshot based on the knowledge available at the time of writing the report and the compilation of the individual assessments. All assessments included in this project are available through the above portals. IUCN will ensure wide dissemination of this data to relevant decision makers, NGOs and scientists to inform the implementation of conservation actions on the ground.

Hierba de la sangre *Sideritis glacialis* (LC) is restricted to higher altitudes (1,500 to 3,250 m) in southern and eastern Spain. It is not considered threatened at present, however it could be vulnerable to disturbance and further research should be undertaken. © Peter M. Greenwood

Gypsophila perfoliata

Photograph by kind permission of A. Lyubchenko

Within the EU 27 region this perennial herb is considered native to Bulgaria and Romania near the Black Sea coast and is an example of a species which is at the edge of its range in Europe. Its range extends eastwards into the Russian Federation (Sea of Azov, lower Don and lower Volga and trans-Volga areas) providing connectivity to a range which extends further eastwards into temperate Asia (Marhold 2011, USDA 2012).

At present in Romania, it is considered to be Vulnerable (Doroftei *et al.* 2011) and it is a protected species in Bulgaria where it is considered to be Endangered (Petrova and Vladimirov 2009). Sub-populations are said to be small at several sites, but sub-populations in the area of Varnensko Lake and south of Zelenka Cape are more numerous (more than 500 individuals). This plant contains chemical compounds such as saponins, alkaloids, phenol carboxylic acids and flavonoids (Rahman 2002, Healing Herbs 2007). Powder derived from the roots is used for wound healing. Formulations from the stems, flowers and fruits are reported to have a bactericidal effect (Healing Herbs 2007). The impact of collection for medicinal use is unknown for the European population of this plant.

Threats to this species in Bulgaria include infrastructure and tourist developments and hydrological changes. Flowers are also picked for sale in the Varna town area (Petrova 2014). Tourist development is a threat to its sandy coastal habitat in the Crimean Peninsula (Drescher *et al.* 2007). In the Ukraine up to 88% of the steppe has been converted for agricultural use (Goriup 1998), which may have caused a loss of habitat, although this species is sometimes known to occur in arable areas.

The species occurs in three Natura 2000 sites in Bulgaria (Pomerie, Besaparski Vazvishenia and Aheloy-Ravda-Nesebar; EUNIS 2010). Most of its localities in Bulgaria are in protected areas, such as the Kaliakra Strict Nature Reserve, Atanasovsko Ezero Strict Nature Reserve, Pomoriiski Solnitsi and Poda Protected Sites (Petrova 2014). It is also listed as a species of the Danube Delta Biosphere Reserve in Romania.

Conservation measures recommended include enforcement of regulations for protected areas and prevention of wild collecting and also raising awareness of the threatened status of this species with flower traders and developers (Petrova 2014).

It is considered to be Near Threatened in the EU27 and Europe as a whole. The records of this species, when mapped, give an extent of occurrence which exceeds the values needed for a threatened category. However, it is suspected that the area of occupancy is less than or approaches the threshold for a threatened category, for example in Bulgaria it is thought to be less than 10 km^2. Sub-populations occur mainly in a narrow coastal area along the Black Sea, but they are suspected not to be severely fragmented, particularly as this species is noted to be able to colonise railway lines which may provide connectivity between areas. However, populations may still decline as these could be considered edge of range satellite populations and subject to demographic stochasticity (Hanski 1982) and threats leading to a decline in the extent and quality of habitat are noted. Further surveys are needed to confirm the current area of occupancy and monitoring is necessary to detect and enumerate declines or indeed any extension of range, if the spread of this species is enabled by man made communication corridors in the form of railway line habitat.

Chimaphila umbellata

This woody, evergreen, perennial herb or low shrub is found in coniferous woods, often on sandy or clay soils, and occasionally in deciduous woods. The species reproduces both by seed and clonally by creeping subterranean rhizomes. Although it is noted to occur in many European countries and its distribution is circumpolar (extending from Scandinavia, central and Eastern Europe eastwards in a narrowing belt to Japan, and throughout much of North America (GRIN 2014)) it is an example of a species which has suffered significant population declines in Europe.

This species is considered to be Endangered in many countries within its range, for example, Slovakia, Hungary and Ukraine. In Germany it is reported to have suffered very strong declines and has been found growing at only a few sites and even there tends to be highly at risk (Ahlmer 2010). It is considered critically threatened in the Czech Republic where at least 90% of the populations recorded have become extinct and those that are extant are declining (Grulich 2012). The species is considered extirpated from France (IUCN France, FCBN and MNHN 2012) and in Switzerland was last recorded in the wild in the 1980s and a reintroduction attempt was unsuccessful (Moser 1999, Moser *et al.* 2002, NERI 2007, M. Jutzi pers. comm. 2014). In Sweden the number of mature individuals is estimated to be 15,000 (10,000 to 30,000) but with a rate of decline amounting to 50 (30-60)% in the last 80 years (ArtDatabanken 2010) and it is listed as Endangered. The population has declined sharply in Norway and is absent from many former areas, and remaining populations are often small (Artsdatabanken 2010) and it is considered Endangered on the basis of decline in area of occupancy (Kålås *et al.* 2010). It changed categories from Least Concern to Near Threatened in Finland between 2000 and 2010 (Kalliovirta *et al.* 2010) and it is also considered Near Threatened in Denmark.

This plant contains chemicals which have a pronounced disinfectant effect within the urinary tract. It contains compounds such as arbutin, sitosterol and ursolic acid and also contains glycosides and an essential oil that are used as an astringent and tonic widely promoted in the Russian Federation and elsewhere for a range of medicinal uses, including in herbal and homeopathic preparations. Although the scale and impact of collection from the wild, for medicinal use, is unknown, it is not thought to be the main cause of decline within much of Europe.

Recruitment studies (Johansson and Eriksson 2013) suggest that the species is 'microsite limited', i.e. there is a lack of suitable sites for it to establish into. A study (Johansson *et al.* 2014 cited in Lundell 2014) of a similar species (*Pyrola chlorantha*) found that 82.5% of the seeds were dispersed within one metre from the source, and 95.7% were dispersed within five metres making re-colonisation of fragmented forest areas less likely. The seeds are very small and have very little endosperm: culture is therefore very difficult (Moser 1999), and may require bare soil for germination (Ericson *et al.* 1997). In addition ongoing studies (V. Johansson submitted manuscript) suggest that the species, in contrast to most other species in the tribe Pyroleae, is fully autotrophic as an adult (the others are mixotrophic, i.e. partly utilise fungi as carbon source), suggesting that the species may be unusually sensitive to shade and to competition from other ground-layer plants (*Vaccinium* spp., grasses, *Picea abies* (Salmia 2011)). Based on the examination of local, still existing, sub-populations of the species in Sweden many, perhaps most, sub-populations are 'remnant' populations, no longer reproducing due to environmental conditions such as dense shade (Lundell 2014).

A major problem for this species is not just that historic 'primary' forest cover has declined greatly or disappeared, but also that forest management regimes have changed, leading to less favourable site conditions. Previously (i.e. until the early-mid 20th century) forests were kept semi-open by selective cutting, grazing, and other management practices. During the last 50-100 years, forestry management has both changed and declined (with

management ceasing in many woodlands and forests or dense plantations favoured), creating even-aged and much more shady forests. At one former site in Switzerland, dense shading from spruce reforestation is believed to be the cause of extinction (Moser 1999, Moser *et al.* 2002). In addition, due to eutrophication, the ground-layer may become more productive leading to out-competing by other species. In parts of central Europe, widespread pollution by nitrogen emissions from industry have been cited as a cause of decline (M. Scheuerer pers. comm. 2014).

Global Forest Change Landsat analysis illustrates considerable losses of forest cover within the range of this species between 2000 and 2012 alone (Hansen *et al.* 2013). For example, in the Carpathian forests, where this species is considered Endangered, forest loss has resulted from intensive logging (especially with clear-cut forest practices), development of large ski resorts and tourist centres and motorways (Perzanowski and Jerzy 2001). This species has also been found to have a very low resistance to disturbance such as trampling and burning (Matthews 1994).

Photograph by kind permission A. Lundell

Extrapolating from the known population declines in some areas and the suspected habitat losses it is inferred there has been an overall population reduction in Europe sufficient to meet the values needed for a threatened category under criterion A and it is considered Vulnerable to extinction.

2. Assessment methodology

2.1 Geographic scope

The geographical scope of this assessment is continent-wide, extending from Iceland in the west to the Urals in the east (including European parts of the Russian Federation), and from Franz Josef Land (Russian Federation) in the north to the Mediterranean in the south (Figure 1). Parts of Macaronesia (Canary Islands, Madeira and the Azores) were included. In the southeast, the Caucasus region was excluded.

Red List assessments were made at two regional levels: 1) for continental Europe ('pan Europe'; limits described above); and 2) for the area of the 27 Member States of the European Union (EU 27).

2.2 Global and regional assessments

Taxa that were determined to be endemic (native and restricted) to pan Europe, were assessed at the global scale and their assessments submitted to the IUCN Red List. Taxa that did not have a native distribution restricted to pan Europe were assessed at the two scales described above (i.e., pan Europe and EU 27).

Taxa were included in the assessment if they are native or considered introduced prior to 1500, and therefore considered an archaeophyte following Preston *et al.* (2004).

2.3 Taxonomic scope

The aim of the project was to assess approximately four hundred plants native (or naturalised prior to 1500) to Europe with known medicinal applications. A small number of subspecies were assessed, but only one was included in the analyses as the others were represented at the species level. The process for developing the list is outlined in section 3.2.

The taxonomic validity of taxa proposed for inclusion was checked against the established taxonomic references for plants accepted by the IUCN Red List; the *World Checklist of Selected Plant Families* (WCSP 2014) was the primary resource followed, with *Euro+Med Plantbase* (2006-2011) and *The Plant List* (2014) consulted and followed in some cases. Expert opinion from botanists familiar with individual taxa informed some taxonomic decisions.

2.4 Assessment protocol

Following production of the list of taxa for inclusion in the project, taxa were assigned to assessors. The majority of the species assessed through this project were produced by consultants (Sonia Khela, Helen Chadburn, Fabian Schweizer and Eglantine Chapuis), who were contracted to draft species assessments and produce distribution maps. A number of taxa were assessed by IUCN staff or by individual experts with personal knowledge of the species (especially in the case of narrow-range endemic taxa). Assessment data were compiled using IUCN's *Species Information Service* (SIS), a web-based database that compiles textual and numerical data, and allows for the coding of threats, habitat and ecological requirements, and conservation and research actions, using established classification schemes (www.iucnredlist.org/technical-documents/classification-schemes).

Assessors compiled the following information for each taxon, using personal knowledge, herbaria records, and published and unpublished data:

- Taxonomic classification
- Geographic range (including distribution map)
- Medicinal and others uses of the plant
- Population data and overall population trend
- Major threats
- Habitat preferences
- Conservation measures
- Red List Category and Criteria
- Primary ecological requirements
- Other general information
- Key literature

A wide range of national floras were consulted, as well as internet based resources (e.g., Anthos (2014; Spain), Association Tela Botanica (2014; France), and GBIF (2014; global scope). National Red Lists, where they exist, were also consulted e.g., Sweden (ArtDatabanken 2010), Switzerland (Info Flora 1994-2012, Moser *et al.* 2002) and Norway (Kålås *et al.* 2010).

Pheasant's Eye *Adonis vernalis* (LC) is widespread in southern, central and eastern Europe. It has a range of medicinal uses, however it is primarily collected from the wild and inappropriate harvesting can harm populations. Pictured here from the Pálava Protected Landscape Area in the Czech Republic. © Dana Turoňová / Nature Conservation Agency of the Czech Republic

2.5 Methodology for spatial analyses

Digital distribution maps were created using distribution data collated from available literature, internet sources, and the *Atlas Flora Europaeae* (Kurtto *et al.* 2013). The data varied immensely in terms of quantity and quality. For some countries (and for some species), including Spain, France, Bulgaria, Sweden and Switzerland, distributions were available as either point location data (latitude/longitude) or in grid cell format and are therefore very precise. Where point or grid data were available, data were projected in a Geographical Information System (GIS) (ESRI ArcMap) and polygons drawn manually, clustering points where appropriate. For some countries it was only determined that the species is extant in that country and therefore the distribution was mapped to the whole country (e.g. Romania and, in other cases, the countries of former Yugoslavia), whilst in some cases data were only available at the subnational level and a taxon was mapped to the appropriate administrative unit (e.g. regions in Italy). Depending on information availability, metadata coding was used to distinguish presence, origin, and seasonality across the spatial extent of a species' distribution. These codes differentiate the species presence (species are recorded as extant, possibly extant or extinct); seasonal presence of the species in the location (the default setting of 'resident' was assigned); and the origin of the species (native, introduced, reintroduced or uncertain). The coding information can be found in the Red List digital distribution metadata guidance (IUCN 2014).

In the analysis of the spatial data, only distributions with the following Presence, Seasonal and Origin codes were used:

- Presence: Extant and Possibly Extant
- Origin: Native and Re-introduced
- Seasonality: Resident

Spatial data were analysed using a geodesic discrete global grid system, defined on an icosahedron and projected to the sphere using the inverse Icosahedral Snyder Equal Area (ISEA) Projection (S39). This corresponds to a hexagonal grid composed of individual units (cells) that retain their shape and area (865 km^2) throughout the globe. These are more suitable for a range of ecological applications than the most commonly used rectangular grids (S40). The range of each species was converted to a hexagonal grid for analysis purposes. Coastal cells were clipped to the coastline. The pattern of overall species richness (Figure 5) was mapped by counting the number of species in each cell (or cell section, for species with a coastal distribution). Patterns of threatened species richness (Figure 6) were mapped by counting the number of threatened species (categories CR, EN, VU at the European regional level) in each cell or cell section. The pattern of endemic species richness was mapped by counting the number of species in each cell (or cell section for coastal species) that were flagged as being endemic to geographic Europe as defined in this study (Figure 7). Finally, the distribution of species assessed as Data Deficient is shown in Figure 8.

2.6 Review and evaluation of the assessments

Given the relatively small number of species included in this assessment, the methodology differed slightly from recent European Red List assessments (e.g., Bilz *et al.* 2011) in not having an assessment review workshop. Instead, assessments were reviewed by relevant Species Survival Commission (SSC) Specialist Groups. On receipt of the draft assessments from consultants, the data were edited and reviewed by IUCN staff, with any questions resolved through communications with the assessors. Additional review and contributions were sought in many cases from individual botanists and from Specialist Groups (the Medicinal Plant Specialist Group (MPSG), the Carnivorous Plant Specialist Group, the Conifer Specialist Group, the Crop Wild Relative Specialist Group, the Freshwater Plant Specialist Group,

the Global Tree Specialist Group, the Macaronesian Island Plant Specialist Group, the Mediterranean Plant Specialist Group, and the Orchid Specialist Group). Finally, consistency in the application of the global and regional IUCN Criteria and Guidelines was checked by IUCN staff from the IUCN Red List Unit, and all global assessments and the majority of regional assessments were then reviewed by the MPSG, the Red List Authority (RLA) for medicinal plants. Following RLA review, assessments were submitted to the Red List Unit and published over the period 2012-2014.

The resulting IUCN Red List assessments are a product of scientific consensus concerning species status and are backed by relevant literature and data sources.

Arnica montana is considered endemic to Europe, where it is relatively widespread. It is a very commonly used medicinal plant and in some countries it is protected or appears on national Red Lists, and it is protected by European legislation. Pictured here from the Šumava National Park in the Czech Republic. © Dana Turoňová / Nature Conservation Agency of the Czech Republic

Rhodiola rosea

This is a perennial succulent plant found in meadows, grassland, coastal cliffs, on mountain rocks and screes, on both acid substrates and limestone from 0 to 3,000 m asl. It has a thick almost tuberous rootstock. In Europe it is found in Iceland, Scandinavia, Ireland, the United Kingdom, through central Europe into the Russian Federation and the Balkan Peninsula and also in France and Spain (Royal Botanical Garden Edinburgh 1998, Marhold 2011, GRIN 2014). Although not considered threatened at present this is a species in which medicinal use is increasing with impacts on wild populations. The leaves, roots and stems can all be eaten raw or cooked and when dried have a rose scent. The species has been used in folk medicine for washing the hair with its pleasant scent and supposed conditioning properties (Galambosi 2006). It has been used in traditional medicine as a tonic and to enhance endurance. Recent research has shown that it increases the body's resistance to stress by regulating hormonal responses. It has a protective effect on neurotransmitters such as serotonin and dopamine. Studies have shown that use of this herb can increase brain serotonin by up to 30% (Plants for a Future 2014). There are other suggested medicinal uses, such as in treatments for depression, some heart disorders and high cholesterol levels. Some consider it may be useful for treating a range of other disorders from cancer, tuberculosis, and diabetes to cold prevention, enhancing immunity and treating liver damage and even improving hearing (WebMD 2014). The chemical composition of the plant has been intensively investigated and many secondary metabolites have been identified within the chemical group of phenols. Cinnamic glycosides, such as rosin, rosavin, and rosarin, are considered the major group responsible for most of the pharmacological activities (Platikanova and Evstatieva 2008). Its medicinal use has increased worldwide (Galambosi 2006).

The growing demand and the high price paid for plant material is increasing pressure on this species. As a result it has become a threatened plant in the Russian Federation, the Czech Republic (Grulich 2012), Slovakia (Ferakova *et al.* 2001) and Bosnia and Herzegovina (Platikanova and Evstatieva 2008). In Bulgaria, it is included in the Law of Biodiversity and its collection is forbidden. In the Bulgarian Red List it is assessed as Critically Endangered due to population reduction from actual or potential levels of exploitation and a decline in the area of occupancy, number of locations or sub-populations (Petrova and Vladimirov 2009). It is not assessed in the Scandinavian countries but commercial quantities are collected in Norway for the manufacture of new products, and Norwegian scientists working with this species have received requests to facilitate deliveries of several tons of the root harvested from natural populations. It is under less threat from collection in some mountain areas of Europe as the difficulties of collection in such terrain make it less economic (Galambosi 2006).

Photograph: Peter A. Mansfeld / Flickr Creative Commons Licence

Cultivation could reduce collection pressure on wild populations, although this has been found difficult outside mountain areas further south because of climatic differences. However, it has been successfully introduced as a commercial crop in the Rhodopes Mountains in Bulgaria, propagated by rhizome cuttings (Platikanova and Evstatieva 2008). Further research is needed since cultivation seems to be the only hope of producing raw material in sufficient quantities for the industrial scale production demanded (Galambosi 2006).

3. The status and distribution of medicinal plants in Europe

3.1 Introduction

The vascular plants (phylum: Tracheophyta) selected for inclusion in this assessment represent 89 families in 46 orders from the following classes;

Equisetopsida	Magnoliopsida
Gnetopsida	Pinopsida
Liliopsida	Polypodiopsida
Lycopodiopsida	Psilotopsida

The plants occupy a wide range of habitat types, representing a wide range of growth forms, including large trees (e.g., *Betula pubescens, Castanea sativa*, and *Quercus frainetto*), aquatic plants (*Oenanthe aquatica, Trapa natans*) and epiphytes (*Viscum album, Chrysosplenium alternifolium*).

The plants identified for this assessment include more than 50 taxa that are listed under European or international policy instruments (see Bilz *et al.* 2011);

- EU Habitats Directive (Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora)
- EU Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention)
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)
- EU Wildlife Trade Regulation (Council Regulation (EC) No 338/97 of 9 December 1996 on the protection of species of wild fauna and flora by regulating trade therein)

An example of how inclusion in legislation and in Red Lists is can drive conservation action is Manzilla de Sierra Nevada *Artemisia granatensis* (EN), which has attracted EU LIFE funding and has a species recovery plan in place (Heywood 2014). The plant occurs within the protected area *Parque Nacional de Sierra Nevada*, a Category V IUCN protected area, where a recovery programme has been established, and *in vitro* cultivation has been developed (Hernández-Bermejo *et al.* 2013).

3.2 Species selection

The requirement for this project was to assess the IUCN Red List status of plants with documented medicinal use that are native to continental Europe. Many plant species used in medicine are also used for other purposes. In compiling the GCL-MP and the European checklist, the term 'medicinal plant' has been understood in a wider sense to include overlapping uses as herbal teas, spices, food, dietary supplements, and cosmetics.

For this project, selection for assessment within the regional sub-set identified prioritized species from the following resources;

- Global Checklist of Medicinal Plants (GCL-MP)
- WHO monographs on selected medicinal plants (WHO 1999, 2007a,b, 2009, 2010)
- FairWild Standard certification applications[2]
- International trade review (Lange 1998)
- Traditional Health Products Directive (EMA 1995-2014)
- European Pharmacopoeia (EDQM 2007)

The draft list compiled through the above process (1,088 plants) was then filtered according to Tutin *et al.* (1964-1980) to identify species present in Europe (469 plants), and then reviewed to remove non-native species. The resulting list of priority taxa was then reviewed against a range of references including Schippmann (2013), Euro+Med (2006-2011), The Plant List (2014), and WCSP (2014) for taxonomy, use and distribution. The final list contained 407 European medicinal plant taxa. Of these, 80 taxa had recently (2010-12) been assessed through the European Red List of Vascular Plants project (Bilz *et al.* 2011), which applied the same geographical focus and methodology as this assessment. Two species (*Quercus infectoria* and *Rheum rhaponticum*) were included in the list of taxa to be assessed but their assessments could not be finalized as consensus could not be reached regarding their identity. Five subspecies (*Centaurium erythraea* subsp. *suffruticosum*, *Erodium foetidum* subsp. *foetidum*, *Origanum vulgare* subsp. *virens, Salvia officinalis*

2 FairWild Foundation (www.FairWild.org); D. Leaman pers. comm. 2012.

subsp. *lavandulifolia* and *Teucrium eriocephalum* subsp. *almeriense*) were assessed but were included in the analyses at the species level. These exclusions resulted in 400 taxa being included in the analyses shown in subsequent chapters.

3.3 Conservation status of selected European medicinal plants

Of the 400 medicinal plants for which regional assessments were undertaken, one was considered Not Applicable (NA) at the EU 27 regional scale (*Cypripedium guttatum*) as its range extends eastwards from European parts of Russia (with unconfirmed records from Belarus and Ukraine). The status of the remaining taxa were assessed at two regional scales (Table 2, Figure 1): pan Europe (400 species) and for the EU 27 (399 species). None of the assessed plants were considered Extinct (EX) or Regionally Extinct (RE). At the pan Europe level, nine plants (2.4% of extant species for which sufficient data are available) were assessed as threatened. Twenty five species were assessed as Data Deficient (DD), and IUCN guidelines on reporting the proportion of threatened species (IUCN 2011) suggest approaches to presenting the uncertainty introduced by DD species; it is important to note however, that 25 species were considered Data Deficient (i.e., that there was insufficient information available to assess against the Red List Criteria) and as a result the precise proportion of threatened species is uncertain and could lie between 2.3% (if all DD species are not threatened) and 8.5% (if all DD species are threatened).

	% threat	
Lower bound	2.3	(CR+EN+VU) / (assessed – EX)
Mid-point	2.4	(CR+EN+VU) / (assessed – EX – DD)
Upper bound	8.5	(CR+EN+VU+DD) / (assessed – EX)

The mid-point figure rises very slightly to 2.5% for the EU 27 region, where ten plants were found to be threatened.

A further 18 taxa (4.5%) at the pan Europe level (20 species (5.0%) at the EU 27 level) are considered Near Threatened; most of these are plants whose populations are declining across Europe and may be considered threatened at the national level, but whose population decline does not yet meet the criteria for a threatened category. One example is the Horse Chestnut *Aesculus hippocastanum* which has a wide introduced range in Europe but with a more restricted natural distribution in Greece and the central Balkan Peninsula; it has been impacted across its natural and introduced range by the invasive Horse Chestnut Leaf-miner moth *Cameraria ochridella*.

The Horse Chestnut *Aesculus hippocastanum* is considered Near Threatened as a result of the Horse Chestnut Leaf-miner moth *Cameraria ohridella*. © Scott Nelson

Spotted Lady's Slipper *Cypripedium guttatum* (LC) in the Komi Republic, Russia. This is the only plant included in the project that is not found in the EU 27 region. © UNDP

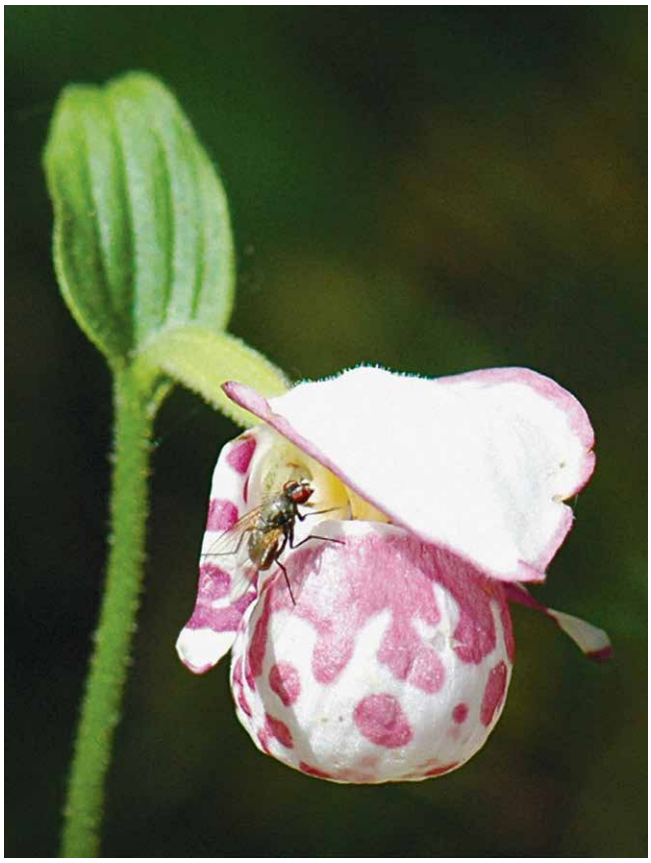
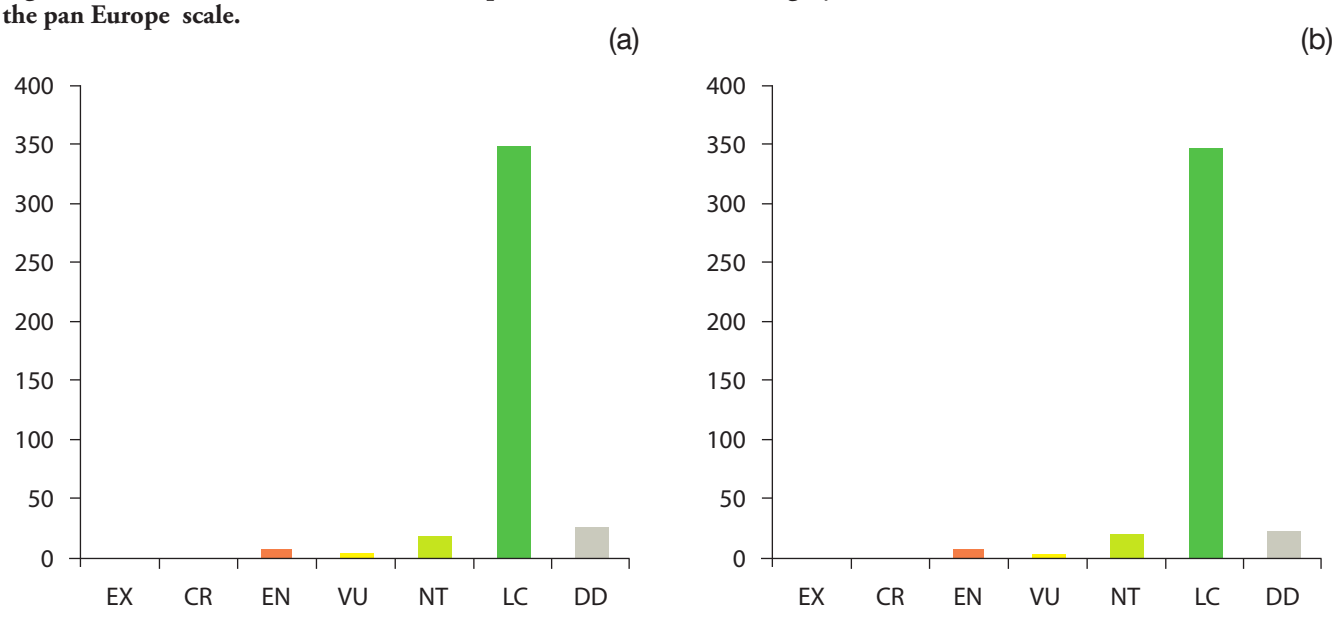


Table 1. Summary of numbers of selected medicinal plants within each Category of threat.

IUCN Red List Category	No. of species Europe (No. of endemic species)	No. of species EU 27 (No. of endemic species)
Extinct (EX)	0	0
Extinct in the Wild (EW)	0	0
Regionally Extinct (RE)	0	0
Critically Endangered (CR)	0	0
Endangered (EN)	6 (3)	7 (2)
Vulnerable (VU)	3 (0)	3 (0)
Near Threatened (NT)	18 (6)	20 (2)
Least Concern (LC)	348 (49)	346 (9)
Data Deficient (DD)	25 (7)	23 (1)
Total number of species assessed	**400 (65)**	**399 (14)**

The highlighted rows (CR, EN, and VU) are the Threatened Red List Categories

Figure 1. The number of assessed medicinal plants in each Red List category at (a) the EU 27 Member State scale, and (b) the pan Europe scale.



The threatened species of medicinal plants assessed though this project are shown in Table 2.

Table 2. Threatened medicinal plants at the pan Europe and EU 27 level.

Family	Taxon	IUCN Red List Category (Europe)	IUCN Red List Category (EU 27)	Endemic to Europe	Endemic to EU 27
Compositae	*Artemisia granatensis*	EN	EN	YES	YES
Cupressaceae	*Tetraclinis articulata*	EN	EN	NO	NO
Labiatae	*Sideritis reverchonii*	EN	EN	YES	YES
Orchidaceae	*Himantoglossum comperianum*	EN	EN	NO	NO
Rosaceae	*Crataegus nigra*	EN	EN	YES	NO
Solanaceae	*Atropa baetica*	EN	EN	NO	NO
Plantaginaceae	*Plantago maxima*	LC	EN	NO	NO
Ericaceae	*Chimaphila umbellata*	VU	VU	NO	NO
Iridaceae	*Iris spuria*	VU	VU	NO	NO
Orchidaceae	*Dactylorhiza iberica*	VU	VU	NO	NO

Giant plantain *Plantago maxima*. Photograph © Le.Loup.Gris. Licensed under Creative Commons Attribution

Giant plantain *Plantago maxima* is an interesting species in that it is considered Least Concern at the pan Europe scale, however it has been assessed as Endangered at the EU 27 scale as it is only recorded from three EU Member States in southeastern Europe; populations have declined in Bulgaria and Hungary and it is considered to be possibly extinct in Romania.

Five subspecies were assessed and published on the Red List but are not included in the above table as they are not represented at the species level. Of these, three are restricted to the Iberian Peninsula and are considered Near Threatened as a result of their restricted range (Table 3).

Table 3. Taxa assessed at both the species and the subspecies level but included in analyses at the species level.

Subspecies	Red List Category	Assessment scope
Centaurium erythraea subsp. *suffruticosum*	DD	Regional assessment
Erodium foetidum subsp. *foetidum*	NT	Global assessment: Endemic to Spain
Origanum vulgare subsp. *virens*	LC	Regional assessment
Salvia officinalis subsp. *lavandulifolia*	LC	Global assessment: Endemic to Spain
Teucrium eriocephalum subsp. *almeriense*	NT	Global assessment: Endemic to Spain

3.4 Spatial distribution of species

3.4.1 Overall species richness

Figure 2 highlights areas of particularly high concentrations of species. Not surprisingly, the highest numbers of species are found in the Mediterranean region, and mountain areas such as the Alps and Pyrenees, the Massif Central in France, and the Balkan Peninsula, with further areas of high richness in the Crimean Peninsula and the Carpathian Mountains (in Romania and western Ukraine).

3.4.2 Distribution of threatened species

The distribution of the nine threatened taxa (those assessed as Endangered or Vulnerable) shows (see Figure 3) some similarities with, but also contrasts to, the overall richness shown in Figure 2.

Caution is required in interpreting this map as it is based on a very small sample size, however it does indicate some interesting trends. The Danube floodplain region of Hungary contains three threatened species (*Chimaphila umbellata* (VU), *Crataegus nigra* (EN), and *Iris spuria* (VU)). The Hungarian Hawthorn *Crataegus nigra* and the Blue Iris *Iris spuria* are both associated with floodplains and alluvial meadows and have been highly impacted by drainage, agricultural conversion and intensification, urbanisation, and (in the case of the iris), by collection of wild plants.

Figure 2. Species richness of selected European medicinal plants.

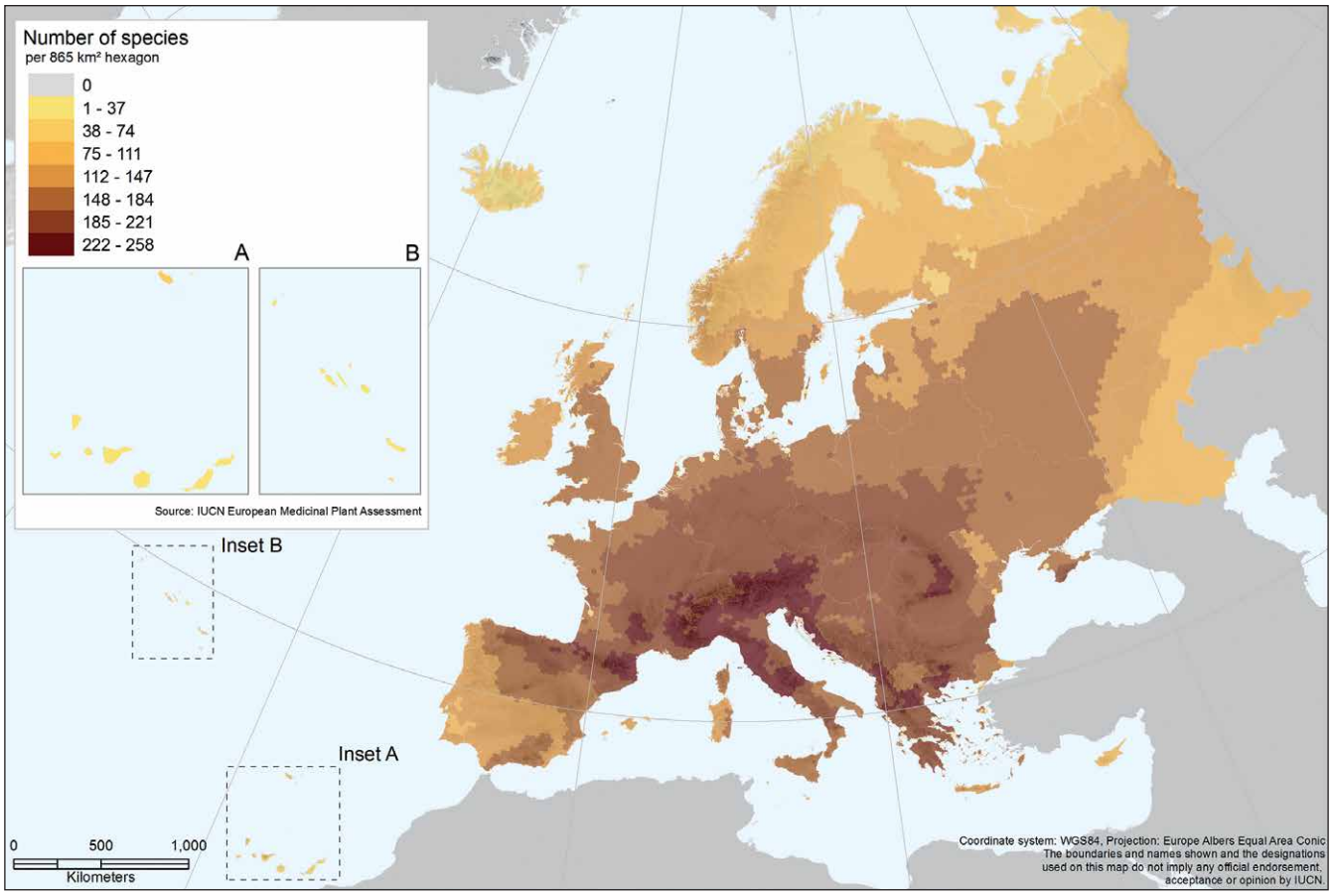
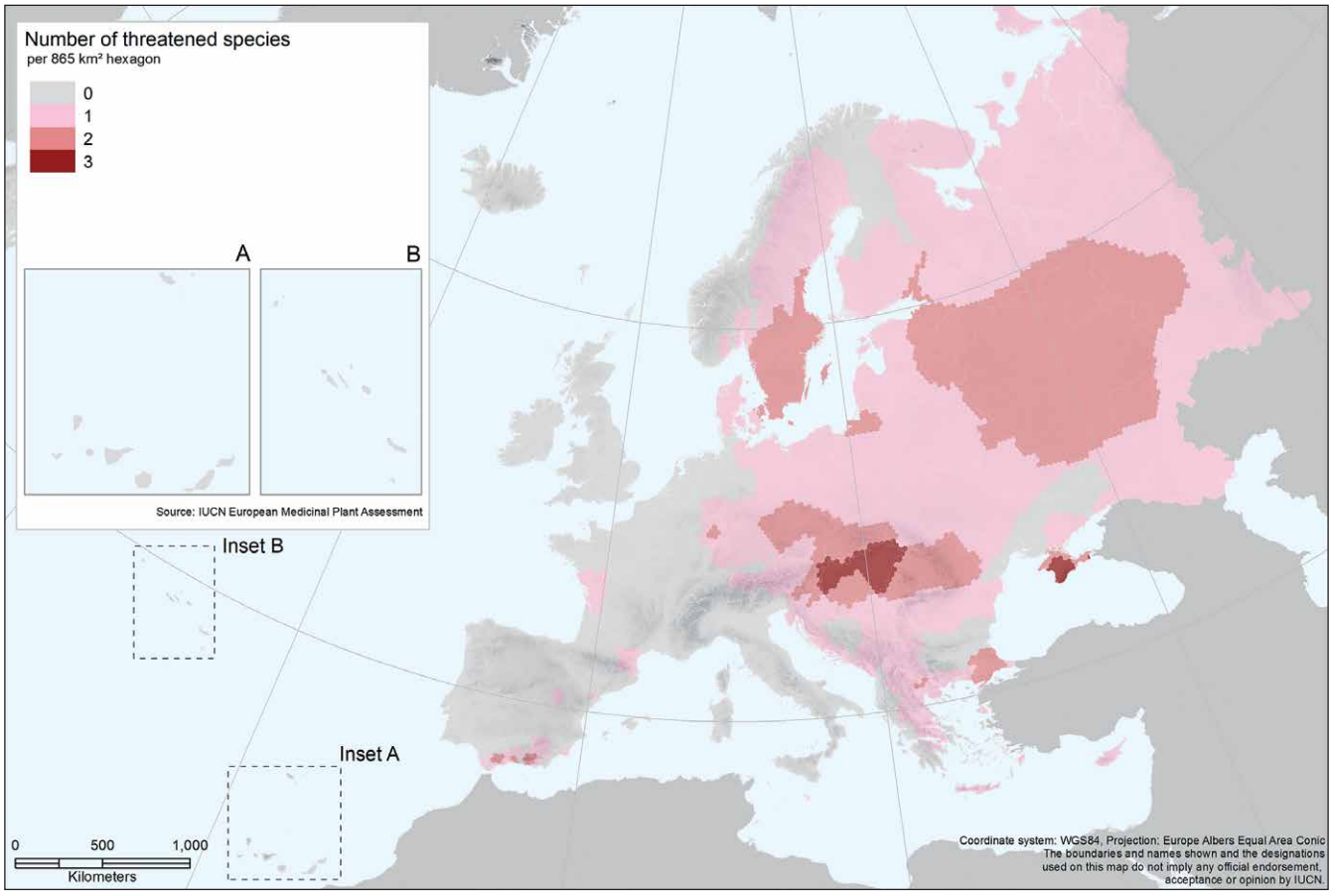


Figure 3. Threatened species richness of selected European medicinal plants.



Iris spuria has been assessed as Vulnerable in Europe as a result of population declines due to habitat loss and degradation. © David Delon

In the Crimea, *Chimaphila umbellata* is again present, together with *Dactylorhiza iberica* (VU) and *Himantoglossum comperianum* (EN). The plants here are impacted by a range of threats including collection from the wild, urbanisation, and habitat loss and degradation primarily from agriculture.

A third concentration of threatened plants is found in the mountains of the southern Iberian Peninsula in Spain, and in contrast to some of the other more widespread threatened species, have more restricted ranges at higher altitudes. *Artemisia granatensis* (EN; altitude range: 2,500 to 3,300 m) and *Sideritis reverchonii* (EN; altitude range: 100 to 1,000 m) are both endemic to the EU 27, whilst *Atropa baetica* (EN; altitude range: 900 to 1,800 m) is non-endemic to the pan Europe region, with a distribution that extends to northern Morocco.

3.4.3 Distribution of endemic species

Sixty five species were found to have distributions restricted to pan Europe, with 25 considered endemic to the EU 27 region (see Appendix 1). This information is presented visually in Figure 4. In common with the results of several other European Red Lists (e.g., vascular plants (Bilz *et al.* 2011)), some of the highest levels of endemism are found in the main mountain chains (Alps, Pyrenees, and through the Balkan Peninsula). In addition, higher levels of endemism are found in the Sierra Nevada in southern Spain, and in the Danube drainage in Hungary.

3.4.4 Distribution of Data Deficient species

Patterns of Data Deficient (DD) species follow those for the overall species richness, i.e., through mountain areas, the Balkan Peninsula, and the northern and southern Iberian Peninsula. Twenty five taxa were identified as

Figure 4. Endemic species richness of selected European medicinal plants.

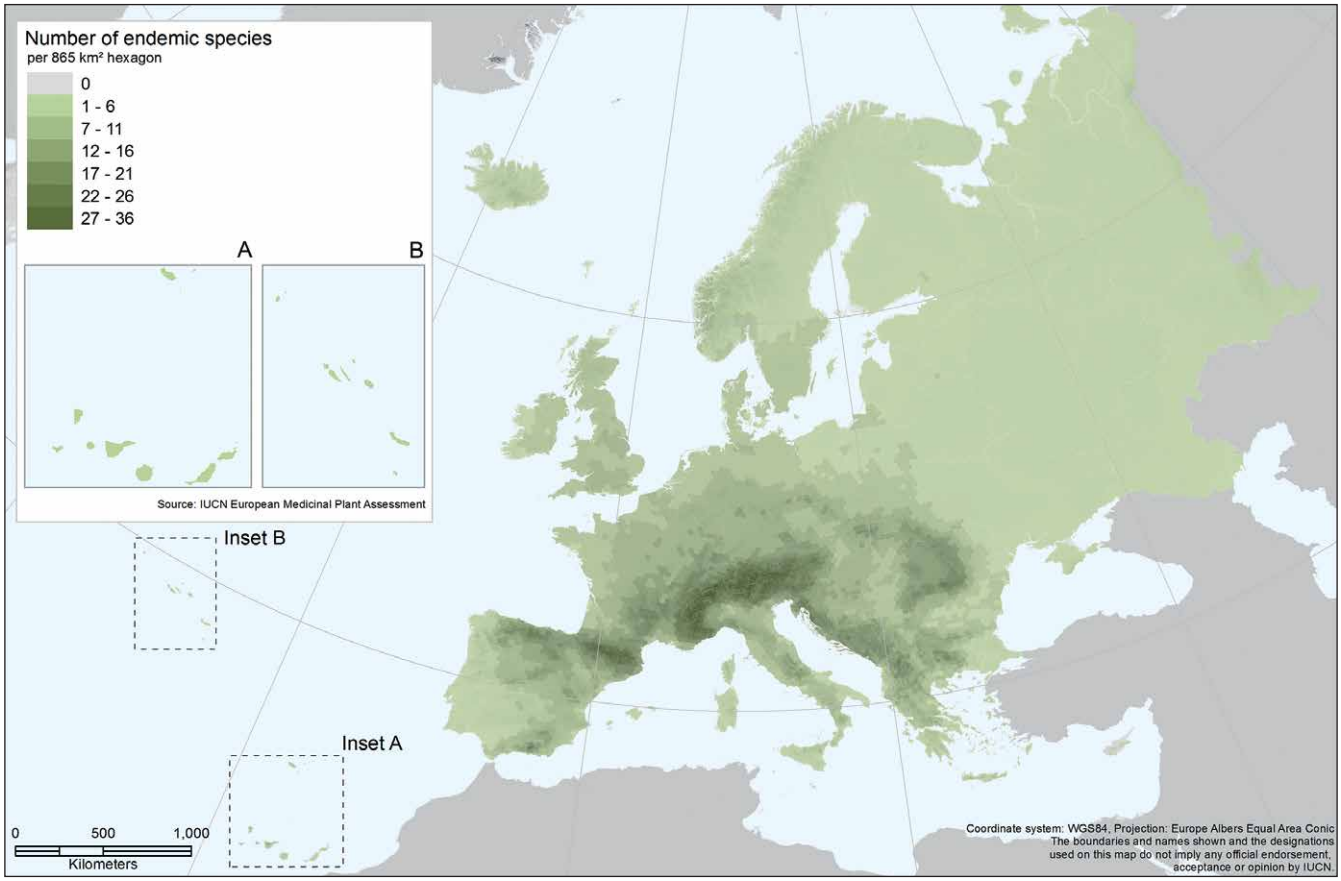
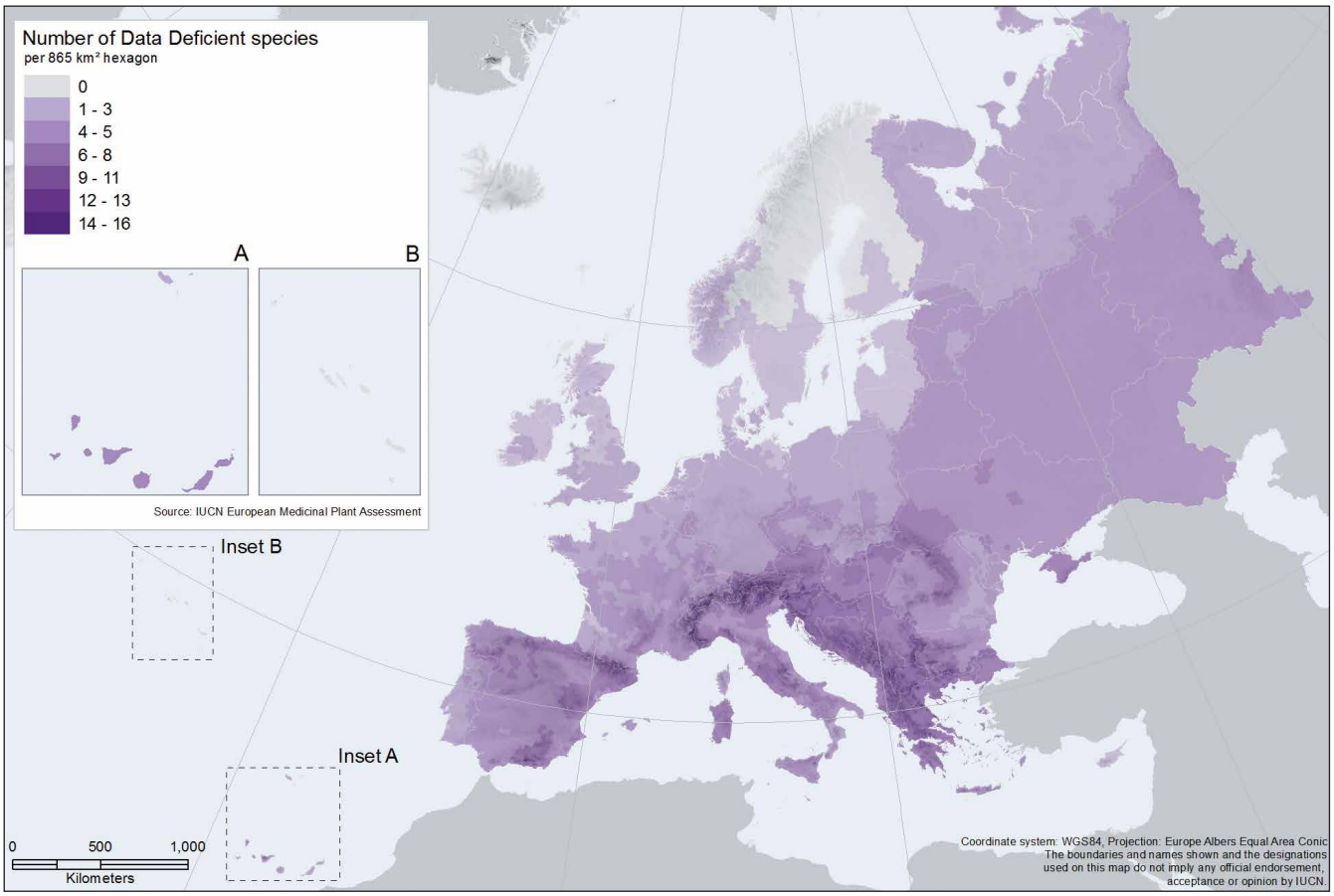


Figure 5. Data Deficient species richness of selected European medicinal plants.



DD at both the pan Europe and EU 27 scales, although only two were identified as endemic to the EU 27 region (*Brassica oleracea* and *Galeopsis segetum*). Several are widespread within the pan Europe region (e.g., *Galeopsis segetum* and *Glechoma hirsuta*), however for many of these plants, population declines have been observed in some countries within their range and there are inadequate data for other parts of their ranges to assign any category other than DD.

3.5 Major threats to medicinal plants in Europe

The major threats to each species were recorded using the IUCN Threats Classification Scheme. A summary of the occurrence of the primary threats identified is shown in Figure 6.

The collection of plants from the wild and loss of habitat through residential and commercial development (including urbanisation, industrialisation, and tourism developments) were identified as the most significant threats, both affecting nearly half (48%) of plants assessed as threatened or Near Threatened (impacting 26% and 30% respectively of all species). Much of this collection is driven by their medicinal value; however collection for the ornamental plant trade and horticulture is significant for some species such as *Anemone halleri* (LC).

Impacts from agriculture (livestock farming, annual and perennial non-timber crops, and plantation forestry) were identified as an important threat to both threatened and Near Threatened (NT, VU, and EN; 67%) and non-threatened (18%) plants, which is consistent with the findings of Bilz *et al.* (2011) for other vascular plants. Such agricultural impacts, together with other threats leading to the landscape changes overall may negatively affect the resilience of both plant populations and habitats, including the resilience to climate change shocks and to wild-harvesting. Chapter 4 discusses a range of measures undertaken in the European region towards the protection of habitats and species.

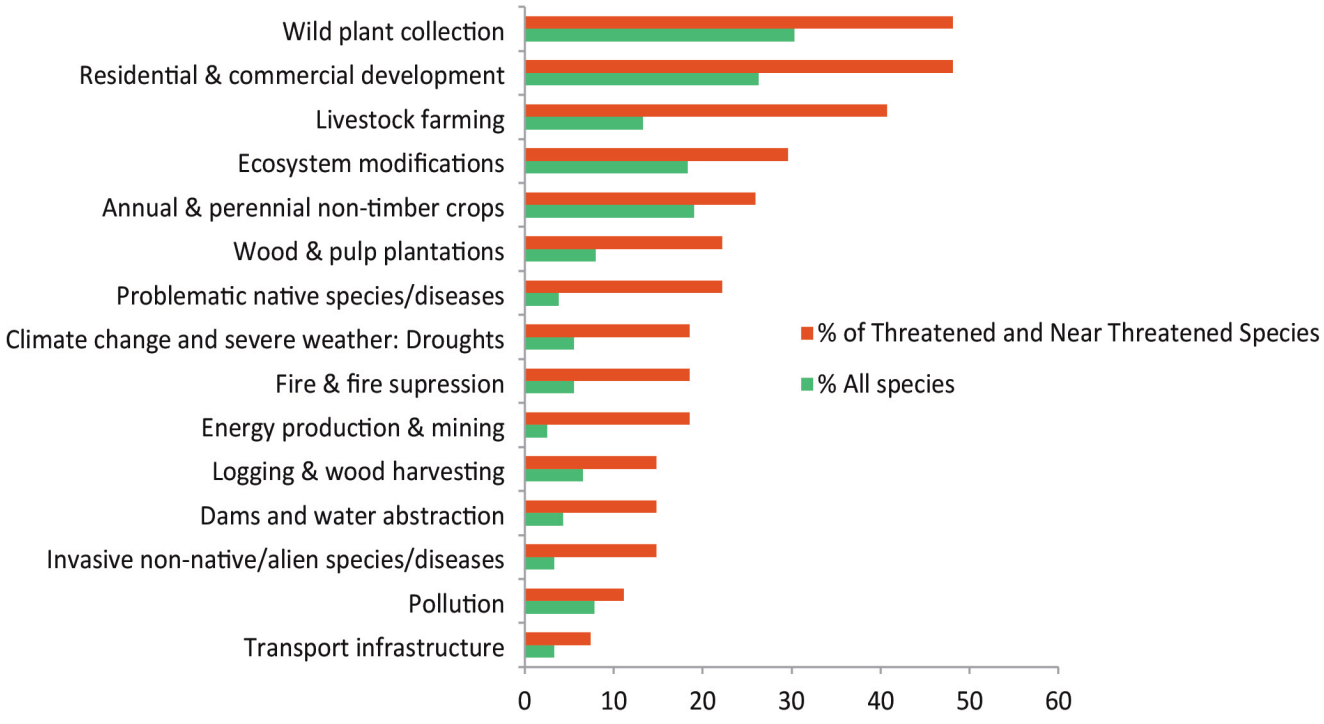
Following the political and economic changes of the 1980-90s, and the collapse of centrally planned economies in central and southeastern Europe (including the change in the provision of collection and purchasing points for wild-collected medicinal plants), coupled with

further urbanisation, the level of wild-collection dropped to a certain extent in the majority of countries that were the most significant source of wild-collected ingredients (Rodina and Timoshyna 2011). However, over 2,000 wild plant species are estimated to be traded commercially in Europe, of which 60-70% are native to central Europe, and over 90% of these species are still collected from the wild (Lange 2004). There is a continuing challenge to ensure that wild-harvesting and trade are sustainable and equitable. It has also been observed, consistent with wild-harvesting activities in other parts of the world, that both the number of collectors and the level of wild plant collection for use and trade, increases in times of economic downturn.

Of the assessed medicinal plant species, 41 are listed in CITES Appendix II, including eight threatened (VU or EN) or Near Threatened species. Pheasant's eye *Adonis vernalis* has been assessed at the regional level as Least Concern, while the international trade in it is regulated. At the same time there is circumstantial evidence of the increased trade in several species of Ironwort or Mountain tea (including *Sideritis scardica* and *Sideritis syriaca*), in southeastern Europe, and additional research into the wild-harvesting and trade of these species is needed. An example of species protected under the EU Habitats Directive as having Unfavourable-Inadequate conservation status in a number of EU habitats (including in Romania, Slovenia, Greece, Bulgaria, Portugal; EIONET 2014), and assessed as Least Concern on European level is Great Yellow Gentian *Gentiana lutea*. With regard to addressing the threat of unsustainable wild plant collection, a number of measures, including legislative and market-based interventions (discussed in Chapter 4) are being employed in Europe, remaining the priority for conservation action.

Hallers Kuhschelle (Haller's anemone) *Anemone halleri* (LC) is widespread in sub-alpine and alpine regions of Europe. © Der Messer / Flickr Creative Commons Licence

Figure 6. Significant threats identified impacting the selected medicinal plants.



3.6 Population trends of medicinal plants in Europe

For the selected medicinal plants, 164 (41.0%) were assessed as having a stable population trend, whilst 125 (31%) were considered to be declining in population size in Europe. More than one quarter (101; 25%) have an unknown population trend and a small part of the group (3%) have increasing populations (Figure 7). As has been stated above, the paucity of data on population trends of taxa across the European region (but especially true for eastern and southeastern parts) has resulted in a number of species being assigned to either the Near Threatened or to the Data Deficient categories.

3.7 End uses of the selected medicinal plants

In compiling the species list used in this European assessment, the term 'medicinal plant' has been understood in a wide sense to include overlapping uses as herbal teas, spices, food, dietary supplements, and cosmetics. 350 plants were determined to have a direct application in human or veterinary medicine (Figure 8), however, all had uses within the above definition, including 150 that were found to be utilised as food for people. Establishing *ex situ* cultivation was also found to be a frequent end use, for both medicinal uses as well as for horticulture and ornamental use.

Figure 7. Population trends of the selected European medicinal plants.

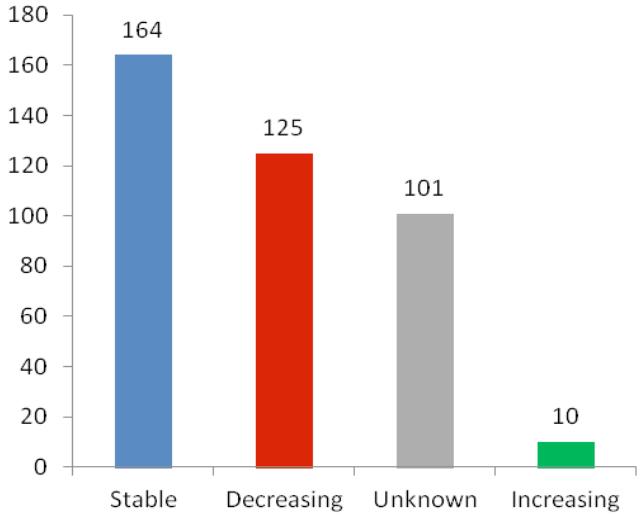
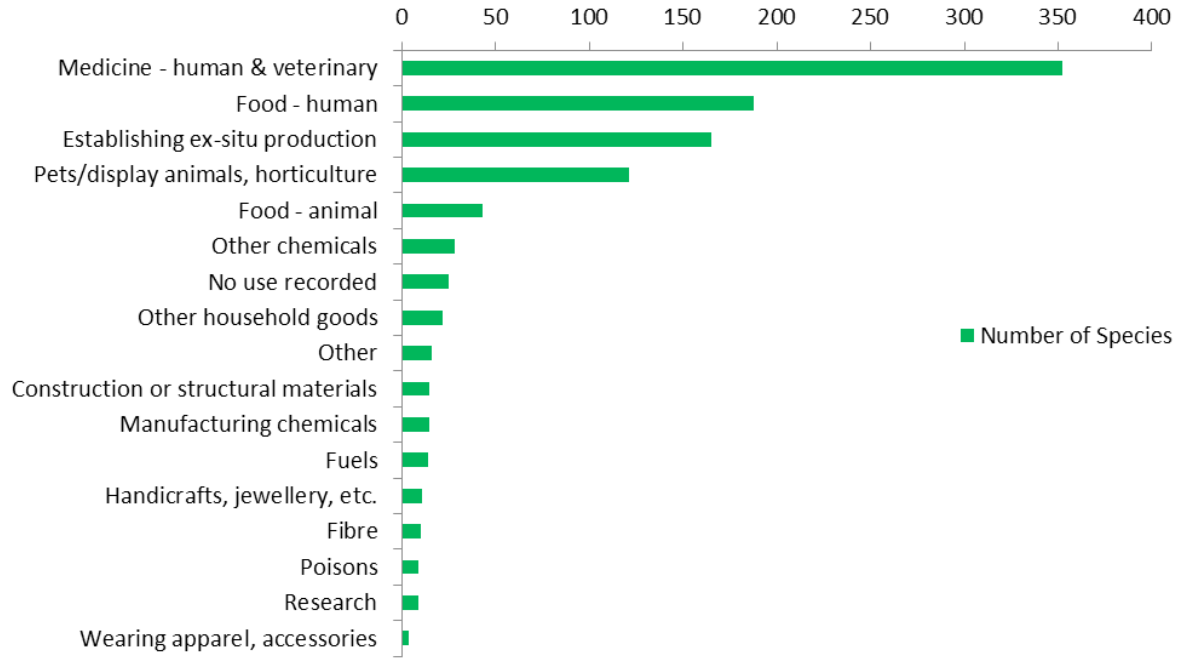


Figure 8. Primary uses identified for the selected medicinal plants



Veratrum album

This is a long-lived robust perennial that grows to a height of 1.5 m and has a sturdy rhizome. It has a large branched spike of numerous flowers which produce nectar and have a strong smell and which are noted to be visited by flies. It grows in alpine and sub-alpine herb communities, in scrub, forests, pastures and hay meadows with a preference for moist conditions. In Europe this plant is found from Turkey through southeastern, east and central Europe to Spain and Portugal in the south. It is also found in northestern Finland and northern Norway (Govaerts 2014, GRIN 2014). It is at the edge of its range here and only known from one locality in Finland. It has a wide altitudinal range but in central Europe is generally found above 800 m (Schaffner *et al.* 2001).

This is an example of a medicinal plant where populations are generally not considered under threat and may even be increasing. Although little numerical data are available for this species it is noted to be quite common and sometimes abundant in many areas (NatureGate 2014). It is even considered an important weed on some grazed mountain grasslands, where preferential grazing of more palatable species may favour its dominance. Farmers may resort to control measures to reduce populations in pastures and hay meadows. It can reach densities of ten plants per square metre and attains pest status in grasslands above 500 m asl in France, Italy, Germany, Austria and Switzerland. It is inferred that the population is very large. Changes in montane grassland management, such as nitrogen inputs and altered grazing and mowing regimes, together with the time and cost involved in weed control, have all acted to favour this species, and the population is suspected to be increasing (Schaffner *et al.* 2001).

This species is cultivated as a garden plant. The pulverised rootstock has been used as an insecticide on currants and gooseberries in Europe and occasionally as an ointment to treat skin diseases such as scabies or to kill lice (Grieve 1931, Keller 2001, Kathe 2003). Grieve (1931) suggests its principal use is in veterinary medicine. Although very poisonous it also has traditional medicinal uses, for example, the roots and rhizomes were used to make medicine to treat epilepsy. The plant contains specific alkaloids which have been used in modern medicine for medication to lower blood pressure but its importance has declined because of poisonous side-effects. If collected, it is mostly from the wild, but it has been locally cultivated in central Europe and parts of Croatia.

Photograph: Nicholas Turland / Flickr Creative Commons Licence

No significant threats to this species have been identified. The survival rate of established plants is very high and it can tolerate repeated disturbance and even the removal of all above ground tissue (Schaffner *et al.* 2001). It is considered to be of Least Concern.

4. Conservation measures

There are extensive conservation efforts focused on plants and their habitats at all scales from the international to the national, and increasingly, market tools are being developed to promote the sustainable use of medicinal plants, with the over-exploitation of wild resources identified here as the primary threat to medicinal plants in Europe, followed by the agricultural impacts and land-use changes affecting habitats and populations

4.1 Protection of habitats and species: international framework

On the international level, the Convention on Biological Diversity (CBD) promotes biodiversity conservation, sustainable use of its components and the equitable sharing of the benefits arising from the use of biodiversity. In relation to plants, the Global Strategy for Plant Conservation (GSPC) was adopted by the CBD at the 2002 Conference of the Parties and updated at the tenth Conference of the Parties (CBD 2010a). The updated GSPC sets targets and objectives for the period 2011-2020 which are of direct relevance to utilised species such as these medicinal plants (CBD 2010a). For example, Target 2 calls for "… an assessment of the conservation status of all known plant species, as far as possible, to guide conservation action". The assessments published in the course of this project contribute to Target 2, and will contribute to Target 5 (the identification of Important Plant Areas), Targets 7 and 8 which deal with *in situ* and *ex situ* conservation of threatened species, and contributes to the longer-term delivery against Target 12, which focuses on sustainable use of wild-plant products. Sharrock *et al.* (2014) undertook a mid-term review of progress towards meeting the 2020 GSPC targets. They reported that, at a global scale, progress towards Targets 2, 8 and 12 has been inadequate to meet the 2020 timescale, and there has been no progress towards Target 7 because the overall continuing loss of natural habitat means that the *in situ* conservation status of many species is getting worse, whilst many species that occur within protected areas are not effectively conserved and are affected by factors such as invasive species, climate change and unregulated harvesting (Sharrock *et al.* 2014).

The CBD Strategic Plan agreed in Nagoya, Japan (CBD 2010b) established a further 20 target actions (the Aichi Biodiversity Targets). The current assessment and its outcomes, in particular, support the delivery against the following Aichi Targets;

Target 12: *By 2020 the extinction of known threatened species has been prevented and their conservation status, particularly of those most in decline, has been improved and sustained.*

Target 13: *By 2020, the loss of genetic diversity of cultivated plants and farmed and domesticated animals and of wild relatives, including other socio-economically as well as culturally valuable species is maintained and strategies have been developed and implemented for minimizing genetic erosion and safeguarding their genetic diversity.*

The CBD is developing an area of work relevant to medicinal plant conservation, around biodiversity and human health, supporting the delivery of primarily Aichi Target 14;

Target 14: *By 2020, ecosystems that provide essential services, including services related to water, and contribute to health, livelihoods and well-being, are restored and safeguarded, taking into account the needs of women, indigenous and local communities and the poor and vulnerable.*

A further outcome of the tenth CBD Conference of the Parties (CBD CoP) was 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* (in brief, Access and Benefit-sharing, ABS) (CBD 2011). The Nagoya Protocol came into force in October 2014, during the eleventh CBD CoP. The objective of the Nagoya Protocol is to set an internationally accepted, legally binding framework to promote the transparent and effective implementation of the ABS concept at the regional, national and local level (Greiber *et al.* 2012). ABS acknowledges the benefits that accrue to a range of sectors and actors from genetic resources (Table 4) with the potential to be of benefit for wider social and economic development, whilst acknowledging that open access to these genetic resources can lead to exploitation, over-utilisation, and/or monopolisation of resources and traditional knowledge.

Table 4. Market sectors and the importance of genetic resources.

Sector	Size of total market in 2006	Importance of genetic resources
• **Pharmaceutical**	US$ 640 billion	20–25% derived from genetic resources
• **Biotechnology**	US$ 70 billion from public companies alone	Many products derived from genetic resources (enzymes, micro-organisms)
• **Agricultural seeds**	US$ 30 billion	All derived from genetic resources
• **Personal care, botanical, and food and beverage industries**	US$ 22 billion for herbal supplements US$ 12 billion for personal care US$ 31 billion for food products	Some products derived from genetic resources: represents 'natural' component of the market

Source: from ten Brink 2011.

The ABS principles regulate access to genetic resources and equitable benefit sharing from their utilization through the requirement for prior and informed consent of the country of origin of the resource, or of the indigenous peoples through mutually agreed terms. In Europe, the Nagoya Protocol is implemented through regulation 511/2014 which came into force on 12 October 2014 (to coincide with the Nagoya Protocol itself).

Another multi-lateral environmental agreement that provides a framework for ensuring the sustainability and legality of trade in medicinal plants is the Convention on International Trade in Endangered Species of Flora and Fauna (CITES). Over 65 plants (41 included in this current assessment) traded as medicinal and aromatic are listed in CITES Appendix II with their trade regulated. Useful tools developed to support the implementation of CITES provisions include the voluntary guidance on non-detriment findings for perennial plants (Leaman and Oldfield 2014) to which the present assessment will provide a useful contribution.

The World Health Organization in its Traditional Medicine Strategy (WHO 2013), prioritizes the finalisation of the update of the Guidelines on Conservation of Medicinal Plants (WHO *et al.* 1993), which will provide an important guidance to WHO members on the conservation and sustainable use of medicinal plants.

4.2 Protection of habitats and species within the pan Europe and the EU 27 regions

European countries and EU Member States are signatories to a number of regional conventions and Directives targeted at conserving species and their habitats, including vascular plants. These include:

- EU Convention on the Conservation of European Wildlife and Natural Habitats (the Bern Convention)
- EU Habitats Directive (Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora)
- EU Wildlife Trade Regulation (Council Regulation (EC) No 338/97 of 9 December 1996 on the protection of species of wild fauna and flora by regulating trade therein)

The Bern Convention is a binding international legal instrument that aims to conserve wild flora and fauna and their natural habitats and to promote European cooperation towards that objective. It covers all European countries and some African states.

Also at the pan European level, pan European countries endorsed the *pan-European 2020 Strategy for Biodiversity* (UNEP 2011), which refocuses efforts to prevent further loss of biodiversity in the pan-European region and provides a European mechanism for supporting the implementation of the global Strategic Plan for Biodiversity.

EU nature conservation policy is based on two main pieces of legislation - the 1979 Birds and the 1992 Habitats Directives. The main aim of the nature directives is to

ensure the favourable conservation status of the habitats and species found in the EU. One of the main tools to enhance and maintain this status is the Natura 2000 network of protected areas, which currently contains over 27,000 terrestrial and marine sites, covering almost a fifth of the EU land areas as well as substantial parts of the surrounding seas.

In addition the EU has committed to a long-term (2050) vision and mid-term headline target for biodiversity, which is 'To halt the loss of biodiversity and the degradation of ecosystem services in the EU by 2020 and restore them in so far as possible, while stepping up the EU contribution to averting global biodiversity loss'.

The establishment of these policy instruments indicates the high political commitment to biodiversity conservation and the need to monitor the status of biodiversity so as to assess progress towards meeting conservation objectives and targets.

Many individual European region countries have national-scale conservation legislation that encompasses vascular plants, and there are a number of geographically-specific conventions (e.g, The Alpine Convention (www.alpconv.org) and Carpathian Convention (Framework Convention on the Protection and Sustainable Development of the Carpathians; www.carpathianconvention.org).

In order to coordinate the implementation of the GSPC at the regional level, the European Strategy for Plant Conservation (ESPC) was adopted. The first European Strategy was developed in 2001 by Planta Europa and the Council of Europe (2001) and was valid until 2007. At the fifth Planta Europa Conference, the Strategy was renewed and targets were set for the period 2008-2014 (Planta Europa 2008) which are aligned to the GSPC. GSPC Target 2 is also of major relevance as it calls for "*A preliminary assessment of the conservation status of all known plant species at national, regional and international levels*". The corresponding ESPC sub-target 2.1 calls for a European Red List of vascular plants.

Plant habitat conservation efforts have in part been focused through the identification of Important Plant Areas (IPAs); IPAs are internationally significant sites for wild plants and threatened habitats. Identified at a national level, they provide a framework for implementing Target 5 of the CBD GSPC, as well as a tool for targeting conservation actions on wild plants and *in situ* habitat protection). IPAs contain over 700 of the most threatened species in Europe and millions of hectares of the most threatened habitats. At least 1,770 IPAs have been identified in 16 European countries (Anderson and Radford 2010).

At the national level, countries have developed legislation to implement international and regional commitments, as well as focussing conservation efforts on of habitats and threatened plants. Examples of relevant legislation include the identification of protected or endangered flora, national Red Books or Red Lists, and by 2007, almost all European countries had initiated national Red Lists (de Iongh and Bal 2007). Countries in the region have also developed National Biodiversity Strategy and Action Plans, in response to the CBD national delivery accompanied by the periodic national reports against the implementation. In some cases, specific national response to the Global Strategy for Plant Conservation (e.g. United Kingdom, France, Austria; see Plants 2020 (2014)). A number of protected areas within the European region are established on different levels, including sub-national, national, and transboundary, which contribute to plant habitat and population conservation efforts.

In terms of addressing the threats to medicinal plants, their conservation, and encouraging sustainable resource management and use, strategies specific to sustainable wild-collection of plants have been developed in a few European countries (e.g., some Balkan states; Nedeljković *et al.* 2010), but such efforts remain scarce. One example of such regulation is from the Republika Srpska (Bosnia and Herzegovina) *Rulebook of Conditions for Utilization and the Methods of Collection of Other Forest Products* (Republika Srpska 2010) and its 2014 amendment, based on the Law of Forests (Republika Srpska 2008). In common with other areas of biodiversity conservation, the level of cooperation between sectorial Ministries (which might need to involve, for example, Ministries responsible for environmental protection, agriculture, forestry, economic development, and health) at the national or sub-national level may be limited, which potentially prevents the development of better medicinal plant conservation strategies.

4.3 Conservation management of European medicinal plants

Work initiated by TRAFFIC, IUCN and WWF on understanding the trade of medicinal plants to Europe (Lange 1998), was followed by a review of the conservation of medicinal plants from selected countries of southeastern Europe (Kathe *et al.* 2006). Over-collection from the wild was identified as the primary threatening factor for the assessed medicinal plants, with several species identified as threatened (and subsequently listed in respective national Red Lists or Protected Species Lists), for example in Bosnia and Herzegovina *Arnica montana*, *Arctostaphylos uva-ursi* and *Gentiana lutea*, which are all assessed as Least Concern at the regional level.

The problem of unsustainable wild-collection is recognised in the CBDs *Global Strategy for Plant Conservation*, and a range of tools and certification schemes have been developed to promote sustainable wild-harvesting, such as the FairWild Standard developed by the FairWild Foundation in partnership with IUCN Medicinal Plant Specialist Group, TRAFFIC, WWF and others, and its adoption by industry, governments and communities is recommended (See Box 'The FairWild Standard and medicinal plant certification'). Wild-harvesting can be sustainable if appropriate management systems are implemented, and can benefit both the health and livelihoods of collectors and communities. In this context, CITES (and in the EU context the EU Wildlife Trade regulation) also provides the framework for regulating the trade in species threatened by international trade, including medicinal plants. In its Traditional Medicine Strategy (WHO 2013), the World Health Organization prioritises the finalisation of the update of the *Guidelines on Conservation of Medicinal Plants* (WHO *et al.* 1993), which will provide important guidance to WHO members on the conservation and sustainable use of medicinal plants.

For some plants that are highly collected from the wild, such as Ramsons *Allium ursinum* (LC), ongoing monitoring of exploited populations are recommended. Here, an *Allium ursinum* resource assessment is underway in the Vlasenica Region of Republica Srpska, Bosnia and Herzegovina. © Sladjana Bundalo / TRAFFIC International

The FairWild Standard and medicinal plant certification www.fairwild.org

Version 2.0 of the FairWild Standard applies to wild plant collection operators who wish to demonstrate their commitment to sustainable collection, social responsibility, and fair trade principles. The purpose of the Standard is to ensure the continued use and long-term survival of wild plant species and populations in their habitats, while respecting the traditions and cultures, and supporting the livelihoods of all stakeholders; in particular collectors and workers. Adoption of the FairWild Standard helps to support efforts to ensure sustainable collection and maintenance of wild plant populations, as well as the sustainable social aspects of collection, and fair conditions of labour.

Beyond the certification process, the FairWild Standard principles can form the basis for the development of community resource management practices, sustainable resource management strategies and regulations. The FairWild Standard is recognised as the best-practice framework for sustainable wild collection and equitable trade in the implementation toolkit of the Global Strategy for Plant Conservation. The FairWild Standard provides guidance on best-practice harvesting and trading of wild-harvested plant (and similar) resources in eleven key areas (FairWild Foundation 2010):

1. Maintaining wild plant resources
2. Preventing negative environmental impacts
3. Complying with laws, regulations, and agreements
4. Respecting customary rights and benefit-sharing
5. Promoting fair contractual relationships between operators and collectors
6. Limiting participation of children in wild-collection activities
7. Ensuring benefits for collectors and their communities
8. Ensuring fair working conditions for all workers of FairWild collection operations
9. Applying responsible management practices
10. Applying responsible business practices
11. Promoting buyer commitment

As such, FairWild certification can also provide a value-adding option for producers in addition to conservation benefits, considering that the demand for FairWild certified products is growing. The European region is important for sourcing the FairWild-certified ingredients for the manufacturing industry in Europe, United States and elsewhere.

Common Nettle *Urtica dioica* (LC). © *Brewbanks*, Flickr Creative Commons Licence

RUNO sp. z o.o. is an operator in Poland dealing with processing herbs and raw herbal material that holds FairWild certification for four wild plant species (Common Nettle *Urtica dioica* and Dandelion *Taraxacum officinale)*. The wild medicinal plants are collected through their network of purchase centres in landscapes surrounding the Białowieża forest, one of the last and largest remaining parts of the primeval forest that once stretched across the European Plain. Collectors are benefiting from fair prices paid for their produce and through participation with the FairWild Premium Fund for community development priorities. Final products using Polish ingredients are manufactured in the USA, and are on sale in the USA, Canada, Japan and elsewhere.

Balsamic Sage *Salvia tomentosa* (LC) is found in southeastern Europe. It is used in herbal teas, to produce an essential oil with potential applications as an insecticide and bactericidal agent. © Errol Vela

In central and southeastern Europe, the number of traditional wild-collectors of medicinal plants is declining due to continuing urbanisation of populations, putting at risk the survival of the tradition of wild-collection and use of medicinal plants. This issue is being addressed through separate initiatives, for example the *Traditional and Wild* project in Hungary, Czech Republic, Slovenia and Poland (Rodina *et al.* 2014), focussing on the promotion of sustainable wild-harvesting, fair trade and revitalisation of the tradition of wild collection. However, wider action is needed on the regional level, including with industry, communities and relevant government agencies.

4.4 Red List extinction risk versus habitat conservation status

The IUCN Red List Criteria classify taxa on the basis of their relative risk of extinction (IUCN 2012a). Identification and protection of critical habitat has been identified as a major factor contributing to positive conservation outcomes for species identified as threatened (Favaro *et al.* 2014). However, Unfavourable Conservation Status according to the EU Habitats Directive has a much broader definition, identified in Article 1 of the Directive (see Box 1). No species meeting the IUCN Red List Criteria for one of the threatened categories at a regional level can be considered to have a Favourable Conservation Status in the EU. To be classified as Vulnerable (the lowest of the three IUCN threatened categories) a species must undergo a reduction in population size of at least 30% over ten years or three generations (or have a very small or small and declining population or geographic range). It is difficult to claim that a species experiencing a decline of this magnitude is maintaining its population, that its range is stable, and that it remains a viable component of its habitat.

Selected provisions of the EU Habitats Directive (92/43/EEC)

Article 1(i) defines the conservation status of a species as;

"the sum of the influences acting on the species concerned that may affect the long-term distribution and abundance of its populations in the European territory of the Member States".

It states that a species' conservation status will be taken as Favourable when:

Population dynamics data on the species concerned suggests that it is maintaining itself on a long-term basis as a viable component of its natural habitats; and

The natural range of the species is neither being reduced nor is likely to be reduced for the considerable future; and

There is, and probably will continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

Crucially, however, this does not mean that the opposite is true: species that are not threatened as defined by IUCN Red List Criteria do not necessarily have a Favourable Conservation Status (BirdLife International 2004). Guidelines issued by the European Commission on the protection of species under the Habitats Directive reinforce this message that 'the fact that a habitat or species is not threatened (i.e. not faced by any direct extinction risk) does not necessarily mean that it has a Favourable Conservation Status'.

Of the 400 selected medicinal plants included in this assessment, a relatively small proportion (2.4% at the pan Europe scale, 2.5% within the EU 27 Member States) of species were assigned a threatened category and 31% were found to have a declining population trend. Collection from the wild, livestock farming, recreational activities, tourism and urban development, invasive alien species, natural system modification and pollution have been identified as the main causes of decline in medicinal plants. Special emphasis needs to be placed on Data Deficient species, especially as some are suspected to be in a critical state of decline at the national level in some parts of the EU and within pan Europe, but the lack of information from across the whole range or part of the range of these species meant that a threat category could not be assigned. These species should not be regarded as having Favourable Conservation Status, and should be the focus of further research across the region.

4.5 Red List status versus priorities for conservation action

Assessment of extinction risk and setting conservation priorities are two related but different processes. Assessment of extinction risk, such as the assignment of IUCN Red List Categories, generally precedes the setting of conservation priorities. The purpose of the Red List categorization is to produce a relative estimate of the likelihood of extinction of a taxon. Setting conservation priorities, on the other hand, normally includes the assessment of extinction risk, but also takes into account other factors such as ecological, phylogenetic, historical, economical, or cultural preferences for some taxa over others, as well as the probability of success of conservation actions, availability of funds or personnel, cost-effectiveness, and legal frameworks for conservation of threatened taxa. In the context of regional risk assessments, a number of additional pieces of information are valuable for setting conservation priorities. For example, it is important to consider not only conditions within the region but also the status of the taxon from a global perspective and the proportion of the global population that occurs within the region. A decision on how these three variables, as well as other factors, are used for establishing conservation priorities is a matter for the regional authorities to determine.

Arnica des montagnes *Arnica montana* is found in alpine areas and grasslands. © Stephanie Klocke / Flickr Creative Commons Licence

Dianthus superbus

This herbaceous perennial with sweet scented flowers is a very popular garden plant with many cultivars and hybrids. It has long been used medicinally, particularly in China, for a variety of purposes, often in combinations with other species. Its uses include treatments for constipation, urinary problems, fever, blood pressure, bacterial infections and as a contraceptive (Plants for a Future 2012). The leaves and stems can be boiled and eaten. Although not considered to fall within a threatened category within the EU 27 and Europe as a whole, it illustrates some of the threats to species of meadow and grassland habitats. It is found in much of Europe except parts of the northwest and southwest. However, it has an uneven distribution, with higher sub-population densities in some areas than others. For example, it is thought possibly extinct in the Netherlands (Kostrakiewicz-Gierałt 2013). In southern Sweden the species has declined and disappeared from many locations (Anderberg 1998). It is noted to be still relatively frequent, on fairly stable sand dunes, in eastern Finnmark, Norway (Ødegaard *et al.* 2014). It is considered to be Critically Endangered in the Czech Republic, Endangered in Estonia, Latvia and Lithuania, Vulnerable in Sweden and Poland, Near Threatened in Hungary and rare in Denmark (Kostrakiewicz-Gierałt 2013, Tamm 2012). It is protected in Finland south from the province of Oulu and a variant growing on serpentine in Kaavi is Critically Endangered (Lehmuskallio 2014).

It is found in a variety of grassland habitats. It occurs in alpine meadows in acidic and nutrient poor soils, for example in Austria and Germany (Deitl and Jorquera 2012), in moor grasslands and forest edges in Poland (Kostrakiewicz-Gierałt 2013) and open woods and meadows in the east of France (Tela Botanica 2012). It is found in Baltic coastal meadow habitats in Denmark, Sweden, Estonia and Finland (Estonian Environmental Board 2011). In Finland it is also noted to occur on sandy and gravelly river banks, dry commons and roadsides (Lehmuskallio 2014). In the south of its range, in Greece, it grows in grassy clearings (Lafranchis and Sfikar 2009).

Photograph: Teun Spaans / Creative Commons Licence

Populations of this species are known to be impacted by changes in meadow management. For example, replacement of meadows with forest, due to successional processes following lack of management, such as reduced grazing or mowing regimes. It has also suffered from replacement of meadows with arable areas due to the intensification of agriculture. A study in western Poland found this species within *Molinia* meadows which are considered to be the most endangered meadows in the region. Within the area studied a general reduction in grasslands, in some parts by up to 50-60% in the last 70 years, was noted (Jermaczek-Sitak 2009). Wet meadows, a habitat for this species, belong to some of the most threatened communities in Central Europe (Myśliwy and Bosiacka 2012). They are affected by abandonment, eutrophication, drainage, and habitat fragmentation (Tájek 2012). Agricultural improvement in Baltic coastal meadows damaged the natural water regime and balance and they dried or became overgrown with reed. A decline in grazing also caused these meadows to become overgrown with high vegetation and scrub (Rannap *et al.* 2004).

In Estonia, of the managed coastal meadows only 9,500 ha remained in use by 1981 and by 2000 this had decreased to 5,100 ha (Rannap *et al.* 2004). Restoration efforts have been undertaken here and 2,400 seedlings, grown in greenhouses, were transplanted to a site which is undergoing monitoring to evaluate its success (Tamm 2012).

5. Conclusion and recommendations

Four hundred medicinal plants native to the European region were selected and their risk of extinction assessed according to the IUCN Red List Categories and Criteria (IUCN 2012a) at two geographical scales (i) the 27 Member States of the European Union and (ii) pan Europe (continental Europe including European parts of the Russian Federation to the Ural mountains). The term 'medicinal plant' has been understood in a wider sense to include overlapping uses as herbal teas, spices, food, dietary supplements, and cosmetics. The Red List Category of each plant was assessed at each of the two regional scales (Table 2, Figure 1). At the pan Europe level, nine plants (2.4% of extant species for which sufficient data are available) were found to be threatened (i.e., having a Red List Category of Vulnerable or Endangered; no plants were considered Critically Endangered, Regionally Extinct, or Extinct). This figure rises very slightly to 2.5% for the EU 27 region. This represents a low level of threat compared with other European regional assessments of vascular plants. By comparison, of groups that have been comprehensively assessed in Europe, 59% of freshwater molluscs, 40% of freshwater fishes, 23% of amphibians, 20% of reptiles, 17% of mammals, 16% of dragonflies, 13% of birds, 9% of butterflies and 8% of aquatic plants are threatened (IUCN 2011b, BirdLife International In prep.). Additional European Red Lists assessing only a selection of species showed that 22% of terrestrial molluscs, 16% of crop wild relatives, 15% of saproxylic beetles, 2% of medicinal plants are also threatened (IUCN 2011b, Allen *et al.* 2014). Medicinal plant species considered Near Threatened (pan Europe 4.5% / EU 27 5%) have populations declining across Europe. Few plants were considered Data Deficient (6.3% DD at the pan Europe scale, 5.8% in the EU 27 Member States), reflecting the generally good state of knowledge of plants across the European Union and the European region. The primary reason for a plant being assigned to the Data Deficient category was a lack of knowledge of population trends across its European range (reflected by the figure of just over 25% of plants for which the population trend could not be determined), and highlights a key research need for European medicinal plants, to better monitor demographic change and drivers of change. The low level of threatened species identified through this assessment should not allow complacency; further research is needed to enable DD species to be reassessed and assigned a different Red List Category, and there are indications that the collection and trade in medicinal plants in Europe is increasing.

This assessment is very clearly the first step in understanding the conservation and sustainable use of medicinal plants in Europe.

5.1 Recommendations for conservation measures

Expand the state of knowledge of European medicinal plants

- Undertake further research on threatened and Near Threatened European species and ensure the adequate identification and management of their critical habitats to inform conservation programmes and identify gaps in conservation actions.
- Reassess threatened plants at least every five years and when new information becomes available. It is recommended that Data Deficient species should also be reassessed every five years.
- Prioritise fieldwork and data collection for Data Deficient species to determine whether they are in need of conservation action.
- Promote data access through the development of national and regional data portals.
- Integrate the outcomes of this assessment and any follow-up research into the European Strategy for Plant Conservation, and showcase in the Global Strategy for Plant Conservation.

Bearberry *Arctostaphylos uva-ursi* is a very widespread plant in Europe. Whilst it is considered Least Concern at the European regional scale, the plant is considered threatened in numerous national Red Lists, and local conservation actions are required. © Terhi Ryttäri

Localise and apply the assessment results

- Promote the awareness of medicinal plant conservation status and the drivers of population declines, as well as the tools available, through regional and national workshops and other relevant awareness-raising activities.
- Use the outcomes of assessment for further sub-regional assessments, to update national Red List assessments or develop if not already in place, and to inform national-level conservation priority-setting and conservation measures, including sustainable use.
- Build capacity and resources at the national level to undertake national assessments.

Capacity-building and awareness

- Tools and resources for building the capacity of resource managers and relevant agencies should be developed and disseminated, including; undertaking Red List assessments at national scales; producing resource inventories; species and area management plans; and monitoring of populations and habitats.
- Strengthen the network of European plant experts by providing training and improving communication, including the mobilisation of financial resources.
- Promote expert engagement in relevant SSC Specialist Groups, especially the Medicinal Plant Specialist Group.

Develop policy and encourage sustainable business practices for conservation and sustainable use of medicinal plants

- Effective government regulations and policies can create an enabling environment for the conservation, sustainable use and trade in wild medicinal plants in Europe. Tools such as the FairWild Standard can be applied to improve existing wild harvesting management practices and provide a framework for such policies.
- Prioritise conservation measures based on the findings of this assessment.
- Integrate medicinal plant conservation measures into National Biodiversity Strategies and Action Plans (NBSAPs), and where relevant develop specific plant conservation strategies at the national or sub-national level.
- Cooperation between sectorial-based ministries is important for the development and implementation of effective medicinal plant conservation and sustainable use strategies. Such cooperation should extend across all government sectors, including environmental protection, agriculture, forestry, economic and rural development, and health.
- Encourage the uptake of the FairWild Standard and certification scheme for sustainable wild-harvesting and equitable trade to prevent further population decline of species impacted by wild collection.
- Engagement of multiple stakeholder groups, including research institutions, NGOs, communities, private sector in the discussions of the assessment outcomes and the design of the follow-up measures is of critical importance to the successful implementation of the activities.

5.2 Application of project outputs

This European Red List of Medicinal Plants is part of a wider project aimed at assessing a range of taxonomic groups, some comprehensively (i.e., including all currently known species present within the pan Europe region, such as freshwater fishes and butterflies), whilst in others, such as this and the other vascular plant groups (Bilz *et al.* 2011), only selected species have been assessed. In conjunction with the data on European birds published by BirdLife International (BirdLife International 2004, In prep.), the European Red Lists provide key resources for decision-makers, policymakers, resources managers, environmental planners and NGOs. It has brought together large volumes of data on the population, ecology, habitats, threats and recommended conservation measures for each species assessed. These data are freely available on the IUCN Red List website (http://www.iucnredlist.org), on the European Commission website (http://ec.europa.eu/environment/nature/conservation/species/redlist/), and through publications (see the list of European Red Lists published at the end of this report).

This European Red List is a dynamic tool that will evolve with time as species are reassessed according to new information or change in species status. It is aimed at stimulating and supporting research, monitoring and conservation action at local, regional and international levels, especially for threatened, Near Threatened and Data Deficient species.

Each species assessment lists the major threats affecting the specific plant as well as conservation measures already in place or needed. This will be useful to inform the application of conservation measures for each species.

The outputs of this project can be applied to inform policy, to identify priority sites and species to include in research and monitoring programmes and to identify internationally important areas for biodiversity. It also contributes to broaden the coverage of plants on the global IUCN Red List as many species assessed during this project are endemic to the European region.

- The European Red List will be a key source of information when undertaking the possible adaptation of the Annexes of European legislation in the future (e.g. EU nature directives, Bern Convention), as well as protected areas identification (e.g. Natura 2000 sites).
- European Red List data is used to track progress towards meeting EU policy targets (e.g. EU 2020 Biodiversity Baseline)
- Since the development of the European Red List, the EU's financial instrument for the environment, the LIFE+ programme, does also give priority funding to those projects that aim actions towards conserving threatened species according to the European Red List.

Liquorice *Glycyrrhiza glabra* (LC) is widely cultivated and wild-collected in Europe for a wide range of uses such as in medicines, herbal drinks, and confectionary. Photographed here at a market Vic in Catalunya. © Ryan Opaz www.ryanopaz.com

5.3 Future work

Through the process of compiling data on the distributions, population trends, ecology and threats to this selected sub-set of medicinal plants for the European Red List, a number of knowledge gaps have been identified. Across Europe there are significant geographic, geopolitical and taxonomic biases in the quality of data available on the distribution and status of species, as well as their representation in protected areas. Whilst most, if not all, countries have national floras and some have national Red Lists, accessing compiled plant data, especially on distributions and population trends, is difficult. This project has made extensive use of regional and national-scale online databases, especially for spatial data (e.g., the Global Biodiversity Information Facility (GBIF), Anthos (2014), SIVIM (Sistema de información de la Vegetación Iberica y Macaronésica; SIVIM 2014) and TÜBİVES (Bakis *et al.* 2014)), and we benefitted greatly from the spatial data made available to us by the Atlas Flora Europeaea (Kurtto *et al.* 2013). However, there are significant gaps in the geographical coverage of such open-source resources, and issues to overcome, including taxonomic standards and data quality (especially accuracy of georeferencing). There is a clear need for drawing together information from all data compilation initiatives under way or planned, and for a wider European medicinal plant conservation action plan to be explored, developed, and progressed, especially in newly acceded Member States, and the eastern parts of the pan Europe region, including European parts of Russia.

It is hoped that by presenting this assessment, both national and regional research will be stimulated to provide new data and to improve on the quality of that already given.

Key challenges for the future are to improve monitoring and data quality, and to further develop data openness and dissemination so that the information and analyses presented here and on the European Red List website can be updated and improved, and so conservation actions can be given as solid a scientific basis as possible.

Pistacia lentiscus

At present this dense evergreen shrub, or less commonly, small tree is not considered threatened in Europe and provides an example of how small scale cultivation aids sustainable use. In the European region, the species is considered native to the Canary Islands, most Mediterranean coastal countries and larger islands in Spain (including the Baleares), Portugal, France (including Corsica), Italy (including Sardinia and Sicily), Croatia, Albania, and Greece (and Crete) (GRIN 2014). It forms part of what is thought of as typical Mediterranean vegetation of thick-leaved evergreen *Maquis*. It is also found in more open steppe, on dry rocky slopes and is common near the sea, sometimes on sand dunes, and in open oak forest (Blamey and Grey-Wilson 1993, Al-Saghir and Porter 2012). In the interior of the Iberian Peninsula it grows in low-altitude scrublands (Garrigas) and sheltered areas, avoiding places with cold winters (Palacio 2005). The species is noted to be deep-rooted and long-lived (more than 100 years), relatively combustible, but with a good ability to survive fire and also an ability to tolerate some degree of wood-cutting. It is also noted to be an unpalatable shrub which may confer protection from grazing (Grove and Rackham 2001). It may be locally threatened by urban expansion and tourist developments and possibly by cultivation of land under plastic, for example, in Spain.

This shrub produces an aromatic resin known as *mastic* which has a long history of use; for example, it is noted to have been used in ancient Egypt as part of the embalming process (Hanelt *et al.* 2001). It has also been used in the production of varnishes and adhesives, for chewing gum, in photography, lithography and dentistry and it is used in liqueurs and cordials (Polunin 1969). The mastic oil is also part of distinct perfumes, hair and skin lotions and the resin is also used in a number of cakes, pastries, sweets and desserts and is an important ingredient in Greek festival breads (Hagidimitrio 2013). The seeds contain about 25% oil, which is used as salad oil, while the wood can be used to produce charcoal, and the branches are used by basket makers (Hanelt *et al.* 2001). There has been recent interest in its medicinal properties and the oil

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and gum are natural antimicrobial agents and possibly have some anti-fungal properties (Lauk 1996). Anti-ulcer (Al-Said *et al.*1986) and anti-tumour activity has also been investigated and a possible future role in cancer prevention suggested (Magkoutaa *et al.* 2009). This species is cultivated for the extraction of *mastic* on the Greek island of Chios. The production of mastic in 1997 was said to amount to 160–170 tonnes annually and to be important to the economy of the island, being the main source of income for about 20 villages in the south (Browicz 1987). It is thought that Chios is the main source of *mastic* for commercial use.

No detailed population data are available. However, as this shrub is a characteristic species of *Maquis* vegetation and open rocky areas around most of the Mediterranean and its islands, the population is inferred to be very large. Palacio (2005), for example studied just one natural population of this shrub, located in north-east Spain, which had more than 300 adults. It is reported to be extremely common in Crete, common in Sardinia and along the coast of Italy (Fielding and Turland 2005, Delfino 2010, Pignatti 1982). Grove and Rackham (2001) suggest there may be some recent expansion of this species within Mediterranean Europe.

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Appendix 1.
The Red List status of selected European medicinal plants at the European and EU 27 levels

FAMILY	*Taxon*	Taxon Authority	EU Policy species*	CITES Appendices	Habitat Directive Annexes	Bern Convention	EU Wildlife Trade Regulation	IUCN Red List Category (Europe)	IUCN Red List Criteria (Europe)	IUCN Red List Category (EU27)	IUCN Red List Criteria (EU27)	Endemic to Europe?	Endemic to EU27?
ALLIACEAE	*Allium schoenoprasum*	L.						LC		LC		NO	NO
ALLIACEAE	*Allium ursinum*	L.						LC		LC		NO	NO
AMARYLLIDACEAE	*Leucojum vernum*	L.						LC		LC		YES	NO
AMARYLLIDACEAE	*Narcissus poeticus*	L.						LC		LC		YES	NO
AMARYLLIDACEAE	*Sternbergia lutea*	(L.) Ker Gawl. ex Spreng.	*	*			*	LC		LC		NO	NO
ANACARDIACEAE	*Cotinus coggygria*	Scop.						LC		LC		NO	NO
ANACARDIACEAE	*Pistacia lentiscus*	L.						LC		LC		NO	NO
APOCYNACEAE	*Nerium oleander*	L.						LC		LC		NO	NO
APOCYNACEAE	*Vinca minor*	L.						LC		LC		NO	NO
AQUIFOLIACEAE	*Ilex aquifolium*	L.						LC		LC		NO	NO
ARALIACEAE	*Hedera helix*	L.						LC		LC		NO	NO
ASPARAGACEAE	*Asparagus officinalis*	L.						LC		LC		NO	NO
ASPLENIACEAE	*Asplenium trichomanes*	L.						LC		LC		NO	NO
BERBERIDACEAE	*Berberis vulgaris*	L.						LC		LC		NO	NO
BETULACEAE	*Betula pendula*	Roth						LC		LC		NO	NO
BETULACEAE	*Betula pubescens*	Ehrh.						LC		LC		NO	NO
BORAGINACEAE	*Alkanna tinctoria*	Tausch						LC		LC		NO	NO
BORAGINACEAE	*Borago officinalis*	L.						LC		LC		NO	NO
BORAGINACEAE	*Pulmonaria officinalis*	L.						LC		LC		YES	NO
BORAGINACEAE	*Symphytum officinale*	L.						LC		LC		NO	NO
BUXACEAE	*Buxus sempervirens*	L.						LC		LC		NO	NO
CANNABACEAE	*Humulus lupulus*	L.						LC		LC		NO	NO
CAPRIFOLIACEAE	*Sambucus ebulus*	L.						LC		LC		NO	NO
CAPRIFOLIACEAE	*Sambucus nigra*	Lour.	*		*	*		LC		LC		NO	NO
CAPRIFOLIACEAE	*Viburnum opulus*	L.						LC		LC		NO	NO
CARYOPHYLLACEAE	*Dianthus superbus*	L.						LC		LC		NO	NO

*Refers to species found in Habitat Directive Annexes, CITES Appendices, the Bern Convention, or the EU Wildlife Trade Regulation

FAMILY	*Taxon*	Taxon Authority	EU Policy species	CITES Appendices	Habitat Directive Annexes	Bern Convention	EU Wildlife Trade Regulation	IUCN Red List Category (Europe)	IUCN Red List Criteria (Europe)	IUCN Red List Category (EU27)	IUCN Red List Criteria (EU27)	Endemic to Europe?	Endemic to EU27?
CARYOPHYLLACEAE	*Gypsophila perfoliata*	L.						NT		NT		NO	NO
CARYOPHYLLACEAE	*Saponaria officinalis*	L.						LC		LC		NO	NO
CARYOPHYLLACEAE	*Stellaria media*	(L.) Vill.						LC		LC		NO	NO
CHENOPODIACEAE	*Beta vulgaris*	L.						LC		LC		NO	NO
COLCHICACEAE	*Colchicum arenarium*	Waldst. & Kit.	*		*	*		LC		LC		YES	NO
COLCHICACEAE	*Colchicum autumnale*	L.						LC		LC		YES	NO
COMPOSITAE	*Achillea crithmifolia*	Waldst. & Kit.						LC		LC		YES	NO
COMPOSITAE	*Achillea millefolium*	L.						LC		LC		NO	NO
COMPOSITAE	*Achillea ptarmica*	L.						LC		LC		YES	NO
COMPOSITAE	*Anacyclus pyrethrum*	(L.) Lag.						DD		DD		NO	NO
COMPOSITAE	*Antennaria dioica*	(L.) Gaertn.						LC		LC		NO	NO
COMPOSITAE	*Arctium lappa*	L.						LC		LC		NO	NO
COMPOSITAE	*Arnica montana*	L.	*		*		*	LC		LC		YES	NO
COMPOSITAE	*Artemisia absinthium*	L.						LC		LC		NO	NO
COMPOSITAE	*Artemisia alba*	Turra						LC		LC		NO	NO
COMPOSITAE	*Artemisia campestris*	L.	*		*			LC		LC		NO	NO
COMPOSITAE	*Artemisia granatensis*	Boiss.	*		*	*		EN	A2ad	EN	A2ad	YES	YES
COMPOSITAE	*Artemisia santonicum*	L.						LC		LC		NO	NO
COMPOSITAE	*Artemisia umbelliformis*	Lam.						LC		LC		YES	NO
COMPOSITAE	*Artemisia vulgaris*	L.						LC		LC		NO	NO
COMPOSITAE	*Aster amellus*	L.						LC		NT		NO	NO
COMPOSITAE	*Chamaemelum nobile*	(L.) All.						LC		LC		YES	YES
COMPOSITAE	*Chiliadenus glutinosus*	(L.) Fourr.						LC		LC		NO	NO
COMPOSITAE	*Cichorium intybus*	L.						LC		LC		NO	NO
COMPOSITAE	*Cnicus benedictus*	L.						DD		DD		NO	NO
COMPOSITAE	*Cyanus segetum*	Hill						LC		LC		NO	NO
COMPOSITAE	*Cynara cardunculus*	L.						LC		LC		NO	NO
COMPOSITAE	*Helichrysum arenarium*	(L.) Moench						NT		NT		NO	NO
COMPOSITAE	*Helichrysum italicum*	(Roth) G.Don						LC		LC		NO	NO
COMPOSITAE	*Helichrysum stoechas*	(L.) Moench						LC		LC		NO	NO
COMPOSITAE	*Inula helenium*	L.						LC		LC		NO	NO
COMPOSITAE	*Lactuca virosa*	L.						DD		DD		NO	NO
COMPOSITAE	*Leontopodium alpinum*	Colm. ex Cass.						LC		LC		YES	NO
COMPOSITAE	*Matricaria chamomilla*	L.						LC		LC		NO	NO
COMPOSITAE	*Petasites albus*	(L.) Gaertn.						LC		LC		NO	NO

FAMILY	*Taxon*	Taxon Authority	EU Policy species	CITES Appendices	Habitat Directive Annexes	Bern Convention	EU Wildlife Trade Regulation	IUCN Red List Category (Europe)	IUCN Red List Criteria (Europe)	IUCN Red List Category (EU27)	IUCN Red List Criteria (EU27)	Endemic to Europe?	Endemic to EU27?
COMPOSITAE	*Petasites hybridus*	(L.) G.Gaertn., B.Mey. & Scherb.						LC		LC		NO	NO
COMPOSITAE	*Rhaponticum scariosum*	Lam.						LC		LC		YES	YES
COMPOSITAE	*Santolina oblongifolia*	Boiss.						NT		NT		YES	YES
COMPOSITAE	*Silybum marianum*	(L.) Gaertn.						LC		LC		NO	NO
COMPOSITAE	*Solidago virgaurea*	L.						LC		LC		NO	NO
COMPOSITAE	*Tanacetum cinerariifolium*	(Trevir.) Sch.Bip.						LC		LC		YES	NO
COMPOSITAE	*Tanacetum parthenium*	(L.) Sch.Bip.						LC		LC		NO	NO
COMPOSITAE	*Taraxacum officinale*	F.H.Wigg.						LC		LC		NO	NO
COMPOSITAE	*Tussilago farfara*	L.						LC		LC		NO	NO
CONVALLARIACEAE	*Convallaria majalis*	L.						LC		LC		NO	NO
CONVALLARIACEAE	*Polygonatum odoratum*	(Mill.) Druce						LC		LC		NO	NO
CRASSULACEAE	*Rhodiola rosea*	L.						LC		LC		NO	NO
CRASSULACEAE	*Sedum acre*	L.						LC		LC		NO	NO
CRASSULACEAE	*Sempervivum marmoreum*	Griseb.						LC		LC		YES	NO
CRASSULACEAE	*Sempervivum tectorum*	L.						LC		LC		NO	NO
CRUCIFERAE	*Armoracia macrocarpa*	(Waldst. & Kit.) Baumg.	*			*		DD		DD		YES	NO
CRUCIFERAE	*Brassica oleracea*	L.						DD		DD		YES	YES
CRUCIFERAE	*Capsella bursa-pastoris*	(L.) Medik.						LC		LC		NO	NO
CRUCIFERAE	*Cochlearia officinalis*	L.						LC		LC		NO	NO
CRUCIFERAE	*Lepidium cartilagineum*	(J.C. Mayer) Thell.						DD		DD		NO	NO
CRUCIFERAE	*Nasturtium officinale*	R. Br.						LC		LC		NO	NO
CRUCIFERAE	*Sisymbrium officinale*	(L.) Scop.						LC		LC		NO	NO
CUPRESSACEAE	*Juniperus communis*	L.						LC		LC		NO	NO
CUPRESSACEAE	*Juniperus oxycedrus*	L.						LC		LC		NO	NO
CUPRESSACEAE	*Juniperus sabina*	L.						LC		LC		NO	NO
CUPRESSACEAE	*Juniperus thurifera*	L.						LC		LC		NO	NO
CUPRESSACEAE	*Tetraclinis articulata*	(Vahl) Mast.	*			*		EN	B1ab(iii)+2ab(iii)	EN	B1ab(iii)+2ab(iii)	NO	NO
DIOSCOREACEAE	*Dioscorea communis*	(L.) Caddick & Wilkin						LC		LC		NO	NO
DROSERACEAE	*Drosera anglica*	Huds.						NT		NT		NO	NO
DROSERACEAE	*Drosera intermedia*	Hayne						NT		NT		NO	NO
DROSERACEAE	*Drosera rotundifolia*	L.						LC		LC		NO	NO
ELAEAGNACEAE	*Elaeagnus rhamnoides*	(L.) A.Nelson						LC		LC		NO	NO
EPHEDRACEAE	*Ephedra fragilis*	Desf.						LC		LC		NO	NO
EPHEDRACEAE	*Ephedra major*	Host						LC		LC		NO	NO

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EQUISETACEAE	*Equisetum arvense*	L.						LC		LC		NO	NO
EQUISETACEAE	*Equisetum hyemale*	L.						LC		LC		NO	NO
EQUISETACEAE	*Equisetum telmateia*	Ehrh.						LC		LC		NO	NO
EQUISETACEAE	*Equisetum variegatum*	Schleich. ex F. Weber & D. Mohr						LC		LC		NO	NO
ERICACEAE	*Arbutus unedo*	L.						LC		LC		NO	NO
ERICACEAE	*Arctostaphylos uva-ursi*	(L.) Spreng.	*				*	LC		LC		NO	NO
ERICACEAE	*Calluna vulgaris*	(L.) Hull						LC		LC		NO	NO
ERICACEAE	*Chimaphila umbellata*	(L.) W.P.C. Barton						VU	A2ac	VU	A2ac	NO	NO
ERICACEAE	*Erica cinerea*	L.						LC		LC		YES	YES
ERICACEAE	*Rhododendron ferrugineum*	L.						LC		LC		YES	NO
ERICACEAE	*Rhododendron hirsutum*	L.						LC		LC		YES	NO
ERICACEAE	*Rhododendron tomentosum*	Harmaja						LC		LC		NO	NO
ERICACEAE	*Vaccinium myrtillus*	L.						LC		LC		NO	NO
FAGACEAE	*Castanea sativa*	Mill.						LC		LC		NO	NO
FAGACEAE	*Quercus frainetto*	Ten.						LC		LC		NO	NO
FAGACEAE	*Quercus petraea*	(Matt.) Liebl.						LC		LC		NO	NO
FAGACEAE	*Quercus robur*	L.						LC		LC		NO	NO
GENTIANACEAE	*Centaurium erythraea*	Rafn						LC		LC		NO	NO
GENTIANACEAE	*Gentiana acaulis*	L.						LC		LC		YES	NO
GENTIANACEAE	*Gentiana asclepiadea*	L.						LC		LC		NO	NO
GENTIANACEAE	*Gentiana cruciata*	L.						LC		LC		NO	NO
GENTIANACEAE	*Gentiana lutea*	L.	*		*		*	LC		LC		NO	NO
GENTIANACEAE	*Gentiana pannonica*	Scop.						NT		NT		YES	NO
GENTIANACEAE	*Gentiana pneumonanthe*	L.						LC		LC		NO	NO
GENTIANACEAE	*Gentiana punctata*	L.						LC		LC		YES	NO
GENTIANACEAE	*Gentiana purpurea*	L.						LC		LC		YES	YES
GERANIACEAE	*Erodium foetidum*	(L.) L'Hér.						LC		LC		YES	YES
GERANIACEAE	*Geranium sanguineum*	L.						LC		LC		NO	NO
GESNERIACEAE	*Ramonda myconi*	(L.) Rchb.						LC		LC		YES	YES
GLOBULARIACEAE	*Globularia alypum*	L.						LC		LC		NO	NO
GLOBULARIACEAE	*Globularia cordifolia*	L.						LC		LC		NO	NO
GROSSULARIACEAE	*Ribes nigrum*	L.						LC		LC		NO	NO
GUTTIFERAE	*Hypericum elegans*	Stephan ex Willd.						LC		LC		NO	NO
GUTTIFERAE	*Hypericum perforatum*	L.						LC		LC		NO	NO

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HIPPOCASTANACEAE	*Aesculus hippocastanum*	L.						NT		NT		YES	NO
HYACINTHACEAE	*Drimia maritima*	L. Stearn						LC		LC		NO	NO
HYACINTHACEAE	*Scilla bifolia*	L.						LC		LC		NO	NO
ILLECEBRACEAE	*Herniaria glabra*	L.						LC		LC		NO	NO
IRIDACEAE	*Iris aphylla*	L.						NT		NT		NO	NO
IRIDACEAE	*Iris lutescens*	Lam.						LC		LC		NO	NO
IRIDACEAE	*Iris pseudacorus*	L.						LC		LC		NO	NO
IRIDACEAE	*Iris pumila*	L.						DD		DD		NO	NO
IRIDACEAE	*Iris sibirica*	L.						NT		NT		NO	NO
IRIDACEAE	*Iris spuria*	L.						VU	A2ce	VU	A2ce	NO	NO
IRIDACEAE	*Iris xiphium*	L.						DD		DD		NO	NO
LABIATAE	*Ballota nigra*	L.						LC		LC		NO	NO
LABIATAE	*Clinopodium alpinum*	(L.) Kuntze						LC		LC		NO	NO
LABIATAE	*Clinopodium serpyllifolium ssp. fruticosum*	(L.) Bräuchler						DD		DD		NO	NO
LABIATAE	*Galeopsis segetum*	Neck., Hist. & Commentat.						DD		DD		YES	YES
LABIATAE	*Glechoma hederacea*	L.						LC		LC		NO	NO
LABIATAE	*Glechoma hirsuta*	Waldst. & Kit.						DD		DD		YES	NO
LABIATAE	*Hyssopus officinalis*	L.						DD		DD		NO	NO
LABIATAE	*Lamium album*	L.						LC		LC		NO	NO
LABIATAE	*Lavandula angustifolia*	Mill.						LC		LC		YES	YES
LABIATAE	*Lavandula latifolia*	Medik.						LC		LC		YES	YES
LABIATAE	*Leonurus cardiaca*	L.						LC		LC		NO	NO
LABIATAE	*Marrubium vulgare*	L.						NT		NT		NO	NO
LABIATAE	*Melissa officinalis*	L.						LC		LC		NO	NO
LABIATAE	*Mentha pulegium*	L.						LC		LC		NO	NO
LABIATAE	*Nepeta cataria*	L.						LC		LC		NO	NO
LABIATAE	*Origanum dictamnus*	L.	*		*	*		NT		NT		YES	YES
LABIATAE	*Origanum onites*	L.						LC		LC		NO	NO
LABIATAE	*Origanum vulgare*	L.						LC		LC		NO	NO
LABIATAE	*Phlomis crinita*	Cav.						LC		LC		NO	NO
LABIATAE	*Prunella vulgaris*	L.						LC		LC		NO	NO
LABIATAE	*Rosmarinus officinalis*	L.						LC		LC		NO	NO
LABIATAE	*Salvia fruticosa*	Mill.						LC		LC		NO	NO
LABIATAE	*Salvia officinalis*	L.						LC		LC		YES	NO

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LABIATAE	*Salvia sclarea*	L.						LC		LC		NO	NO
LABIATAE	*Salvia tomentosa*	Mill.						LC		LC		NO	NO
LABIATAE	*Satureja cuneifolia*	Ten.						LC		LC		NO	NO
LABIATAE	*Satureja hortensis*	L.						DD		LC		NO	NO
LABIATAE	*Sideritis arborescens*	Salzm. ex Benth.						LC		LC		NO	NO
LABIATAE	*Sideritis glacialis*	Boiss.						LC		LC		YES	YES
LABIATAE	*Sideritis hyssopifolia*	L.						LC		LC		YES	NO
LABIATAE	*Sideritis leucantha*	Cav.						LC		LC		YES	YES
LABIATAE	*Sideritis reverchonii*	Willk.						EN	B2ab(i,ii,iii)	EN	B2ab(i,ii,iii)	YES	YES
LABIATAE	*Sideritis scardica*	Griseb.						NT		NT		YES	NO
LABIATAE	*Sideritis syriaca*	L.						LC		LC		NO	NO
LABIATAE	*Stachys officinalis*	(L.) Trevis.						LC		LC		NO	NO
LABIATAE	*Stachys palustris*	L.						LC		LC		NO	NO
LABIATAE	*Teucrium botrys*	L.						LC		LC		NO	NO
LABIATAE	*Teucrium chamaedrys*	L.						LC		LC		NO	NO
LABIATAE	*Teucrium eriocephalum*	Willk.						LC		LC		YES	YES
LABIATAE	*Teucrium montanum*	L.						LC		LC		NO	NO
LABIATAE	*Teucrium scorodonia*	L.						LC		LC		NO	NO
LABIATAE	*Thymbra capitata*	(L.) Cav.						LC		LC		NO	NO
LABIATAE	*Thymus baeticus*	Boiss. ex Lacaita						LC	LC	LC		YES	YES
LABIATAE	*Thymus hyemalis*	Lange						LC		LC		NO	NO
LABIATAE	*Thymus mastichina*	(L.) L.						LC	LC	LC		YES	YES
LABIATAE	*Thymus serpyllum*	L.						LC		LC		NO	NO
LABIATAE	*Thymus vulgaris*	L.						LC	LC	LC		YES	YES
LABIATAE	*Thymus zygis*	L.						LC		LC		NO	NO
LAURACEAE	*Laurus nobilis*	L.						LC		LC		NO	NO
LEGUMINOSAE	*Astragalus glycyphyllos*	L.						LC		LC		NO	NO
LEGUMINOSAE	*Ceratonia siliqua*	L.						LC		LC		NO	NO
LEGUMINOSAE	*Galega officinalis*	L.						LC		LC		NO	NO
LEGUMINOSAE	*Glycyrrhiza glabra*	L.						LC		LC		NO	NO
LEGUMINOSAE	*Medicago sativa*	L.						LC		LC		NO	NO
LEGUMINOSAE	*Melilotus officinalis*	(L.) Lam.						LC		LC		NO	NO
LEGUMINOSAE	*Ononis spinosa*	L.						LC		LC		NO	NO
LEGUMINOSAE	*Pisum sativum*	L.						LC		LC		NO	NO
LEGUMINOSAE	*Trifolium alpinum*	L.						LC		LC		YES	YES

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LEGUMINOSAE	*Trifolium pratense*	L.						LC		LC		NO	NO
LENTIBULARIACEAE	*Pinguicula vulgaris*	L.						LC		LC		NO	NO
LILIACEAE	*Lilium candidum*	L.						NT		NT		NO	NO
LILIACEAE	*Lilium martagon*	L.						LC		LC		NO	NO
LYCOPODIACEAE	*Huperzia selago*	(L.) Bernh. ex Schrank & Mart.						LC		LC		NO	NO
LYCOPODIACEAE	*Lycopodium clavatum*	L.	*				*	LC		LC		NO	NO
LYTHRACEAE	*Lythrum salicaria*	L.						LC		LC		NO	NO
MALVACEAE	*Althaea officinalis*	L.						LC		LC		NO	NO
MALVACEAE	*Malva neglecta*	Wallr.						LC		LC		NO	NO
MALVACEAE	*Malva sylvestris*	L.						LC		LC		NO	NO
MELANTHIACEAE	*Veratrum album*	L.						LC		LC		NO	NO
MENYANTHACEAE	*Menyanthes trifoliata*	L.	*				*	LC		LC		NO	NO
MYRTACEAE	*Myrtus communis*	L.						LC		LC		NO	NO
NYMPHAEACEAE	*Nuphar lutea*	(L.) SM.						LC		LC		NO	NO
NYMPHAEACEAE	*Nymphaea alba*	L.						LC		LC		NO	NO
OLEACEAE	*Fraxinus angustifolia*	Vahl						LC		LC		NO	NO
OLEACEAE	*Fraxinus excelsior*	L.						NT		NT		NO	NO
OLEACEAE	*Olea europaea*	L.						DD		DD		NO	NO
ONOCLEACEAE	*Onoclea struthiopteris*	(L.) Roth.						LC		LC		NO	NO
OPHIOGLOSSACEAE	*Botrychium lunaria*	(L.) Swartz						LC		LC		NO	NO
ORCHIDACEAE	*Anacamptis coriophora*	(L.) R.M.Bateman, Pridgeon & M.W.Chase	*	*				LC		LC		NO	NO
ORCHIDACEAE	*Anacamptis laxiflora*	(Lam.) R.M.Bateman & Pridgeon & Chase	*	*				LC		LC		NO	NO
ORCHIDACEAE	*Anacamptis papilionacea*	(L.) R.M.Bateman, Pridgeon & M.W.Chase	*	*				LC		LC		NO	NO
ORCHIDACEAE	*Anacamptis pyramidalis*	(L.) Rich.	*	*	*		*	LC		LC		NO	NO
ORCHIDACEAE	*Anacamptis sancta*	(L.) R.M.Bateman, Pridgeon & M.W.Chase	*	*				NT		NT		NO	NO
ORCHIDACEAE	*Cypripedium guttatum*	Sw.	*	*				LC		NA		NO	NO
ORCHIDACEAE	*Dactylorhiza iberica*	(M.Bieb. ex Willd.) Soó	*	*				VU	B2ab(iii)	VU	B2ab(iii)	NO	NO
ORCHIDACEAE	*Dactylorhiza romana*	(Sebast.) Soó	*	*				LC		LC		NO	NO
ORCHIDACEAE	*Epipactis helleborine*	(L.) Crantz	*	*				LC		LC		NO	NO
ORCHIDACEAE	*Gymnadenia conopsea*	(L.) R.Br. in W.T.Aiton	*	*				LC		LC		NO	NO
ORCHIDACEAE	*Himantoglossum comperianum*	(Steven) P.Delforge	*	*				EN	B2ab(iii,v)	EN	B2ab(iii,v)	NO	NO

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ORCHIDACEAE	*Himantoglossum robertianum*	(Loisel.) P.Delforge	*	*				LC		LC		NO	NO
ORCHIDACEAE	*Neotinea maculata*	(Desf.) Stearn	*	*				LC		LC		NO	NO
ORCHIDACEAE	*Neotinea tridentata*	(Scop.) R.M.Bateman, Pridgeon & M.W.Chase	*	*				LC		LC		NO	NO
ORCHIDACEAE	*Ophrys bombyliflora*	Link	*	*				LC		LC		NO	NO
ORCHIDACEAE	*Ophrys ferrum-equinum*	Desf.	*	*				LC		LC		NO	NO
ORCHIDACEAE	*Ophrys fuciflora*	(F.W.Schmidt) Moench	*	*				LC		LC		NO	NO
ORCHIDACEAE	*Ophrys fusca*	Link	*	*				LC		LC		NO	NO
ORCHIDACEAE	*Ophrys lutea*	Cav.	*	*				LC		LC		NO	NO
ORCHIDACEAE	*Ophrys reinholdii*	Spruner ex Fleischm.	*	*				LC		LC		NO	NO
ORCHIDACEAE	*Ophrys scolopax*	Cav.	*	*				LC		LC		NO	NO
ORCHIDACEAE	*Ophrys speculum*	Link	*	*				LC		LC		NO	NO
ORCHIDACEAE	*Ophrys tenthredinifera*	Willd.	*	*				LC		LC		NO	NO
ORCHIDACEAE	*Ophrys umbilicata*	Desf.	*	*				LC		LC		NO	NO
ORCHIDACEAE	*Orchis anatolica*	Boiss.	*	*				LC		LC		NO	NO
ORCHIDACEAE	*Orchis anthropophora*	(L.) All.	*	*				LC		LC		NO	NO
ORCHIDACEAE	*Orchis italica*	Poir.	*	*				LC		LC		NO	NO
ORCHIDACEAE	*Orchis militaris*	L.	*	*				LC		LC		NO	NO
ORCHIDACEAE	*Orchis pallens*	L.	*	*				LC		LC		NO	NO
ORCHIDACEAE	*Orchis provincialis*	Balb.	*	*		*	*	LC		LC		NO	NO
ORCHIDACEAE	*Orchis purpurea*	Huds.	*	*				LC		LC		NO	NO
ORCHIDACEAE	*Orchis simia*	Lam.	*	*				LC		LC		NO	NO
ORCHIDACEAE	*Orchis spitzelii*	Saut. ex W.D.J.Koch	*	*				NT		NT		NO	NO
ORCHIDACEAE	*Platanthera chlorantha*	(Custer) Rchb. in J.C.Mössler & H.G.L.Reichenbach	*	*				LC		LC		NO	NO
ORCHIDACEAE	*Serapias vomeracea*	(Burm.f.) Briq.	*	*				LC		LC		NO	NO
ORCHIDACEAE	*Traunsteinera globosa*	(L.) Rchb.	*	*				LC		LC		NO	NO
OSMUNDACEAE	*Osmunda regalis*	L.						LC		LC		NO	NO
PAEONIACEAE	*Paeonia mascula*	(L.) Mill.						LC		LC		NO	NO
PAEONIACEAE	*Paeonia officinalis*	L.						LC		LC		YES	NO
PAEONIACEAE	*Paeonia peregrina*	Mill.						LC		LC		NO	NO
PAPAVERACEAE	*Chelidonium majus*	L.						LC		LC		NO	NO
PAPAVERACEAE	*Fumaria officinalis*	L.						LC		LC		NO	NO
PAPAVERACEAE	*Glaucium flavum*	Crantz						LC		LC		NO	NO
PAPAVERACEAE	*Papaver rhoeas*	L.						LC		LC		NO	NO

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PAPAVERACEAE	*Papaver somniferum*	L.						LC		LC		NO	NO
PARNASSIACEAE	*Parnassia palustris*	L.						LC		LC		NO	NO
PINACEAE	*Abies alba*	Mill.						LC		LC		YES	NO
PINACEAE	*Larix decidua*	Mill.						LC		LC		YES	NO
PINACEAE	*Pinus mugo*	Turra						LC		LC		YES	NO
PINACEAE	*Pinus pinaster*	Aiton						LC		LC		NO	NO
PINACEAE	*Pinus sylvestris*	L.						LC		LC		NO	NO
PLANTAGINACEAE	*Plantago afra*	L.						LC		LC		NO	NO
PLANTAGINACEAE	*Plantago arenaria*	Waldst. & Kit.						LC		LC		NO	NO
PLANTAGINACEAE	*Plantago lanceolata*	L.						LC		LC		NO	NO
PLANTAGINACEAE	*Plantago major*	L.						LC		LC		NO	NO
PLANTAGINACEAE	*Plantago maxima*	Juss. ex Jacq.						LC		EN	B1ab(i,ii,iii,iv) +2ab(i,ii,iii,iv)	NO	NO
PLANTAGINACEAE	*Plantago ovata*	Forssk.						LC		LC		NO	NO
POLYGALACEAE	*Polygala calcarea*	F.W.Schultz						LC		LC		YES	YES
POLYGALACEAE	*Polygala major*	Jacq.						LC		LC		NO	NO
POLYGONACEAE	*Persicaria bistorta*	(L.) Samp.						LC		LC		NO	NO
POLYGONACEAE	*Polygonum aviculare*	L.						LC		LC		NO	NO
POLYGONACEAE	*Rumex acetosella*	L.						LC		LC		NO	NO
POLYGONACEAE	*Rumex alpinus*	L.						LC		LC		NO	NO
POLYGONACEAE	*Rumex crispus*	L.						LC		LC		NO	NO
POLYPODIACEAE	*Polypodium vulgare*	L.						LC		LC		NO	NO
PRIMULACEAE	*Cyclamen hederifolium*	Aiton						LC		LC		NO	NO
PRIMULACEAE	*Cyclamen purpurascens*	Mill.						LC		LC		YES	NO
PRIMULACEAE	*Primula elatior*	(L.) Hill						LC		LC		NO	NO
PRIMULACEAE	*Primula farinosa*	L.						LC		LC		NO	NO
PRIMULACEAE	*Primula veris*	L.						LC		LC		NO	NO
PTERIDACEAE	*Adiantum capillus-veneris*	L.						LC		LC		NO	NO
RANUNCULACEAE	*Aconitum lycoctonum*	L.						LC		LC		NO	NO
RANUNCULACEAE	*Aconitum napellus*	(Nyár.) W.Seitz	*			*		LC		LC		YES	NO
RANUNCULACEAE	*Actaea spicata*	L.						LC		LC		NO	NO
RANUNCULACEAE	*Adonis vernalis*	L.	*	*			*	LC		LC		NO	NO
RANUNCULACEAE	*Anemone halleri*	All.						LC		LC		YES	NO
RANUNCULACEAE	*Aquilegia nigricans*	Baumg.						DD		DD		YES	NO
RANUNCULACEAE	*Delphinium staphisagria*	L.						LC	NO	LC		NO	NO
RANUNCULACEAE	*Ficaria verna*	Huds.						LC		LC		NO	NO

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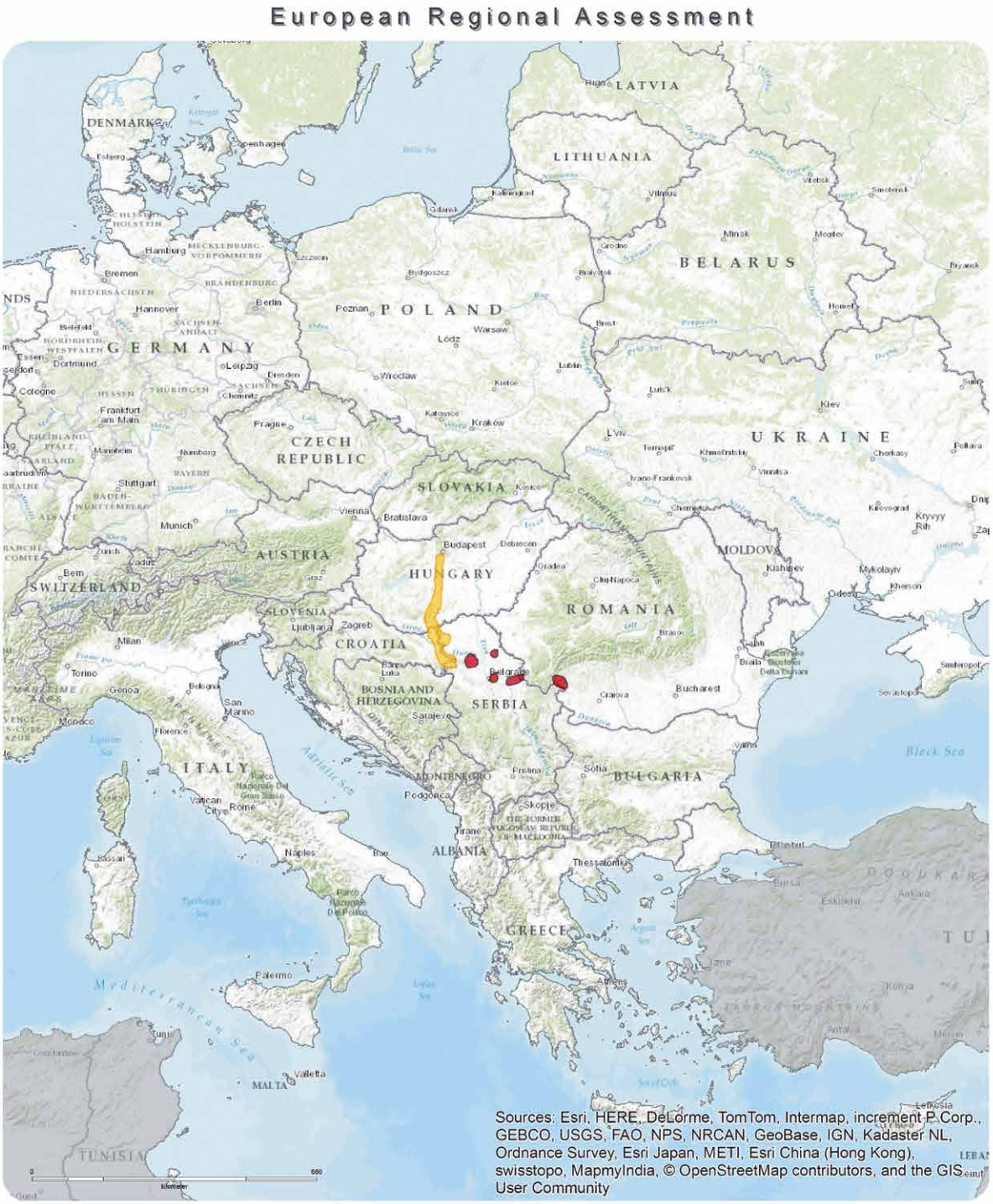
RANUNCULACEAE	*Helleborus foetidus*	L.						LC		LC		NO	NO
RANUNCULACEAE	*Helleborus purpurascens*	Waldst. & Kit.						LC		LC		YES	NO
RANUNCULACEAE	*Hepatica nobilis*	Mill.						LC		LC		NO	NO
RANUNCULACEAE	*Pulsatilla vernalis*	(L.) Mill.						LC		LC		YES	NO
RANUNCULACEAE	*Pulsatilla vulgaris*	Mill.	*		*			NT		NT		YES	YES
RHAMNACEAE	*Frangula alnus*	Mill.						LC		LC		NO	NO
ROSACEAE	*Agrimonia eupatoria*	L.						LC		LC		NO	NO
ROSACEAE	*Alchemilla acutiloba*	Opiz						LC		LC		NO	NO
ROSACEAE	*Alchemilla crinita*	Buser						DD		DD		NO	NO
ROSACEAE	*Alchemilla mollis*	(Buser) Rothm.						DD		DD		NO	NO
ROSACEAE	*Alchemilla xanthochlora*	Rothm.						LC		LC		YES	NO
ROSACEAE	*Aphanes arvensis*	L.						LC		LC		NO	NO
ROSACEAE	*Crataegus azarolus*	L.						LC		LC		NO	NO
ROSACEAE	*Crataegus laevigata*	(Poir.) DC.						LC		LC		YES	NO
ROSACEAE	*Crataegus monogyna*	Jacq.						LC		LC		NO	NO
ROSACEAE	*Crataegus nigra*	Waldst. & Kit.						EN	A2ac; B1ab (i,ii,iii,iv,v)+ 2ab(i,ii,iii,iv,v)	EN	A2ac; B1ab (i,ii,iii,iv,v) +2ab(i,ii,iii ,iv,v)	YES	NO
ROSACEAE	*Crataegus pentagyna*	Waldst. & Kit.						DD		DD		NO	NO
ROSACEAE	*Filipendula ulmaria*	(L.) Maxim.						LC		LC		NO	NO
ROSACEAE	*Filipendula vulgaris*	Moench						LC		LC		NO	NO
ROSACEAE	*Fragaria vesca*	L.						LC		LC		NO	NO
ROSACEAE	*Geum urbanum*	L.						LC		LC		NO	NO
ROSACEAE	*Malus sylvestris*	(L.) Mill.						DD		DD		YES	NO
ROSACEAE	*Potentilla erecta*	(L.) Raeusch.						LC		LC		NO	NO
ROSACEAE	*Prunus spinosa*	L.						LC		LC		NO	NO
ROSACEAE	*Rosa agrestis*	Savi						LC		LC		NO	NO
ROSACEAE	*Rosa canina*	L.						LC		LC		NO	NO
ROSACEAE	*Rosa gallica*	L.						DD		NT		NO	NO
ROSACEAE	*Rosa marginata*	Wallr.						LC		LC		NO	NO
ROSACEAE	*Rosa pendulina*	L.						LC		LC		YES	NO
ROSACEAE	*Rosa rubiginosa*	L.						LC		LC		NO	NO
ROSACEAE	*Rosa stylosa*	Desv.						DD		DD		NO	NO
ROSACEAE	*Rosa tomentosa*	Sm.						LC		LC		NO	NO
ROSACEAE	*Rosa villosa*	L.						DD		DD		NO	NO

FAMILY	*Taxon*	Taxon Authority	EU Policy species	CITES Appendices	Habitat Directive Annexes	Bern Convention	EU Wildlife Trade Regulation	IUCN Red List Category (Europe)	IUCN Red List Criteria (Europe)	IUCN Red List Category (EU27)	IUCN Red List Criteria (EU27)	Endemic to Europe?	Endemic to EU27?
ROSACEAE	*Rubus caesius*	L.						LC		LC		NO	NO
ROSACEAE	*Rubus fruticosus*	L.						LC		LC		NO	NO
ROSACEAE	*Rubus idaeus*	L.						LC		LC		NO	NO
ROSACEAE	*Sanguisorba officinalis*	L.						LC		LC		NO	NO
RUBIACEAE	*Galium aparine*	L.						LC		LC		NO	NO
RUBIACEAE	*Galium odoratum*	(L.) Scop.						LC		LC		NO	NO
RUBIACEAE	*Galium verum*	L.						LC		LC		NO	NO
RUSCACEAE	*Ruscus aculeatus*	L.	*		*			LC		LC		NO	NO
RUSCACEAE	*Ruscus hypoglossum*	L.						LC		LC		NO	NO
RUTACEAE	*Dictamnus albus*	L.						LC		LC		NO	NO
RUTACEAE	*Ruta graveolens*	L.						LC		LC		NO	NO
SALICACEAE	*Populus alba*	L.						LC		LC		NO	NO
SALICACEAE	*Salix alba*	L.						LC		LC		NO	NO
SALICACEAE	*Salix daphnoides*	Vill.						LC		LC		YES	NO
SALICACEAE	*Salix fragilis*	L.						LC		LC		NO	NO
SALICACEAE	*Salix purpurea*	L.						LC		LC		NO	NO
SAXIFRAGACEAE	*Chrysosplenium alternifolium*	L.						LC		LC		NO	NO
SAXIFRAGACEAE	*Saxifraga vayredana*	Luizet	*		*	*		LC		LC		YES	YES
SCROPHULARIACEAE	*Digitalis grandiflora*	Mill.						LC		LC		NO	NO
SCROPHULARIACEAE	*Digitalis lanata*	Ehrh.						LC		LC		NO	NO
SCROPHULARIACEAE	*Digitalis purpurea*	L.						LC		LC		NO	NO
SCROPHULARIACEAE	*Euphrasia rostkoviana*	Hayne						LC		LC		NO	NO
SCROPHULARIACEAE	*Gratiola officinalis*	L.						LC		LC		NO	NO
SCROPHULARIACEAE	*Scrophularia nodosa*	L.						LC		LC		NO	NO
SCROPHULARIACEAE	*Verbascum densiflorum*	Bertol.						LC		LC		NO	NO
SCROPHULARIACEAE	*Verbascum phlomoides*	L.						LC		LC		NO	NO
SCROPHULARIACEAE	*Verbascum thapsus*	L.						LC		LC		NO	NO
SCROPHULARIACEAE	*Veronica officinalis*	L.						LC		LC		NO	NO
SMILACACEAE	*Smilax aspera*	L.						LC		LC		NO	NO
SOLANACEAE	*Atropa baetica*	Willk.	*		*	*		EN	B2ab(iii,iv); D	EN	B2ab(iii,iv); D	NO	No
SOLANACEAE	*Physalis alkekengi*	L.						LC		LC		NO	NO
SOLANACEAE	*Scopolia carniolica*	Jacq.						LC		LC		NO	NO
SOLANACEAE	*Solanum dulcamara*	L.						LC		LC		NO	NO
SOLANACEAE	*Withania somnifera*	(L.) Dunal						DD		DD		NO	NO
THYMELAEACEAE	*Daphne laureola*	L.						LC		LC		NO	NO

FAMILY	*Taxon*	Taxon Authority	EU Policy species	CITES Appendices	Habitat Directive Annexes	Bern Convention	EU Wildlife Trade Regulation	IUCN Red List Category (Europe)	IUCN Red List Criteria (Europe)	IUCN Red List Category (EU27)	IUCN Red List Criteria (EU27)	Endemic to Europe?	Endemic to EU27?
THYMELAEACEAE	*Daphne mezereum*	L.						LC		LC		NO	NO
TILIACEAE	*Tilia cordata*	Mill.						LC		LC		NO	NO
TILIACEAE	*Tilia platyphyllos*	Scop.						LC		LC		YES	NO
TILIACEAE	*Tilia tomentosa*	Moench						LC		LC		NO	NO
TRAPACEAE	*Trapa natans*	L.	*			*		NT		NT		NO	NO
TRILLIACEAE	*Paris quadrifolia*	L.						LC		LC		NO	NO
UMBELLIFERAE	*Ammi majus*	L.						LC		LC		NO	NO
UMBELLIFERAE	*Ammi visnaga*	(L.) Lam.						LC		LC		NO	NO
UMBELLIFERAE	*Angelica archangelica*	L.						LC		LC		NO	NO
UMBELLIFERAE	*Apium graveolens*	L.						LC		LC		NO	NO
UMBELLIFERAE	*Bupleurum falcatum*	L.						LC		LC		NO	NO
UMBELLIFERAE	*Carum carvi*	L.						LC		LC		NO	NO
UMBELLIFERAE	*Cicuta virosa*	L.						LC		LC		NO	NO
UMBELLIFERAE	*Crithmum maritimum*	L.						LC		LC		NO	NO
UMBELLIFERAE	*Daucus carota*	L.						LC		LC		NO	NO
UMBELLIFERAE	*Eryngium maritimum*	L.						LC		LC		NO	NO
UMBELLIFERAE	*Eryngium planum*	L.						LC		LC		NO	NO
UMBELLIFERAE	*Foeniculum vulgare*	Mill.						LC		LC		NO	NO
UMBELLIFERAE	*Oenanthe aquatica*	(L.) Poir.						LC		LC		NO	No
UMBELLIFERAE	*Oenanthe crocata*	L.						LC		LC		NO	YES
UMBELLIFERAE	*Peucedanum officinale*	L.						LC		LC		NO	NO
UMBELLIFERAE	*Sanicula europaea*	L.						LC		LC		NO	NO
URTICACEAE	*Urtica dioica*	L.						LC		LC		NO	NO
URTICACEAE	*Urtica kioviensis*	Rogow.						DD		DD		YES	NO
URTICACEAE	*Urtica urens*	L.						LC		LC		NO	NO
VALERIANACEAE	*Valeriana officinalis*	L.						LC		LC		NO	NO
VERBENACEAE	*Verbena officinalis*	L.						LC		LC		NO	NO
VERBENACEAE	*Vitex agnus-castus*	L.						DD		DD		NO	NO
VIOLACEAE	*Viola arvensis*	Murray						LC		LC		NO	NO
VIOLACEAE	*Viola canina*	L.						LC		LC		NO	NO
VIOLACEAE	*Viola odorata*	L.						LC		LC		NO	NO
VIOLACEAE	*Viola tricolor*	L.						LC		LC		NO	NO
VISCACEAE	*Viscum album*	L.						LC		LC		NO	NO
VITACEAE	*Vitis vinifera*	L.						LC		LC		NO	NO
ZYGOPHYLLACEAE	*Tribulus terrestris*	L.						LC		LC		NO	NO

Appendix 2. Example species summary and distribution map: *Crataegus nigra*



Crataegus nigra

Range

Extant (resident)

Extinct

Compiled by:

Map created 07/15/2014

The boundaries and names shown and the designations used on this map do not imply any official endorsement, acceptance or opinion by IUCN.

THE IUCN RED LIST OF THREATENED SPECIES™

environment

EUROPEAN COMMISSION

Crataegus nigra - Waldst. & Kit.

PLANTAE - TRACHEOPHYTA - MAGNOLIOPSIDA - ROSALES - ROSACEAE - Crataegus - nigra

Common Names: Hungarian Thorn (English), Crni glog (Croatian), Fekete galagonya (Hungarian), Pannonian Black Hawthorn (English)
Synonyms: Mespilus nigra (Waldst. & Kit.) Willd.

Red List Status
EN - Endangered, A2ac; B1ab(i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v) (IUCN version 3.1)

Red List Assessment

Assessment Information

Reviewed?	Date of Review:	Status:	Reasons for Rejection:	Improvements Needed:
true	2014-05-28	Passed	-	-

Assessor(s): Bartha, D.

Reviewer(s): Allen, D.J., Idzojtic, M. & Leaman, D.J.

Contributor(s): Khela, S., Király, G., Turonova, D. & Idzojtic, M.

Assessment Rationale

The species is endemic to central-eastern Europe (Carpathian Basin) and the northern Balkans; confirmed historical native records of the species are from Hungary, Slovakia, Croatia, Romania, and Serbia, however it appears that the species range has greatly diminished in recent years, with confirmed current records only known from the Danube floodplain in Hungary and Croatia (D. Bartha pers com 2014) and Serbia, with no recent records of the species from other former parts of its range, and it is considered possibly extinct in Slovakia and Romania.

In Hungary, the forest habitat area has been reduced due to industrialization. It is also impacted by a range of threats including forest clearance, forest management methods, development of plantations, declining groundwater levels, and grazing by wild animals (primarily deer). Based on available recent records of the species from Hungary and Croatia (D. Bartha pers. comm. 2014), the extent of occurrence of the species is estimated at 3,188 km^2 and the area of occupancy at 128 km^2 (the latter is assumed to be an under-estimate).

This species is given a precautionary assessment of Endangered (A2ac; B1ab(i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v)) in both Europe (and thus globally) and the EU 27, as it is threatened or has disappeared across a significant portion of its range over the past several decades, and continues to decline. Although the population decline can't be accurately estimated with the data available, it is thought to approach or exceed 50% in the past three generations, with causative declines in AOO, EOO, and habitat quality and extent.

More information on the current population size, trends and the overall rate of decline is needed, and confirmation of the species presence and distribution in all parts of its former range. This species' habitat should be protected, unfavourable forest management methods improved, and alien species controlled to protect declining populations.

Distribution

Geographic Range

The species is endemic to central-eastern Europe (the Carpathian Basin) and the northern Balkans (Kurtto 2009, USDA 2013). Confirmed records of the species are from Hungary, Slovakia, Croatia, Romania and Serbia (G. Király pers. comm. 2013), however it appears that the species' range has greatly diminished in recent years, with current confirmed records known only from the Danube floodplain in Hungary and Croatia (D. Bartha pers. comm. 2014).

In the northern Balkans, the species was known from the Danube basin, but is considered possibly extinct from here, with no recent records (D. Bartha pers. comm. 2014). Records from the Suva Planina Mountains in southeast Serbia (Papp and Erzberger 2009) require confirmation as they may be a misidentification of *Crataegus pentagyna,* as may records from Montenegro (D. Bartha pers. comm. 2014).

Hungary
26 recent populations known, ten populations disappeared in the last 50 years, with recent records of the species restricted to along the Danube from Csepel Island to the Hungarian border.

Slovakia
Possibly extinct; previously recorded from Bratislava (old data); currently only known in cultivation (Marhold and Hindák 2014).

Croatia
The species is present south from the Hungary-Croatia border along the Danube, in the Baranja and Eastern Slavonia regions; the southeastern population is near Ilok.

Serbia
Previously known from nine sites along the Danube, but considered likely to have been lost from some; there are recent records from the Begečka Jama wetlands (Danube Virtual Museum 2014), the Gornje Podunavlje Ramsar wetland (Stojnić 2007) and the Karapandža natural park (Márkus and Ŝakić undated); records of the species from the Suva Planina Mountains require confirmation.

Romania
Five sites were known along the Danube; possibly extinct, the eastern occurrence of the species was from Turnu Severin, with the last record from 1955.

Considered introduced (cultivated) in the Czech Republic (Danihelka *et al.* 2012). The species has in the past been misidentified as *Crataegus pentagyna* Waldst. & Kit. ex Willd., but this species lives in xerotherm forests, while *C. nigra* is found in alluvial forests (Bartha and Kerényi-Nagy 2010).

Based on available recent records of the species from Hungary and Croatia (D. Bartha pers. comm. 2014), the extent of occurrence of the species is estimated at 3,188 km^2 and the area of occupancy at 128 km^2 (the latter is assumed to be an under-estimate).

Elevation / Depth / Depth Zones

Elevation Lower Limit (in metres above sea level): 80

Elevation Upper Limit (in metres above sea level): 100

Map Status

Map Status	Data Sensitive?	Justification	Geographic range this applies to:	Date restriction imposed:
Done	-	-	-	-

Biogeographic Realms

Biogeographic Realm: Palearctic

Occurrence

Countries of Occurrence

Country	Presence	Origin	Formerly Bred	Seasonality
Croatia	Extant	Native	-	Resident
Czech Republic	Extant	Introduced	-	Resident
Hungary	Extant	Native	-	Resident
Romania	Possibly Extinct	Native	-	Resident
Serbia	Extant	Native	-	Resident
Serbia -> Serbia	Extant	Native	-	Resident
Slovakia	Possibly Extinct	Native	-	Resident

Population

The total population size is unknown, but this species is uncommon across its remaining range; it is rare in Hungary and Croatia (M. Idzojtic pers. comm. 2014), and possibly extinct in the wild in Serbia, Romania, and Slovakia (Kurtto 2009, G. Király pers. comm. 2013).

In Slovakia its threat status is unclear according to Čeřovský *et al.* (1999); Marhold and Hindák (2014) list it as occurring only in cultivation in Slovakia. Although it is rare and fairly unknown in Croatia, it is naturally widespread along the Danube River in Baranja and Eastern Slavonia. The population is considered endangered and declining in Hungary, where a majority of the subpopulations are found (Baričevič *et al.* 2004, Király 2007, G. Király pers. comm. 2013).

In Croatia, the number of known sub-populations has declined by nearly 50% (from 57 to 29 sub-populations; D. Bartha, pers. comm. 2014).

Population Information

Continuing decline in mature individuals?	Qualifier	Justification
Yes	Observed	-

Habitats and Ecology

A deciduous tree or shrub found in found in alluvial forests (Bartha and Kerényi-Nagy 2010), forest edges and shrubland. It occurs sporadically in closed forest stands, though it does not thrive there. It differs from other European species of *Crataegus* in that it is found in flooded alluvial habitats along major waterways and edges of poplar, ash and oak forests, where it usually forms small stands in the form of secondary hydrophilic bushy communities (Papp and Erzberger 2009, Čarni *et al.* 2004, Franjić *et al.* 2006). Many *Crataegus* species are long-lived, with some living for hundreds of years; the generation length for this species is estimated at 30-50 years.

IUCN Habitats Classification Scheme

Habitat	Season	Suitability	Major Importance?
1.4. Forest -> Forest - Temperate	resident	Suitable	No
3.8. Shrubland -> Shrubland - Mediterranean-type Shrubby Vegetation	resident	Suitable	Yes
5.2. Wetlands (inland) -> Wetlands (inland) - Seasonal/Intermittent/Irregular Rivers/Streams/Creeks	resident	Suitable	Yes
6. Rocky areas (eg. inland cliffs, mountain peaks)	resident	Suitable	No

Life History

Generation Length	Justification	Data Quality
30-50	Likely to be more than 10 years, since many Crataegus species are long-lived, with some living for hundreds of years.	unknown

Breeding Strategy

Does the species lay eggs?	Does the species give birth to live young	Does the species exhibit parthenogenesis
No	No	No

Does the species have a free-living larval stage?	Does the species require water for breeding?
No	No

Systems

System: Terrestrial

Use and Trade

General Use and Trade Information

This species is planted along water courses to repair embankments (Papp and Erzberger 2009, Čarni *et al.* 2004, Franjić *et al.* 2006). It is considered to be a medicinal and aromatic plant (Kathe *et al.* 2003) and is known for its fruit (Baričevič *et al.* 2004).

Subsistence:	Rationale:	Local Commercial:	Further detail including information on economic value if available:
No	-	Yes	-

National Commercial Value: Yes

International Commercial Value: No

Is there harvest from captive/cultivated sources of this species? Yes

Threats

In Hungary, the forest habitat area has been reduced due to industrialization (Baričevič *et al.* 2004). It is also threatened by forest clearance, rough forest management methods, forestation with alien species, overpopulated game-stock, introgressive hybridization, gene pool erosion and shrub clearance (Bartha and Nagy 2004, Bartha and Kerényi-Nagy 2013), as well as significant hybridization with *Crataegus monogyna* (Király 2007). Additional threats include declining groundwater levels, and grazing by wild animals (primarily deer).

Conservation

Assessed as Endangered in Hungary, where a major proportion of its subpopulations are found and it is strictly protected (Király 2007, G. Király pers. comm. 2013). It is listed as presumably extinct in Slovakia in the Euro+Med Plantbase (Kurtto 2009), though according to Čeřovský *et al.* (1999), its threat status is unclear. It does not appear in the Carpathian Red List (Witkowski *et al.* 2003), and is not listed in the Red Book of Vascular Flora of Croatia (Nikolić and Topić 2005). The species occurs in several protected areas within its range including Béda-Karapancsa / Karapandža transboundary park, the Begečka Jama wetlands, and the Gornje Podunavlje Ramsar wetland.

More information is needed on the overall population size and trends. Where the species is threatened, its habitat should be protected, unfavourable forest management methods improved, and game-stock and alien species controlled to protect declining populations.

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The Species Survival Commission (SSC) is the largest of IUCN's six volunteer commissions with a diverse global membership of nearly 10,000 experts. With biodiversity loss as one of the world's most pressing crises, and many species declining to critical levels, the SSC drives its efforts and expertise to conserving nature through positive and informed action. This is achieved through the strength of its dedicated science-based network of volunteer experts who constitute the invaluable "power house" of the SSC.

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The IUCN Global Species Programme supports the activities of the IUCN Species Survival Commission and individual Specialist Groups, as well as implementing global species conservation initiatives. It is an integral part of the IUCN Secretariat and is managed from IUCNs international headquarters in Gland, Switzerland. The Global Species Programme includes a number of technical units covering Species Trade and Use, The IUCN Red List, Freshwater Biodiversity Unit and Climate Change Unit (all located in Cambridge, UK), the Biodiversity Assessment Unit (located in Arlington, VA, USA), and the Marine Biodiversity Unit (hosted by Old Dominion University Norfolk VA, USA).

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The IUCN European Union Representative Office is located in Brussels. It is an out-posted Headquarters office unit providing global services to the organization, and vital linkages for IUCN - its Members, National Committees, scientific Commissions and the global Secretariat - to key EU institutions and other public and private actors with regional headquarters in Brussels. The IUCN EU Office is the focal point for EU nature policies, partnerships and networking, and influencing decisions and raising awareness of nature conservation among the EU institutions are at the core of its mandate. The IUCN EU Office hosts staff dedicated to the above mentioned functions as well as project staff from the Global Species Programme.

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The European Red List is a review of the conservation status of European species according to IUCN regional Red Listing guidelines. It identifies those species that are threatened with extinction at the regional level – in order that appropriate conservation action can be taken to improve their status.

This publication summarises results for a selection of Europe's native species of medicinal plants. 2.4% of the 400 extant species for which sufficient data are available are threatened with extinction at the European level as a result of threats that include collection of plants from the wild and agriculture (livestock farming, annual and perennial non-timber crops, and plantation forestry). Although the level of threat is currently low, data for many of the species is lacking and monitoring of harvest and trade is recommended.

The European Red List was compiled by IUCN's Global Species Programme and the European Union Representative Office and is the product of a service contract with the European Commission. It is available online at http://ec.europa.eu/environment/nature/conservation/species/redlist and http://www.iucnredlist/initiatives/europe

KH-07-14-079-EN-N

DOI: 10.2779/907382

Publications Office