# Appendix 2.5: Provision of medicinal plant resources in Europe and Central Asia

## *Introduction*

This appendix provides more detail about the assessment approach for the medicinal plants section. This includes results from the literature review on medicinal plants and the expert elicitation that reviewed the collated information which was presented in the Second Order Draft of the assessment, with in addition some focused elicitation questions regarding evidence and key recommendations.

For the specific literature review on medicinal plants, we built on the recent state of knowledge (SoK) review coordinated by WHO and CBD ((World Health Organization & Secretariat of the Convention on Biological Diversity, 2015)). We only searched the period 2014 – February 2017 in order to update the SoK. We looked for reviews only, adding some non-review papers if relevant. For medicinal plants, exceptionally, we also included non-review papers. Further, we added two regional categories: General region (e.g. Europe, Balkan, Mediterranean region) and Marine. We used the following specific search string for medicinal plants:

(TS=("biological diversity" OR biodivers* OR "living natural resource*" OR "living resource*" OR "natur* diversity" OR "diversity in nature" OR "*species diversity" OR "diversity of species" OR "habitat diversity" OR "diversity of habitat*" OR "int*-speci* diversity" OR "genetic diversity" OR "diversity of gene*" OR "landscape diversity" OR "diversity of landscape*" OR ecosystem* OR "ecological system*" OR "ecosystem service*" OR "landscape service*" OR "environmental service*" OR "ecological service*" OR "natur* capital*" OR "nature based solution*" OR "environmental capital*" OR "green infrastructure" OR greenspace* OR "green space*" OR "blue infrastructure" OR bluespace* OR "blue space*" OR flora* OR fauna* OR wildlife OR "natural habitat*" OR "ecological habitat" OR "wildlife habitat*" OR "invasive * species" OR biogeograph* OR "bio-geograph*" OR "natur* space*" OR "natur* environ*")) NOT (TS=("the nature of" OR "*power plant*" OR "*hydro plant" OR "*nuclear plant" OR "*electric plant" OR "*thermal plant" OR "*coal plant" OR "*fired plant") OR TI=(America* OR "US" OR Africa* OR Russia OR Australia* OR Oceania*)) AND ((TS=("biodiversity for medicine" OR "biodiversity for food and medicine" OR "biological diversity for medicine" OR "biological diversity for food and medicine" "biodiversity-based medicin*" OR "biodiversity-derived medicin*" OR bioprospecting OR "biodiversity-based prospecting" OR "biodiversity based prospecting" OR "prospecting from natur*" OR "medicine* from natur*" OR "medicine* derived from natur*" OR "medicinal species" OR "medicinal plant*" OR "medicinal and aromatic plant*" OR "medicinal animal*" OR "medicinal fung*") OR (TS=(("animal model*" OR "biomedical model*" OR "ecologic* model*" OR "plant model*" OR "wildlife model*" OR "biomedical research" OR biomim*ic* OR "comparative anatom*" OR "comparative audiolog*" OR "comparative biochemistry" OR "comparative dolorolog*" OR "comparative immunolog*" OR "comparative endocrinolog*" OR "comparative neurolog*" OR "comparative oncolog*" OR "comparative opthalmolog*" OR "comparative osteolog*" OR "comparative toxicolog*" OR "innate immunity" OR neurogen* OR "cell regeneration" OR "organ regeneration" OR "tissue regeneration" OR "regeneration research" OR "stem-cell research" OR "wildlife immun*" OR "evo-devo" OR "evo-eco-devo" OR "eco-evo-devo" OR "evolution and development" OR "evolution, ecology and development"))

Why an expert elicitation? The linkages between nature and health are of increasing research and policy interest. Whilst research efforts are increasingly interdisciplinary, there is still a need for greater integration of different fields of expertise and recognition of the importance of accounting for different forms of knowledge, as with other aspects of biodiversity policy ((Pullin, Frampton, & Jongman, 2016)).

With this perspective in mind, in addition to following the literature methodology of this chapter we also engaged in a process of IPBES-approved expert elicitation to strengthen the quality of the assessment and literature review. This also supports a key aim of IPBES, which is to build capacity in this rapidly growing field.

First, we present here the text on medicinal plants as it was presented to the experts taking part in the expert elicitation. We incorporated some key suggestions from reviewers in order to as to not leave the valuable review comments without use and to the extent practically feasible at this stage: we consider more structural changes not very useful at this stage, as we had to drastically downsize the assessment text on medicinal plants and we want readers to keep a good understanding of the information basis of the expert elicitation.

Second, we present the questions posed to the experts and the outcomes of the expert elicitation.

## *Literature review results put forward in the expert elicitation*

The value of biodiversity as a resource for the production of medicines is perhaps one of the clearest and most readily understood examples of the relationships between the natural world and our health and well-being. Numerous species of plants, animals and fungi have been used to produce traditional therapies since ancient times, and wild flora and fauna continue to support the development of modern pharmaceutical products. This intersection of biodiversity, health and culture is a fertile ground for inter- and transdisciplinary studies, with interest across numerous disciplines including anthropology, health psychology, archaeology, ethnobiology, ethnopharmacy, veterinary, human medicine and others (Heinrichs & Jäger, 2015; Payyappallimana & Subramanian, 2015).

This section considers medicinal plants 1. as part of traditional and local medicinal practices, 2. as the more mainstream use of medicinal plant products which are sold commercially in the ECA region, and 3. as the use of medicinal plants in modern pharmaceutical development. It covers plants which are harvested directly from the wild, as well as those which are grown in home gardens or cultivated commercially at larger scales. It is important to note also that the topic of medicinal plants overlaps in many ways with issues relating to agriculture, food and nutrition, and genetic resources, and that many of the policy and ethical issues associated with medicinal plants converge with issues of equitable access to, and sharing of the benefits from, genetic resources.

## *Distribution and conservation status of medicinal plants in Europe and Central Asia*

A number of sub-regions in Europe are characterized by particularly high medicinal plants species richness, including the Mediterranean region, the Alps and the Pyrenees, the Massif Central in France, the Balkan Peninsula, the Crimean Peninsula and the Carpathian Mountains (**Figure 2.5.1**) (Allen et al., 2014).

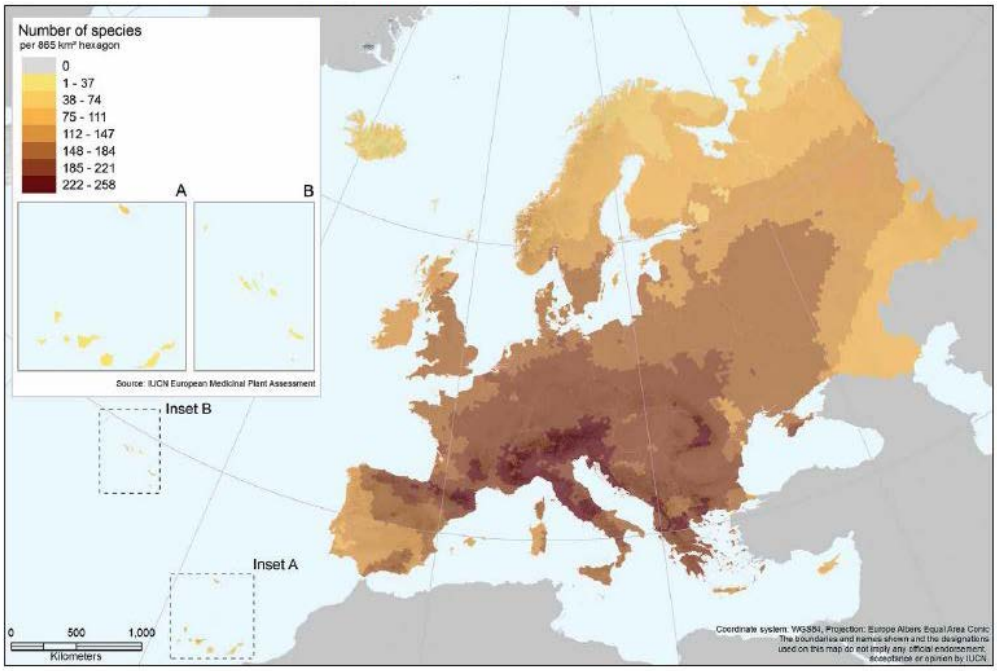


**Figure 2.5.1: Species richness of selected European medicinal plants. Source: Allen et al. (2014).**

While comprehensive data on the conservation status of these species in the entire region is scarce, an assessment of the IUCN Red List status of medicinal vascular plants has recently been undertaken for the EU and for continental Europe ("pan-Europe") (Allen et al., 2014). The report concluded that 2,4 % of the 400 assessed extant medicinal plant species in pan-Europe were threatened – out of them three Vulnerable (VU), six Endangered (EN), but none Critically Endangered (CR) (Allen et al., 2014). However, twenty-five species were considered Data Deficient, meaning that these species can potentially also be threatened. A further eighteen taxa (4.5%) at the pan-Europe level were considered Near Threatened (Allen et al., 2014). As for population trends, 41% of the evaluated four hundred medicinal plants species in Europe were assessed as having a stable population trend and 31% were considered to be declining in population size in Europe (Allen et al., 2014). The same study (Allen et al., 2014) identified collection of plants of the wild and loss of habitat due to residential and commercial development as the most significant threats affecting medicinal plants in Europe. For more detailed information about international and national medicinal plants conservation policy instruments see **Table 2.5.1.**

**Table 2.5.1 International and national medicinal plants conservation policy instruments**

| | |
|---|---|
| *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 |
| *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 |
| *Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES)* | 41 medicinal plants species included in the recent European List of Medicinal Plants report are listed in CITES Appendix II (Allen et al., 2014). |
| *Several national policies e.g. in Bulgaria* | 770 medicinal plants species were reported in Bulgaria by (Evstatieva, Hardalova, & Stoyanova, 2007), including 180 arboreal plants used in different areas of medicine (Tashev & Tsavkov, 2008) |

At the international level the Convention on Biological Diversity (CBD) provides an overarching framework for conservation of biological diversity and sustainable use of its components. In national CBD reports 12 countries report about medicinal plants (mainly Eastern Europe and Central Asia), be it mentioning different kind of information about these species which makes it difficult to compare (**Table 2.5.2.**).

**Table 2.5.2: ECA region national CBD reports mentioning medicinal plants (N=12).**

| *Country* | *Source* | *Number of medicinal plants reported* | *Production* |
|---|---|---|---|
| Armenia | Fifth national report (2014) | 10% of the species composition of the flora of Armenia<br><br>122 species of macrofungi with pharmacological properties | |
| Azerbaijan | Fifth national report (2014) | 800 plant species of medicinal value, including 150 species used in pharmacology | |
| Belarus | Fifth national report (2014) | 81 medicinal plant species | |
| Bosnia and Herzegovina | Fifth national report (2014) | | 3.406.573 kg of medicinal plants and forest fruit was exported in 2010 only |
| Georgia | Fifth national report (2015) | 1200 plant species used as medicinal herbs | |
| Israel | Fifth national report (2016) | 80 kinds of wild plants identified to have medical benefit | |
| Kazakhstan | Fifth national report (2014) | 1525 species of medicinal plants | |
| Kyrgyzstan | Fifth national report (2014) | More than 200 medicinal plants species used in traditional and official medicine | |
| Lithuania | Fourth national report (2009) | Over 100 medicinal plants species growing in the forests | Decrease in medicinal plants purchases from 22576 kg in 2004 to 16129 kg in 2008 |
| Republic of Moldova | Fifth national report (2015) | 200 species of medicinal plants | |
| Serbia | Fifth national report (2014) | | In 2012 the turnover of medicinal and aromatic herbs amounted to more than 24.5 million dollars, of which the income from export amounted to 19 million dollars |
| Tajikistan | Fifth national report (2014) | More than 60 varieties of wild-growing medicinal herbs that in one or another form permitted to use by the public health authorities | |

Different studies provide different estimates of the number of medicinal plants growing in Europe and Central Asia but there are no figures available for this entire region. Some sources estimate between

1200 and 1300 medicinal and aromatic plant species to be native to Europe (Lange, 1998). Several studies include relatively high numbers for individual countries (**Table 2.5.3**). In a review of recent scientific literature (2014-Feb 2017), we found a total of 64 relevant scientific publications in English. These studies also display information about plant species, health treatments derived from them as well as some socio-economic information. According to our review, the number of studies is higher in the Mediterranean and Central European region, with Turkey having most publications per country (N=17).

**Table 2.5.3: Country or region studies listing medicinal plants.**

| *Region* | *Medicinal species* | *Source* |
|---|---|---|
| Former USSR | Up to 600 species | Землинский 1958 |
| Central Asia | 200 medicinal plant species from forest ecosystems only | (FAO, 2006) |
| | up to 600 species | (Egamberdieva et al., 2013) |
| Turkestan Range in South-western Kyrgyzstan | 50 medicinal plant taxa | (Pawera., 2016) |
| Chatkal Biosphere Reserve in Uzbekistan | 117 medicinal plants | (Egamberdieva et al., 2013) |
| Kyrgyzstan | 200 species of medicinal vascular plants | (Eisenmanet al., 2014) |
| Uzbekistan | 600 species of medicinal vascular plants | |
| Armenia | 1700 medicinal plant species | (Zolotnitskaya, 2014) |

## *Medicinal plant knowledge*

### *Experimental knowledge*

In a recent literature search (2014 – Feb 2017) we found 28 publications dealing with experimental medicinal plant studies (**Table 2.5.7**). 16 are focused on establishing evidence for medicinal effectiveness of medicinal plants. Some of these studies specifically focus on establishing evidence regarding local traditional medicinal use in countries where the research was done. Some experimental studies focused on (e.g. chemical or genetic) characterization of medicinal plants. This can e.g. be important for informing local users.

### *Traditional medicinal knowledge*

"Traditional medicine" follows the definition outlined by the World Health Organisation[1], as "the sum total of the knowledge, skills, and practices based on the theories, beliefs, and experiences indigenous to different cultures, whether explicable or not, used in the maintenance of health as well as in the prevention, diagnosis, improvement or treatment of physical and mental illness."

The importance of biodiversity-derived medicines for population health has been widely reported, with the WHO estimating that 70-80% of the global population depend on some form of traditional or indigenous medicinal knowledge for their primary health care (Ekor, 2014). Medicinal plant knowledge in Europe is rooted in a long history of health traditions dating back to ancient Sumerian, Egyptian, Greek, Roman and Arabic medical systems and, over the millennia, has been transmitted from generation to generation through both oral histories and written texts. Plant use has formed the basis of European Traditional Medicine since at least the Middle Ages (fifth to fifteenth centuries AD), with more specialised use of plants, such as homeopathy and the extraction of alkaloids, emerging from the nineteenth Century onwards (Allen et al., 2014; Firenzuoli & Gori, 2007; Petrovska, 2012; C. L. Quave, Pardo-De-Santayana, & Pieroni, 2012). Over time, Chinese, Indian, African and American medicinal plants have entered into the European tradition (Leonti & Verpoorte, 2017). Central Asian herbalism

[1] See: http://www.who.int/medicines/areas/traditional/definitions (accessed 27th February, 2017)

has been strongly influenced by Greek, Indian and Chinese, later by Arabic traditions (Eisenman et al., 2014). While some of these traditions have survived throughout the centuries, many others have changed or disappeared, and new uses of plants have emerged, both from local experience and imported from other traditions. This results in a very rich pharmacopoeias and a profound local knowledge surrounding medicinal plants. Due to the differing traditions the approach towards products of herbal origin is remarkably different from country to country (e.g. (A. Máthé, 2015; Payyappallimana & Subramanian, 2015)).

In a recent literature search (2014 – Feb 2017) we found 25 recent studies focusing on traditional medicinal, either in new ethnobotanical studies in which traditional medicinal knowledge holders are consulted or in review studies take into account traditional medicinal knowledge literature (**Table 2.5.4**). A wide diversity of medicinal plant species are taken into account and also wide ranges of medicinal uses are identified. Several studies conclude the need for more ethnobotanical research on traditional medicinal knowledge. We highlight some purposes of medicinal plants key arguments for ethnobotanical research from recent studies in **Table 2.5.5**.

**Table 2.5.4: Recent (2014 – Feb 2017) studies highlighting different purposes of medicinal plant characterization studies.**

| *Region/country* | *Purpose* | *Source* |
|---|---|---|
| Turkey | Informative for safe usage of the correct plant, when known by different names in different regions | (Hayta, Tasar, Cakilcioglu, & Gedik, 2014) |
| Russia | Informative for conservation measures, such as e.g. for genetic resources | (Kholina, Nakonechnaya, Koren, & Zhuravlev, 2014) |
| Italy | Salinity stress | (Amiripour, Hashemloian, & Azimi, 2016) |
| Poland | Mercury contamination | (Ordak, Wesolowski, Radecka, Muszynska, & Bujalska-Zazdrozny, 2016) |
| Romania | Thallium contamination | (Vlaia et al., 2014) |
| Kazakhstan | Radio-active contamination | (Aidarkhanova, G. S.; Samatova, I. S.; Khusainov, 2015) |

**Table 2.5.5: Arguments in the literature supporting ethnobotanical research**

| *Source* | *Arguments* |
|---|---|
| (Güzel, Güzelşemme, & Miski, 2015) | Development of new medicines and discuss the impact of the rich biodiversity, rich ethnocultural structure and deep historical roots to the ethnomedicinal knowledge |
| (Menale et al., 2016) | Preservation of traditional medicinal knowledge is often dependent of an oral tradition that allows the persistence of such information. Recovering ancient knowledge is very important for preserving ethno-biodiversity and to discover new entities for a further evaluation of their biological activity. |
| (Jarić et al., 2015) | Medicinal plants are an invaluable resource for local communities and need to be protected as they contribute to an improvement in living standards and the survival of people threatened by unfavourable demographic trends. They warn for over-exploitation, causing some plants to have become exceptionally rare and under threat, leading to the need for their rational use and protection so as to ensure they are still around for future generations |
| (Mustafa et al., 2015) | From a cultural perspective they point at the potential of cross-cultural ethnobiological for fostering collaboration and reconciliation among diverse ethnic and religious communities. |
| (Pawera et al., 2016) | Authors highlight a gap in documentation of traditional knowledge in Kyrgyzstan, indicating that further studies on the traditional use of wild plant resources could |

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| | bring important insights into ecosystems' diversity with implications to human ecology and bio-cultural diversity conservation in Central Asia. |
| (Efferth, Banerjee, Paul, Abdelfatah, Arend, Elhassan, Hamdoun, Hamm, et al., 2016) | Authors focus their review on biopirarcy, which is the use of biological resources and/or knowledge of indigenous tribes or communities without sharing with them the revenues generated from any economic exploitation of the resource/knowledge. They argue that the patenting of herbs or natural products by pharmaceutical corporations disregards the ownership of the knowledge possessed by the indigenous communities on how these substances worked, and this is not sufficiently prevented by current treaties and court decisions. They call upon scientists to take responsibility in publishing relevant data, preferably with indigenous communities, thus avoiding patenting by pharmaceutical companies. |

***From tradition to market, from rural to urban***

In our fast-changing environment, resulted especially from an increasing urbanisation and changing agricultural practices, many traditions are disappearing in rural areas, with a profound loss of knowledge, particularly among the younger generations. A high rate of decline of traditional medical knowledge has been highlighted by several European scientific studies (e.g. Quave et al., 2012; Sánchez-Mata, María de Cortes, Tardío, 2016). In some regions direct links have been identified between disappearing traditional farming systems and decline of biodiversity of medicinal plants. On the other hand, increasing interest in preserving traditional forms of knowledge in the face of societal change and globalisation have seen a renewed interest in medicinal plants as a form of cultural heritage (Pardo-de-Santayana, Pieroni, & Puri, 2010).

Outside of local and indigenous communities recent decades have seen an increase in the use of medicinal plants as a form of complementary, non-conventional or alternative forms of medicine (Roberti di Sarsina, 2007; Barata, Rocha, Lopes, & Carvalho, 2016). Reasons cited for this increased attention have included public desire for affordable health remedies, and a perception that “natural” products are somehow safer and more effective than mainstream medicines. These factors have stimulated a rapid expansion of commercial markets for these remedies (FAO, 2005; Leonti & Verpoorte, 2017). The commercialisation of traditional medicines and indigenous medicinal knowledge has seen many of these remedies move from traditional practice to conventional health markets and beyond.

In Europe, many of the medicinal plants widely used and marketed do not belong to its historical medical tradition; markets for medicinal plants and related preparations utilise plants and plant products originating from outside Europe or previously consumed only in some parts of the continent. Migrant populations moving into Europe and Central Asia from other regions have also brought their own traditional knowledge and related medicinal practices with them, and evidence suggests that these communities rely largely on plants and plant products imported from their home countries rather than alternatives which occur naturally from their new home regions ( Pieroni et al., 2013; C. L. Quave et al., 2012).

Therefore, there is a need of capacity building on medicinal plant expertise in urban societies. Appropriate education systems, professional assistance, aligned legislations and multidisciplinary science-based evidence regarding local and traditional medicines are needed to ensure safe, responsible, sustainable and rational use of herbal products in order to protect human health and the biodiversity of medicinal plants (Rakotoarisoa, Blackmore, & Riera, 2016). There is a growing need for health systems to recognise the important role which medicinal plants and related aspects of traditional ecological knowledge may play in patient care. This is particularly important for minority groups who may be representative of local or indigenous communities overseas who traditionally rely on medicinal plant species for their primary care. It may be helpful when understanding of traditional medicinal practices is mainstreamed into national public health care systems. This should incorporate

appropriate systems of regulation for products, practices and providers to ensure safety and quality; recording and preservation of traditional knowledge systems; provision of education and training for traditional medicine providers to promote sustainable use of biodiversity, as well as public safety; and close collaboration between biodiversity and health regulators.

### *Public health perspectives*

In addition to their potential role in supporting population health, traditional medicines may provide other social and economic benefits. Since by its nature traditional medicinal knowledge is developed, curated and administered at the local level, it can promote decentralised, community-based and culturally competent healthcare. Research in Tajikistan and Afghanistan has indicated that the use of medicinal plant species contributed significantly to local health sovereignty and security, which was particularly important during a period of social and political instability (Kassam et al., 2010). Where the associated living resources are conserved and sustainably utilised, these practices may also promote biocultural diversity.

As stated above, we can distinguish between the use of medicinal plants as part of traditional medicinal practice, principally utilising wild species or those cultivated at small scales in home gardens, and the use of commercial herbal remedies and supplements, sold either as health treatments or for food. Both cases raise several important issues in public safety (**Table 2.5.6**).

With increased human migration throughout the ECA region, health practitioners are dealing with increased numbers of ethnic minorities, some of whom may still depend on their own traditional health care strategies. Various social, cultural or economic factors may combine to prevent immigrants freely and fully availing of primary care services in their new country of residence; even where these barriers are not significant, continuance of traditional medicinal practices associated with home regions may be considered important in immigrant communities. As already mentioned, research in Europe suggests that some immigrant communities who previously relied more extensively on traditional medicine continue to utilise medicinal plants imported from their home countries in their new country of residence ( Pieroni et al., 2013; Quave et al., 2012). This raises a number of further issues for conservation and public health, including those related to the collection, importation, sale and use of plants across borders outside of normal regulatory frameworks. Whilst it appears that migrants utilise medicinal plants and related products imported from their home regions in preference to locally-native alternatives, increasing demand may see alternative plant species being sought migrants' new home environments, presenting a further challenge for sustainable exploitation of living resources.

From a public health perspective, it is important to ensure that traditional medicinal practices that do not use marketed products but instead rely directly on harvested plants are recorded and assessed, and to engage with practitioners to explore and communicate on issues of safety and efficacy. Commercial codes or standards (e.g. for sustainable production and harvesting and for consumer protection) combined with community-based conservation initiatives may help to address these issues, affording legitimacy and protection within the context of wider regulation or standardisation.

**Table 2.5.6: Public safety issues related to medicinal plants**

| *Source* | *Concerns and regulatory issues* |
|---|---|
| Dhami & Mishra, 2015 | Outside of mainstream markets traditional medicines are largely unregulated; most medicinal plant remedies have not been evaluated for safety or efficacy. There is little or no standardisation across traditions regarding the selection or quantities of plant or extract materials, whilst genetic, environmental and seasonal factors can affect the quantity and bioavailability of any pharmacologically active ingredients within a plant. |

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| Calapai, 2008 | Commercially available herbal products, which may be based on traditional practice, are not subjected to the same levels of scrutiny as pharmaceutical or food products. Indeed, it can be difficult for companies marketing medicinal plant products to demonstrate medical efficacy to the extent normally required for pharmaceuticals and foods. In Europe, this resulted in a range of different approaches in different countries until Directives introduced in 1999 and 2004 set out to improve harmonisation. European market access for medicinal plant products is now based on a two-tiered regulatory framework according to the evidence base supporting the purity, safety and efficacy of the product. |
| Izzo et al., 2015 | Some herbal extracts may be marketed for a single purported effect, and yet preparations may contain several active compounds that might produce a range of potentially undesirable effects if they interact with other herbal products or if they are contra-indicated for mainstream pharmaceuticals or for particular medical conditions |
| Chan, 2003; Ekor, 2014 | In some areas, although the herbal derivative used may not itself produce a direct risk, the presence of contaminants (e.g. heavy metals, biocides, radionuclides, mycotoxins,…)) in the growing environment (in the wild or under cultivation) or introduced during handling or transit, may pose a health risk to the consumer |
| Colson & De Broe, 2005; Stickel & Shouval, 2015 | The pharmacology of many herbal remedies – if and how well they are absorbed by the body, if and how they produce an effect and indeed whether they are actually safe or effective for specific ailments – is largely unknown, and cases of injury arising from use of herbal medicines have been documented |
| Ouedraogo et al., 2012 | Given the number of herbal products on the market and relatively low budgets available for research so far, safety assessment has been carried out on relatively few herbs according to modern guidelines |
| Shaw et al., 2012; Zhang et al., 2012 | The importance of pharmacovigilance in detecting any unfortunate adverse events |
| Xu et al., 2013 | Given the various distribution channels encountered in different countries, an efficient connection is required to develop pharmacovigilance procedures that may rapidly detect, assess and collect warning signals for adverse events |
| De Smet, 2004 | Reliance on traditional remedies which are ultimately ineffective for a specific ailment may divert patients from seeking other effective medical advice or support, thereby endangering patients' health |

**Table 2.5.7: Experimental studies on medicinal plants (2014 – Feb 2017) (N=28)**

| *Region* | *Medicinal plants reported* | *Ailment categories reported* | *Method* | *Source* |
|---|---|---|---|---|
| Armenia (1) | 5 medicinal plant species | Armenia has large diversity of flora with many endemic species. In Armenian folk medicine plant materials have been used to treat various microbial diseases since ancient times. | Experimental research: to evaluate antimicrobial efficiency of different parts of five wild plants species which are commonly used in Armenian traditional medicine. | (Ginovyan, Petrosyan, & Trchounian, 2017) "Antimicrobial activity of some plant materials used in Armenian traditional medicine." Bmc Complementary and Alternative Medicine 17 |
| Balkan region (3) | Dalmatian sage (Salvia officinalis L., Lamiaceae) is a well-known aromatic and medicinal Mediterranean plant that is native in coastal regions of the | Antioxidant, anti-inflammatory, fungicidal and bactericidal, virucidal, anti-spasmatic, anti-diabetic, | Experimental research: Knowledge of its genetic diversity and spatiotemporal patterns is important for plant breeding programmes and conservation. | (Rešetnik et al., 2016) "Genetic Diversity and Demographic History of Wild and Cultivated/Naturalised Plant Populations: Evidence from Dalmatian Sage |

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| | western Balkan and southern Apennine Peninsulas and is commonly cultivated worldwide | gastroprotective and anti-obesity activity. | | (Salvia officinalis L., Lamiaceae)." Plos One 11(7) |
| | The plants studied were Hyssopus officinalis, Angelica pancicii, Angelica sylvestris, Laserpitium latifolium, Achillea grandifolia, Achillea crithmifolia, Artemisia absinthium and Tanacetum partheniurn. | The antimicrobial activities of methanolic extracts of the plant tissues against 16 bacterial isolates | The study evaluated the antibacterial activities and antioxidant capacity of eight aromatic plants, indigenous to the flora of the Balkan Peninsula, which are used as medicinal plants in traditional medicine | (Stankovic et al., 2016) "Antibacterial and Antioxidant Activity of Traditional Medicinal Plants from the Balkan Peninsula." Njas-Wageningen Journal of Life Sciences 78: 21-28 |
| | Salvia officinalis (Lamiaceae), common or Dalmatian sage, is a Mediterranean aromatic and medicinal plant used in medicine since ancient times | Not specifically addressed | Experimental research: Knowledge on current genetic patterns and genealogical history of its natural populations is required for both breeding efforts and species conservation. | (Stojanović, Aleksić, Jančić, & Jančić, 2015) "A Mediterranean medicinal plant in the continental Balkans: A plastid DNA-based phylogeographic survey of Salvia officinalis (Lamiaceae) and its conservation implications." Willdenowia 45(1): 103-118. |
| (Region in) Bulgaria (2) | Gypsophila trichotoma Wend. (Caryophyllaceae) is a medicinal plant which is protected in Bulgaria by the Biodiversity Law. | Anticancer | Experimental research: Gypsogenic acid, isolated from Gypsophila trichotoma roots, was evaluated for cytotoxic activity. | (Krasteva et al., 2014) "Cytotoxicity of gypsogenic acid isolated from Gypsophila trichotoma." Pharmacognosy Magazine 10(38): 430-433 |
| | The review includes the following families: Amaryllidaceae, Fabaceae, Geraniaceae, Lamiaceae, Onagraceae, Ranunculaceae, Rosaceae, Scrophulariaceae and Rhodophyta | A good alternative for overcoming antiviral adverse effects and resistance is the use of natural products which have several major advantages over the currently applied chemotherapeutics. Development of resistant strains to such antivirals is hampered due to | Review research: is to summarize comprehensively the investigations on the antiviral activity of Bulgarian medicinal plants from the past three decades | (Todorov, Hinkov, Shishkova, & Shishkov, 2014)"Antiviral potential of Bulgarian medicinal plants." Phytochemistry Reviews 13(2): 525-538. |

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| | | their complex chemical structure and often to their multi-stage mode of action | | |
| | Teucrium chamaedrys L. (Wall germander) is a widely distributed species of Teucrium (Lamiaceae) found in the spontaneous flora of Bulgaria, and some Central and South European countries | This is a medicinal plant with a history of traditional use in Bulgaria and in other Balkan countries for herbal tea and basic medical healing treatments. | Experimental research: in vitro study, chloroform and methanol extracts received by soxhlet extraction as well as methanol extract obtained by thermostat extraction were tested for antiviral activity | (Todorov et al., 2015) "EFFECT OF TEUCRIUM CHAMAEDRYS L. EXTRACTS ON HERPES SIMPLEX VIRUS TYPE 2." Comptes Rendus De L Academie Bulgare Des Sciences 68(12): 1519-1526. |
| Region in Greece (1) | Greek and Mediterranean species due to the fact that biodiversity is on threat: Basel, Miscanthus, Thymus, Salvia, Hyssopus, Oregano | In spring between the two proposed scenarios of vegetation more effective in reducing temperature seems to be the scenario of cultivating medicinal and aromatic species because it presents the best “temperature behaviour” among the buildings. | Experimental research: In this research, a scenario with absence of vegetation, the current state and two scenarios with different vegetation in urban gardens are analyzed. The first scenario involves horticulture species and the second one the cultivation of aromatic and medicinal species. | (Tsilini, Papantoniou, Kolokotsa, & Maria, 2015) "Urban gardens as a solution to energy poverty and urban heat island." Sustainable Cities and Society 14: 323-333. |
| Region in Israel (1) | Plants growing in the Judea region are widely used in traditional medicine. Six Judean Plants selected for analysis. | Analysis revealed that many of the plants growing in the Judea region may hold a geroprotective potential | Experimental research. Wide screen of dozens of candidate herbal extracts for their cell protective, wound-healing, anti-inflammatory, and anti-cancer activities | (Budovsky et al., 2014) "Uncovering the Geroprotective Potential of Medicinal Plants from the Judea Region of Israel." Rejuvenation Research 17(2): 134-139 |
| Including an Italian variety (1) | Rocket (Eruca sativa L.) medicinal plant; two varieties of rocket plants, the Iranian and Italian ones, were studied. | Rocket plant has different medical applications, such as ability to improve the eyesight, subsiding children’s coughs and above all, restricting different sorts of intestinal worms In addition, according to clinical reports, its anti-cancer activity inhibiting the production of tumor, | Experimental research regarding soil salinity tolerance. | (Amiripour et al., 2016) "Morpho-physiological responses of Rocket (Eruca sativa L.) varieties to sodium sulfate (Na2SO4) stress: an experimental approach." Acta Physiologiae Plantarum 38(10) |

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| | | liver-protective effects (, anti-inflammatory and anti-ulcer activities, could be attributed to this plant . Besides, the erucin and sulforaphane extracted from rocket caused the prevention and treatment of inflammatory skin diseases. | | |
| Region in Kazakhstan (1) | No specific details mentioned in the abstract | Supporting evidence for pharmacological properties of some species harvested by locals of the region. Further no specific details mentioned in the abstract except for radio-active substances (due to a nuclear test site) contaminating medicinal plants | Experimental research. During the expedition and field works ecological and geobotanic habitat features of dominant species of medicinal plants were studied, and was carried out a description of the experimental areas where plants were sampled for analysis. In laboratory conditions researches were performed to determine the content of Cs-137, Sr-90. | (Aidarkhanova, G. S.; Samatova, I. S.; Khusainov, 2015) "RADIONUCLIDE CONTAMINATION OF MEDICINAL PLANTS IN DISTURBED AND NATURAL NATURAL-ECOLOGICAL SYSTEMS OF CENTRAL KAZAKH UPLAND." Oxidation Communications 38(1): 266-270 |
| Lithuania (1) | Chamerion angustifolium (L.) Holub | Several medicinal properties: inhibit growth of human prostatic epithelial cells, influence the expression of oestrogen receptor, possess antimicrobial activity, have analgesic properties, modulate phagocyte functions, reduce lipid oxidation, exhibit antifungal activity, possess the immune enhancing properties and distinguish by antioxidant activity. | Experimental research: screening of antioxidant activity and volatile compounds composition of Chamerion angustifolium (L.) Holub | (Kaškonienė et al., 2016) "Screening of antioxidant activity and volatile compounds composition of Chamerion angustifolium (L.) Holub ecotypes grown in Lithuania." Natural Product Research 30(12): 1373-1381 |
| Mediterranean | Thymus longicaulis C. Presl. is a small aromatic plant | Traditionally used as remedy for cold, flu, cough, nephritis and | Experimental research on Influence of seasonal variation on | (Galasso, S., Pacifico, S., Kretschmer, N., Pan, S., Marciano, S., |

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| region (2) | abundant in Mediterranean macchia with traditional medicinal use. The plant, known for the antimicrobial properties of its essential oils, is a rich source of polyphenol compounds. | abdominal pain. Antioxidant and anti-inflammatory properties. | Thymus longicaulis C. Presl chemical composition and its antioxidant and anti-inflammatory properties | Piccolella, S., Monaco, P., Bauer, 2014) "Influence of seasonal variation on Thymus longicaulis C. Presl chemical composition and its antioxidant and anti-inflammatory properties." Phytochemistry 107: 80-90 |
| | Ruta chalepensis L. (Rutaceae) is widespread in the Mediterranean area. | Emmenagogue, anti-fungal, anti-helmintic, anti-inflammatory, anti-radical in colon cancer, anti-bacterial and spasmolytic activities. Recently, the insect repellent activity of R. chalepensis has been emphasised. | Experimental research: To exhaustively characterise the chemical composition of the aerial parts from R. chalepensis plants collected from the wild in Sicily | (Tedone, Costa, De Grazia, Ragusa, & Mondello, 2014). "Monodimensional (GC-FID and GC-MS) and Comprehensive Two-dimensional Gas Chromatography for the Assessment of Volatiles and Fatty Acids from Ruta chalepensis Aerial Parts." Phytochemical Analysis 25(5): 468-475. |
| Region in Poland (1) | A set of 45 samples obtained from 20 medicinal plant species was analyzed | Many literature reports have provided evidence for toxic effects of low levels of mercury in the human body | Experimental research: Seasonal Variations of Mercury Levels in Selected Medicinal Plants Originating from Poland - Spring (4-35 ng/g); Autumn (4-81 ng/g) | (Ordak et al., 2016) "Seasonal Variations of Mercury Levels in Selected Medicinal Plants Originating from Poland." Biological Trace Element Research 173(2): 514-524 |
| A region in Romania (3) | Ninety-six plant samples representing plant organs of 29 medicinal species employed in phytotherapy were collected from the wild flora | The study analyzes the potential of medicinal plants to contribute to an adequate Zn intake and to attenuate dietary Zn deficiencies, and to substantiate Mn and Ni intakes | Experimental research. Zn contents were measured by inductively coupled plasma - atomic emission spectrometry (ICP-AES) | (Antal et al., 2015) "Zinc Across Medicinal Plants from Romanian Biodiversity and the Implications for Human Health." Revista De Chimie 66(2): 236-239 |
| | Two medicinal plants: Cornus mas and Crataegus monogyna | Traditionally known to be efficient in preventing cardiotoxicity. | Experimental research. Compare the phenolic and flavonoid composition of two medicinal plants from the wild flora of Romania | (Badalica-petrescu, Dragan, Ranga, Fetea, & Socaciu, 2014) "Comparative HPLC-DAD-ESI(+)MS Fingerprint and Quantification of Phenolic and Flavonoid |

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| | | | | Composition of Aqueous Leaf Extracts of Cornus mas and Crataegus monogyna, in Relation to Their Cardiotonic Potential." Notulae Botanicae Horti Agrobotanici Cluj-Napoca 42(1): 9-18 |
| | 50 species of wild-growing medicinal plants | Thalium as toxic element in medicinal plants | Experimental research: Thallium is one of the most toxic elements, without known biological function in living beings. In the case of Tl there are no regulations in prime matters intended for phytomedicines, and its monitorization is not performed. The present research provides for the first time data on the Tl content of over 50 species of wild-growing medicinal plants, evaluated on human health. 17-26 ng/g Highest content: *Echium vulgare*, Boraginaceae | (Vlaia et al., 2014) "Uptake of Thallium by Medicinal Plants: First Data for Romanian Flora and Significance to Human Health." Revista De Chimie 65(10): 1158-1162. |
| Region in Russia (2) | Wild ginseng, Panax ginseng Meyer, is an endangered species of medicinal plants. The study was on P. ginseng, at artificial plant cultivation. The roots of wild P. ginseng Meyer plants were sampled from a non-protected natural population in Sikhote-Alin mountain range, Russian Far East. | Under conditions of artificial reproduction, the medical properties of ginseng are believed to have become weaker, and the amount of the main biologically active compound - ginsenosides – decreases. | Experimental research: the study analyzed variations within the ribosomal DNA (rDNA) cluster to gain insight into the genetic diversity of the Oriental ginseng, P. ginseng, at artificial plant cultivation. | (Chelomina et al., 2015) "Variation in the number of nucleoli and incomplete homogenization of 18S ribosomal DNA sequences in leaf cells of the cultivated Oriental ginseng (Panax ginseng Meyer)." Journal of Ginseng Research 40(2): 176-184 |
| | medicinal plant Acanthopanax sessiliflorus (Rupr. et Maxim.) Seem. (Araliaceae) | tonic, stimulant, and analgesic agent; antioxidant, hypoglycemic, and thrombolytic proper_ ties and exhibit antitumor activity | Experimental research: Based on the analysis of 17 genes encoding the allozyme diversity of 12 enzyme systems, data were obtained on the genetic variation of | (Kholina et al., 2014). "Genetic variation of the relict species Acanthopanax sessiliflorus (Rupr. et Maxim.) Seem. (Araliaceae) in |

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| | | | a relict of the Tertiary flora, a valuable medicinal plant Acanthopanax sessiliflorus (Rupr. et Maxim.) Seem. (Araliaceae) in the Russian area of its range | Primorsky Krai." Russian Journal of Genetics 50(12): 1264-1270 |
| Region in Spain | 21 medicinal or potential medicinal plants sampled from eight different locations on the territory of Spain | antioxidant and antimicrobial activity | Experimental research: In the presented study, a comparative analysis of phenolic compounds, parallel with antioxidant and antimicrobial activity of selected plants from Spanish medicinal flora was conducted | (Stanković, Radić, Blanco-Salas, Vázquez-Pardo, & Ruiz-Téllez, 2016) "Screening of selected species from Spanish flora as a source of bioactive substances." Industrial Crops and Products 95: 493-501. |
| Region in Switzerland | Rhodiola rosea L. | It has been used for centuries in folk medicine in Scandinavia, Eastern Europe and Asia as a general immune-stimulant: increasing human resistance to fatigue, attention, memory and work productivity. | Experimental research: genetic survey of Rhodiola rosea L. populations from the Swiss Alps based on SSR markers. | (György, Vouillamoz, Ladányi, & Pedryc, 2014) "Genetic survey of Rhodiola rosea L. populations from the Swiss Alps based on SSR markers." Biochemical Systematics and Ecology 54: 137-143 |
| Region in Turkey (7) | Apiaceae are a family of medicinal plants widely used in traditional medicine and they are employed commercially as species or drugs because of their richness on useful secondary metabolites | Therapeutic effects of several medicinal plants and vegetables, which are commonly used in folk medicine against many diseases, are usually attributed to their phenolic contents and their antioxidant ingredients. | Experimental research. Water-distilled essential oils from the aerial parts of Artedia squamata and Malabaila secacul were analysed. | (Bagci & Dogan, 2015) "Composition of the Essential Oils of Two Umbelliferae Herbs (Artedia squamata and Malabaila secacul) Growing Wild in Turkey." Journal of Essential Oil Bearing Plants 18(1): 44-51 |
| | Three different Lamium species. | Antimicrobial and Antioxidant Properties of Lamium galactophyllum Boiss & Reuter, L-macrodon Boiss & Huet and L-amplexicaule | Experimental research aimed to screen the possible antimicrobial and antioxidant properties as well as total phenolic, resveratrol and flavonoid contents of extracts of three different Lamium species. | (Erbil, Nurcan; Alan, Yusuf; Digrak, 2014) "Antimicrobial and Antioxidant Properties of Lamium galactophyllum Boiss & Reuter, L-macrodon Boiss & Huet and L-amplexicaule from Turkish Flora." Asian |

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| | Sweet basil (Ocimum basilicum L., Lamiaceae), an important medicinal plant and culinary herb. It is a condimental plant cultivated in some parts of Turkey but not grown naturally. Basil plants are grown commercially and ornamentally. | Only generally addressed: there is great demand for herbal medicines in developed and developing countries because of their wide biological activity and higher safety margin than synthetic drugs. | Experimental research: genetic variation among basil accessions in Turkey has not been extensively examined with molecular markers. Genetic diversity was determined. | (Giachino et al., 2014) "RAPD and essential oil characterization of Turkish basil (Ocimum basilicum L.)." Plant Systematics and Evolution 300(8): 1779-1791 |
| | Melia azedarach L. (Chinaberry) is fleshy fruited small to medium sized tree native to China and North Western India. It grows in Pakistan and Turkey in various areas facing great environmental changes to maintain its survival. | Not specifically addressed | Experimental research: aimed to estimate the genetic variation among the populations of Melia azedarach that were collected from five different locations in Turkey and three different locations in Pakistan | (Rind et al., 2016) "EVALUATION OF GENETIC DIVERSITY AMONG MELIA AZEDARACH L. (MELIACEAE) WITH RAPD MARKERS." Fresenius Environmental Bulletin 25(7): 2374-2382 |
| | Calamintha nepeta (L.) Savi subsp. nepeta (Lamiaceae) - lesser calamint | Not specifically mentioned in abstract | Experimental research: essential oil constituents, antimicrobial and herbicidal assays of lesser calamint | (Ulukanli, Demirci, & Yilmaztekin, 2016) "Essential oil constituents, antimicrobial and herbicidal assays of lesser calamint (Calamintha nepeta (L.) Savi subsp. nepeta) from East Mediterranean Region of Turkey." Biointerface Research in Applied Chemistry 6(6): 1867-1871. |
| | Crataegus monogyna, Vitis vinifera, Glycrrhiza glabra, Alnus glutinosa L. gaertn, and Alcea rosea | Anticancer | Experimental research: antiproliferative activities against rat brain tumor (C6) and human cervical cancer (HeLa) cell lines. The results were compared with the standard anticancer drugs. | (Sahin Yaglıoglu, Eser, Tekin, & Onal, 2016) "Antiproliferative activities of several plant extracts from Turkey on rat brain tumor and human cervix carcinoma cell lines." Frontiers in Life Science 9(1): 69-74 |

**Table 2.5.8: Ethnobotanical studies on medicinal plants including traditional knowledge (2014 – Feb 2017) (N=18)**

| *Region* | *Medicinal plants reported* | *Ailment categories reported* | *Method* | *Source* |
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| Region in Albania (2) | The uses of 84 botanical taxa were recorded as well as a number of other folk remedies for the treatment of both humans and livestock | Approx. 150 distinct remedies cited for human use, the majority (32) were dedicated to treatment of conditions of the skin (such as burns, wounds, infections, and inflammations), followed by therapies for complaints pertaining to the gastrointestinal (18), urogenital (17), musculoskeletal (15), and respiratory (14) systems. | 32 local informants for participation in semi-structured interviews regarding the use of the local flora for food, medicinal, veterinary and ritual purposes. The collected data were compared with findings from previous studies in other but similar regions, also in Bulgaria. | (Pieroni et al., 2014) "Local knowledge on plants and domestic remedies in the mountain villages of Peshkopia (Eastern Albania)." Journal of Mountain Science 11(1): 180-193 |
| | 104 botanical taxa, representing 42 families and 68 genera, were cited by the study participants | Cardiovascular, dermatological, endocrinological, gastrointestinal, general health, gynaecological, andrological, nephrological, urological, musculoskeletal and neurological, ophthalmological, oral and dental, otolaryngological and respiratory | In-depth, semi-structured interviews in five rural communities, in total 107 local participants | (C. Quave & Pieroni, 2015)"A reservoir of ethnobotanical knowledge informs resilient food security and health strategies in the Balkans." Nature Plants 1(2): 1-6 |
| Region in Bosnia & Herzegovina (1) | 58 species (including two subspecies) from 35 families, which were cited in 307 medicinal, 40 food, and seven material use reports. | Genitourinary system disorders, panacea, pain, and circulatory system disorders, skin/subcutaneous cellular tissue disorders, respiratory system disorders, and several ill-defined symptoms | Individual semi-structured interviews with 25 local community healers. | (Ferrier et al., 2015) "An ethnobotany of the Lukomir Highlanders of Bosnia & Herzegovina." Journal of Ethnobiology and Ethnomedicine 11 |
| Region in Northern Cyprus (1) | 47 species (8 medicinal, 18 edible and 21 edible-medicinal); variety of purposes, including medicine (2 %) | Only ‘use on aching body parts’ is mentioned | 135 informants of various ages and backgrounds and with a sound traditional knowledge of the | (Ciftcioglu, 2015) "Sustainable wild-collection of medicinal and edible plants in Lefke region of |

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| | | | target plants were interviewed | North Cyprus." Agroforestry Systems 89(5): 917-931 |
| Region in Italy (3) | The inventory included 106 taxa belonging to 45 families; among these, 87 were wild species and 20 were cultivated species. | Internal applications to treat digestive system disorders, infections and respiratory system disorders mainly, and external applications, especially to treat skin/subcutaneous cellular tissue disorders and injuries. | Semi-structured and open interviews with native people who had strong links with the traditional human activities of the area. | (Fortini, Di Marzio, Guarrera, & Iorizzi, 2016) "Ethnobotanical study on the medicinal plants in the Mainarde Mountains (central-southern Apennine, Italy)." Journal of Ethnopharmacology 184: 208-218 |
| | 87 plant species belonging to 76 genera and 35 families used as medicine for treating various diseases, both human and veterinary. These plants are very easy to find as they are often cultivated or they are common in the wild. | Cough is the most treated human disease followed by wounds healing. Other ailments mentioned: cold, ear pain, high blood pressure, worm or microbial infection, warts, babies colic, toothache, bronchitis, burns and headache. Most of the plants used for human medicine had more than a single therapeutic use, with e.g. 2 species used in the treatment of 10 ailments, and 24 to solve 2 disorders. | Open and semi-structured interviews with 72 native knowledge holders | (Menale & Muoio, 2014) "Use of medicinal plants in the South-Eastern area of the Partenio Regional Park (Campania, Southern Italy)." Journal of Ethnopharmacology 153(1): 297-307 |
| | total number of 132 plant species, belonging to 110 genera and 51 families mentioned for medicinal purposes. 70 are spontaneous or subspontaneous and 62 are cultivated above all in the kitchen gardens or in the apartments, as food or as ornamental. Herbs represent the majority, followed by | The investigated plants were used to cure 116 different human health diseases and 4 veterinary problems. The highest number of plants was recorded for gastrointestinal system (56), followed by skin and cutaneous appendages (55) and respiratory system (48). | Semi-structured and unstructured interviews with 136 persons living in the investigated area. | (Menale et al., 2016) "Ethnobotanical investigation on medicinal plants in the Vesuvio National Park (Campania, Southern Italy)." Journal of Ethnopharmacology 192: 320-349 |

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| | trees and shrubs or subshrubs. | Regarding specific ailments, natural remedies are mainly used for treating cough (31.1% of plants cited), followed by bronchitis (21.2% ), cold ( 20.5%), abdominal pains (15.2%), pimples (14.4%), as digestive (12.1%), haemorrhoids and wounds (9.8% each). Regarding the plants used in human medicine, most of them had more than a single use. E.g. one species was used in the treatment of 17 ailments and 47 entities were used for treating 1 ailment. The most common ailments are mainly solved by using cultivated species or very common herbs. | | |
| Region in Kosovo | Local uses of 114 species were used for medicinal purposes, 29 for food (wild food plants), and 20 in handicraft activities. 44 medicinal species included in European Pharmacopoeia. | The most frequent medicinal uses: gastrointestinal (17.8%), respiratory (15.1%) ailments, heart disease (13.6%), illnesses affecting the urogenital system (12.4%) and the skin (10.5%). | Semi-structured interviews with 139 local people. | (Mustafa et al., 2015) "A cross-cultural comparison of folk plant uses among Albanians, Bosniaks, Gorani and Turks living in south Kosovo." Journal of Ethnobiology and Ethnomedicine 11 |
| Region in Kyrgyzstan | A total of 50 medicinal plant taxa were documented, distributed among 46 genera and 27 botanical families | 63 human and three animal ailments. Gastro-intestinal system disorders most prevalent ailment category. Further circulatory system disorders, skeleto-muscular system disorders, skin disorders, infections/infestations, injuries/wounds, haemorrhoids, immunity disorders, | Participant observation and both semi-structured and in-depth interviews with 10 herbal specialists. | (Pawera et al., 2016) "Medical ethnobotany of herbal practitioners in the Turkestan Range, southwestern Kyrgyzstan." Acta Societatis Botanicorum Poloniae 85(1) |

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| | | respiratory and throat disorders, genito-urinary system disorders, neurological problems, blood system disorders, dental and mouth care problems. | | |
| Region of Serbia (2) | This study identified 128 plants and 2 fungi which are used in ethnomedicine, 5 plant species used in ethnoveterinary medicine, and 16 plants used for 'other' purposes | The most common conditions treated with medicinal plants are respiratory (79), urogenital (53), gastrointestinal (51), skin (43) and those relating to the circulatory system (35). | Open and semi-structured interviews with 66 local people (37 women and 29 men), aged between 49 and 90 (with a mean age of 71). Inclusion criteria: gender balance, permanent residents of the region, and mature adults. Also a comparison with previously published data collected from surrounding regions. | (Jarić et al., 2015) "An ethnobotanical survey of traditionally used plants on Suva planina mountain (south-eastern Serbia)." Journal of Ethnopharmacology 175: 93-108. |
| | 231 wild plant species of medicinal importance from 172 genera and 62 families, and 101 original preparations were documented | Wound infections, insect/snake bites, blood purification, menstrual and nervous disorders, bronchial/lung catarrhs, cough, cardiac disorders, constipation, diarrhea, urinary infections, rheuma | Interviews with 65 local peasants | (Popović, Smiljanić, Kostić, Nikić, & Janković, 2014) "Wild flora and its usage in traditional phyto-therapy (Deliblato Sands, Serbia, South East Europe)." Indian Journal of Traditional Knowledge 13(1): 9-35 |
| Switzerland | A total of 254 medicinal plant species, belonging to 218 genera and 87 families, were recorded in 934 use reports. | Dermatological, respiratory, nervous, and gastrointestinal problems. A large variety of plants are used as tonics for disease prevention and to strengthen the immune system. | Swiss herbalists with broad, empirical medicinal plant knowledge and use were interviewed: 61 expert interviews and 3 group interviews | (Dal Cero, Saller, & Weckerle, 2014, 2015) "Herbalists of Today's Switzerland and Their Plant Knowledge. A Preliminary Analysis from an Ethnobotanical Perspective." Forschende Komplementarmedizin 22(4): 238-245 |
| Region in Turkey (6) | Information about 202 medicinal plant taxa was compiled. Among these plants, 39 have either not yet been | For 93 ailments in following categories: respiratory system, digestive system, dermal, endocrine, | Two separate studies; one was conducted in 1975, interviewing 29 people, and the other was conducted in | (Güzel et al., 2015) "Ethnobotany of medicinal plants used in Antakya: A multicultural |

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| | mentioned in ethnobotanical or medicinal studies, or have been used for a medicinal purpose other than those encountered in a literature review | ear, nose and throat, eye, urogenital, cardiovascular, skeletal- muscular, neurological & psychological, gynaecological, blood and other: anticancer, toothache, jaundice & antipyretic | 2011-2013, interviewing 182 people. Also a comparison was done with the data obtained from other regions of Turkey and from other Mediterranean regions. | district in Hatay Province of Turkey." Journal of Ethnopharmacology 174: 118-152 |
| | 84 food plants belonging to 30 families were identified in the region. A large proportion of edible plants are also being used for medicinal purposes. | Not mentioned specifically | Interviews with native people with knowledge of food plants. | (Kaval, Behçet, & Çakilcioğlu, 2015) "Survey of wild food plants for human consumption in Gecitli (Hakkari, Turkey)." Indian Journal of Traditional Knowledge 14(2): 183-190 |
| | 82 food plants belonging to 28 families; a large proportion of edible plants are also being used for medicinal purposes. | Not mentioned specifically | Interviews with native people with knowledge of food plants. | (Mükemre, Behçet, & Çakılcıoğlu, 2016) "Survey of wild food plants for human consumption in villages of Catak (Van-Turkey)." Indian Journal of Traditional Knowledge 15(2): 183-191 |
| | A total of 59 medical plants belonging to 27 families were identified in the region | Many plants are used for analgesia (pain killer) and the treatment of bronchitis, colds, diabetes disease, kidney-stone, peptic and intestinal ulcers. | Interviews with 25 local people. Comparison of the data with data obtained in previous laboratory studies | (Paksoy, Selvi, & Savran, 2016) "Ethnopharmacological survey of medicinal plants in Ulukisla (Nigde-Turkey)." Journal of Herbal Medicine 6(1): 42-48 |
| | Information about medicinal use of 55 wild and 15 cultivated plants were collected: 3 plants are not available among the records in the literature | Respiratory tract problem, gastrointestinal disorders, urogenital disorders, cardiovascular disorders, dermatological disorders, diabetes disease, head and | 128 local persons knowledge regarding medicinal plants were interviewed. Literature review of the plants included in the study | (Polat et al., 2015) "An ethnobotanical study on medicinal plants in Espiye and its surrounding (Giresun-Turkey)." Journal of Ethnopharmacology 163: 1-11 |

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| | | rheumatic pain, nervous system | | |
| | A total of 62 food plants belonging to 28 families were identified in the region. Wild plants being used for nutritional purposes are also used for medicinal purposes. | Not specifically mentioned | Interviews with 212 local people with knowledge about food plants | (Menale et al., 2015) "Survey of wild food plants for human consumption in Elazig (Turkey)." Indian Journal of Traditional Knowledge 14(1): 69-75 |

**Table 2.5.9: Review studies on medicinal plants including traditional knowledge (2014 – Feb 2017) (N=7)**

| *Region* | *Medicinal plants reported* | *Ailment categories reported* | *Method* | *Source* |
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| Balkan region (1) | Sideritis scardica Griseb. is an endemic species in the Balkan Peninsula | Used in traditional medicine as a loosening agent in bronchitis and bronchial asthma; against the common cold and lung emphysema; in the treatment of inflammation, gastrointestinal disorders and coughs; and as an active constituent of dietary supplements for the prevention of anemia | Review is based on information collected from scientific journals, books, and electronic search. These sources include Scopus, Pubmed, Web of Science, and Google scholar as well as local books on ethnopharmacology and botany of this plant. | (Todorova & Trendafilova, 2014) "Sideritis scardica Griseb., an endemic species of Balkan peninsula: Traditional uses, cultivation, chemical composition, biological activity." Journal of Ethnopharmacology 152(2): 256-265. |
| Caucasus region Europe (1) | Bladdernut | Antibacterial, antidote, aphrodisiac, antirheumatic, anti-inflammatory, carminative/laxative, cancer medicine, diuretic, hemostatic use, hepatical disorders, general medical purposes, mental and nervous disorders, headaches, against the plague, respiratory disorders skin disorders, warning against toxicity | Critically evaluating the extant literature on material evidence, written historical sources, and ethnographic studies on Staphylea pinnata across Europe. | (Heiss et al., 2014) "A Fistful of Bladdernuts: The Shifting Uses of Staphylea pinnata L. as Documented by Archaeology, History, and Ethnology." Folk Life-Journal of Ethnological Studies 52(2): 95-136 |
| Europe (1) | Iridaceae | In Europe, traditional healers have recommended the use of aqueous extracts of Iris germanica roots as | This review provides a comprehensive overview on the isolated phytochemicals and reported biological | (Singab et al., 2016) "Shedding the light on Iridaceae: Ethnobotany, phytochemistry and biological activity." |

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| | | enemas or topical preparations for arthritic limbs | activities for the most popular genera of Iridaceae. | Industrial Crops and Products **92**: 308-335. |
| Global including Europa (1) | Medicinal plants in general in relation to traditional knowledge of indigenous communities; no species details | Medicinal effects such as anti-inflammatory, wound-healing or anti-diarrhea activity | An overview of the legal frameworks, and some exemplary cases of biopiracy and bioprospecting | (Efferth, Banerjee, Paul, Abdelfatah, Arend, Elhassan, Hamdoun, Jongman, et al., 2016) "Biopiracy of natural products and good bioprospecting practice." Phytomedicine 23(2): 166-173 |
| Region in Italy (1) | 45 plant species | 95 plant uses (no specific details on medical use) | Study of two datasets of medicinal plants and a dataset of non-medicinal plants (handicraft production, domestic and agro-pastoral practices) and two floras of the Amalfi Coast. | (Savo, Joy, Caneva, & McClatchey, 2015). "Plant selection for ethnobotanical uses on the Amalfi Coast (Southern Italy)." Journal of Ethnobiology and Ethnomedicine 11 |
| Three different regions in Granada Spain (1) | 325 medicinal plants and 160 food plants | Not addressed | Review of three ethnobotany studies. This paper is focused on the floristic and ecological diversity of the ethnobotanical resources of Granada Province in South Spain. | (Benítez, Molero-Mesa, & González-Tejero, 2016) "A model to analyse the ecology and diversity of ethnobotanical resources: case study for Granada Province, Spain." Biodiversity and Conservation 25(4): 771-789 |
| Switzerland (1) | 768 species, i.e. 32% of the vascular plants of the Swiss Flora are documented as medicinal plants. But, 465 formerly documented species do not occur in the ethnobotanical studies and thus seem not to be used any more. Overall, 104 species are documented through all time period. | Not specifically mentioned | Totally 25 herbals from the antiquity, monastic medicine, Renaissance, early modern era and the contemporary time as well as five recent ethnobotanical studies were considered. The choice of modern herbals largely based on interviews with 61 herbalists (unpublished data). | (Dal Cero et al., 2014) "The use of the local flora in Switzerland: A comparison of past and recent medicinal plant knowledge." Journal of Ethnopharmacology 151(1): 253-264 |

**Table 2.5.10: Taxonomic studies on medicinal plants (2014 – Feb 2017) (N=7)**

| *Region* | *Medicinal plants reported* | *Ailment categories reported* | *Method* | *Source* |
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| Greek historical documents (1) | 40 plants | Several pharmaceutical properties described, such as for treatment of gastric and intestinal ailments, as analgesic, prespiratory and anti-shivering agents. | Taxonomic historical document analysis | (Evergetis & Haroutounian, 2015) "The Umbelliferae (Apiaceae) of Dioscorides annotated in codex Neapolitanus Graecus #1." Journal of Ethnopharmacology 175: 549-566 |
| Region in Italy (1) | 408 taxa were identified, of which 332 species, 73 subspecies and 3 varieties, belonging to 275 genera and 74 families. 26 medicinal and aromatic plants | Mentioned uses are e.g.: diuretic, astringent and enlargement of spleen; for diaper rash and to solve respiratory problems, antifungal activity; digestive, antiseptic, balsamic, carminative, and antitussive | Taxonomical research: A floristic study of vascular flora of ancient olive groves | (Perrino, Ladisa, & Calabrese, 2014) "Flora and plant genetic resources of ancient olive groves of Apulia (Southern Italy)." Genetic Resources and Crop Evolution 61(1): 23-53. |
| Mediterranean region (1) | 22 species representing 11 of the 12 sections recognized within the genus Trigonella were analysed. Traditionally, consumed as fresh vegetable and as spice to add flavor to the Indian cuisines, fenugreek is gaining importance around the world due to its rare medicinal properties. | Fenugreek contains three important chemical constituents with medicinal value; i.e. steroidal sapogenins; galactomannans and isoleucine. These constituents seem to work in a synergistic way to produce health effects and have placed fenugreek among the most commonly recognized ‘‘nutraceutical’’ or health food products. | Taxonomic research. Phylogenetic relationships in 22 species representing 11 of the 12 sections recognized within the genus Trigonella were analyzed using nuclear ITS and plastid trnL-F DNA sequences. | (Dangi, Tamhankar, Choudhary, & Rao, 2016) "Molecular phylogenetics and systematics of Trigonella L. (Fabaceae) based on nuclear ribosomal ITS and chloroplast trnL intron sequences." Genetic Resources and Crop Evolution 63(1): 79-96 |

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| Region in Turkey (4) | Ebenus haussknechtii | Ebenus species have been shown to have antifungal, anticonvulsant, antioxidant, and estrogenic activity | Experimental research: in this study, morphological, morphometrical, karyological and detailed pollen morphology of Ebenus haussknechtii endemic to Turkey was studied for the first time | (Hayta et al., 2014) "Morphological, karyological features and pollen morphology of endemic Ebenus haussknechtii Bornm. ex Hub.-Mor. from Turkey: A traditional medicinal herb." Journal of Herbal Medicine 4(3): 141-146 |
| | Certain Salvia Species - ten different Turkish Salvia (sage) species | Bactericidal, virucidal, fungistatic, spasmolytic, and anti-hypertention effects are some of the best known therapeutic effects of Salvia. Furthermore, Salvia is a potentially extensive and important source for the production of phytochemical compounds.[ | Experimental research: Determination of DNA in Certain Salvia Species by Capillary Gel Electrophoresis | (Öncü-Kaya, Uysal, Ozturk, Cenkci, & Tuncel, 2015) "Determination of DNA in Certain Salvia Species by Capillary Gel Electrophoresis." Journal of Liquid Chromatography & Related Technologies 38(14): 1417-1425 |
| | The genus Ziziphora L. (Lamiaceae) | Sedative, stomachic, aphrodisiac and carminative uses. Also used to heal wounds or as antiseptics. | Taxonomical research: to determine the palynological and karyological features of these taxa. The pollen morphology and exine structure of Ziziphora species were investigated by light microscope and scanning electron microscope | (Selvi, Satil, Martin, Celenk, & Dirmenci, 2015) "Some evidence for infrageneric classification in Ziziphora L. (Lamiaceae:Mentheae)." Plant Biosystems 149(2): 415-423 |
| | Tanacetum is one of the large genera, belonging to the Anthemideae tribe of Asteraceae | Anti-inflammatory, antihistaminic and insecticidal effects. The essential oils when | Taxanomic research: In this study, anatomical features of six endemic species to Turkey viz. | (Tekin & Kartal, 2016) "COMPARATIVE |

| | | | | |
|---|---|---|---|---|
| | family and has numerous medicinal plants and widely usage in folk medicine. 6 species thereof | rubbed on skin, repel insects and have antibacterial and anti-yeast activity. Roots and rhizomes have been used in the Iranian traditional medicine as digestive and stomatic tonic. In addition, aerial parts, especially the leaflets against arthritis, migraine and asthma ( | Tanacetum albipannosum, T argenteum subsp. argenteum, T cappadocicum, T densum subsp. sivasicum, T haussknechtii and T heterotomum, were investigated for the first time | ANATOMICAL INVESTIGATIONS ON SIX ENDEMIC TANACETUM (ASTERACEAE) TAXA FROM TURKEY." Pakistan Journal of Botany 48(4): 1501-1515. |

**Table 2.5.11: Socio-economic studies on medicinal plants (2014 – Feb 2017) (N=2)**

| *Region* | *Medicinal plants reported* | *Ailment categories reported* | *Method* | *Source* |
|---|---|---|---|---|
| Albania (1) | Albania has rich natural resources and appropriate soil and climatic conditions to produce wild and cultivated Medicinal and Aromatic Plants (MAPs). There are more than 300 species of MAPs in the Albanian flora, which are considered important from a natural resource and economic viewpoint. | Not specifically addressed | Socio-economic research: This paper analyzes the MAPs sector in Albania based on expert interviews and desk research. Figures and graphs on export and price trends. | (Imami, Ibraliu, Fasllia, Gruda, & Skreli, 2015) "Analysis of the Medicinal and Aromatic Plants Value Chain in Albania." Gesunde Pflanzen 67(4): 155-164 |
| Turkey (1) | In Turkey, 500 plant species used for medicinal purpose of which 200 have export potential. The world oregano trade volume is roughly 12-15 thousand tons and Turkey provides 80% of this amount. | Not addressed in detail | Review: the main aim is to show the importance of medicinal and aromatic plants (MAPs) in rural development as an alternative crop | (Samet & Cikili, 2015) "Importance of Medicinal and Aromatic Plants as an Alternative Crop in the Rural Development of Turkey." Journal of Rural and Community Development 10(4): 75-84 |

**Table 2.5.12: Conservation studies on medicinal plants (2014 – Feb 2017) (N=1)**

| *Region* | *Medicinal plants reported* | *Ailment categories reported* | *Method* | *Source* |
|---|---|---|---|---|
| Region in Italy (1) | Of the total of 2212, folk medicine (32.0%, 709 taxa), | Not specifically addressed | Conservation research: The aim of this study was to construct a solid basis for developing a crop wild relatives (CWR) and wild harvested plants (WHP) conservation strategy at the European and national levels | (Landucci et al., 2014) "A Prioritized Inventory of Crop Wild Relatives and Wild Harvested Plants of Italy." Crop Science 54(4): 1628-1644. |

**Table 2.5.13: Historical botanical studies on medicinal plants (2014 – Feb 2017) (N=1)**

| *Region* | *Medicinal plants reported* | *Ailment categories reported* | *Method* | *Source* |
|---|---|---|---|---|
| Poland (1) | Medical mosses | Nowadays bryophytes are a subject of intensive phytochemical studies. It has been proved that they possess real medicinal properties, as many other plants. | Historical botanical research. The paper presents information about the earliest botanical work from Poland, Warsavia physice illustrata which takes bryophytes into account. | (Drobnik & Stebel, 2014) "Medicinal mosses in pre-Linnaean bryophyte floras of central Europe. An example from the natural history of Poland." Journal of Ethnopharmacology 153(3): 682-685 |

**Questions of the expert elicitation on medicinal plants**

| Original questions on characterization of evidence posed to the experts | | | | | |
|---|---|---|---|---|---|
| **Key findings from the literature review** | *Well established* | *Unresolved* | *Established but incomplete* | *Inconclusive* | *I do not know* |
| *1) Indigenous and local knowledge plays an essential role regarding reaping the health benefits of medicinal plants.* | ☐ | ☐ | ☐ | ☐ | ☐ |
| *2) Collection of plants of the wild and loss of habitat due to residential and commercial development are the most significant threats affecting medicinal plants in Europe.* | ☐ | ☐ | ☐ | ☐ | ☐ |
| *3) Ethnobotanical research is crucial for a better understanding of the medicinal potential of medicinal plants in the ECA-region.* | ☐ | ☐ | ☐ | ☐ | ☐ |
| *4) There is a high rate of decline of traditional medical knowledge in the ECA region* | ☐ | ☐ | ☐ | ☐ | ☐ |
| *5) Because of increasing inward migration into the ECA region from other regions, there is an urgent need to increase understanding of traditional medicinal practices within national public health care systems.* | ☐ | ☐ | ☐ | ☐ | ☐ |

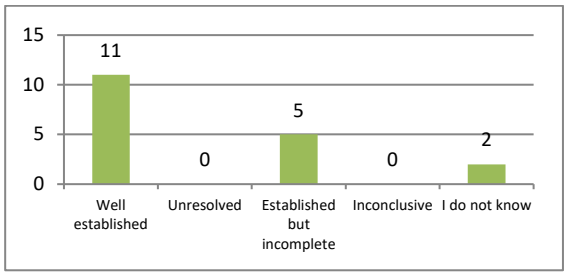
| Original key messages posed to the experts for ranking |
|---|
| **Key message** |
| *1) The impact of existing conservation measures and land use strategies on medicinal plants and associated cultural diversity should be further explored.* This knowledge could help to improve planning for conservation and sustainable use of medicinal plant species. For example, in some areas the loss of medicinal plant diversity has been linked to disappearance of traditional farming systems; yet little is known about the potential for High Nature Value farmland and related agrobiodiversity conservation strategies to support sustainable management of these species. |
| *2) A broader inter-disciplinary approach is required for policies and practical strategies for conservation of medicinal plant species and associated cultural diversity.* This should include development of appropriate education systems, professional assistance and aligned legislations, to ensure safe, sustainable and rational use of herbal products in order to protect human health and the biodiversity of medicinal plants. In particular, greater involvement of the health sector in policy development and implementation on issues related to traditional medicinal knowledge and medicinal plant use is important. |
| *3) More integrated research approaches would be beneficial to better explore the potential health benefits of medicinal plant species, and related issues surrounding safety and sustainable use.* This would ideally include topical and methodological integration, e.g. experimental and ethnobotanical studies, but also collaboration between different relevant disciplines. |
| *4) Inventories of medicinal plant species, with details of their conservation status, use and related trends should be maintained at national and regional levels.* Information currently available on medicinal plants, their potential benefits, threats to their conservation and the legal basis for their collection and use in the ECA region is incomplete. Improved national efforts for collating relevant information from different sources within and across countries would support more integrated conservation planning at national, regional and international level, and help assess the various health, ecological, environmental, cultural, legal, and socio-economic aspects. |

**Outcomes of the expert elicitation on medicinal plants**

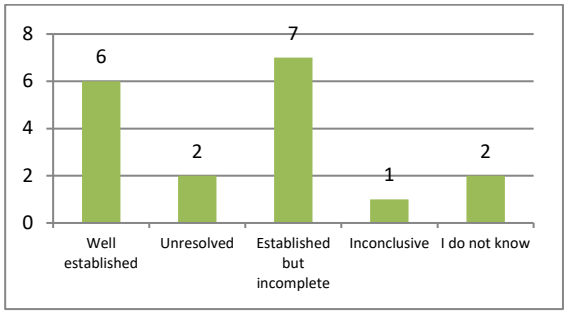
**Key findings**

An initial set of eight draft key findings was prepared and submitted to an expert panel for consideration. The key messages as presented here are slightly adapted for improvement of precision and clarity, and they were re-ordered to have a better flow of content. The original key messages are provided above.

1) **Indigenous and local knowledge plays an essential role in creating greater understanding of the potential benefits of many plant species to human health.** *("Well-established" - "established but incomplete")*

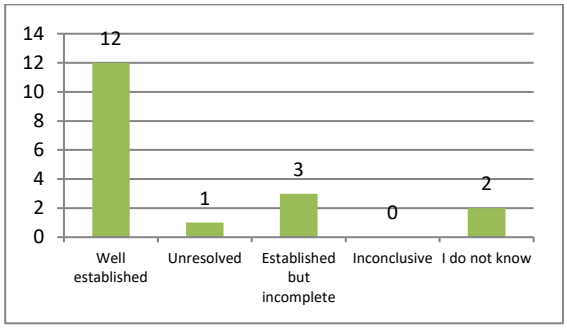



2) **Collection of plants from the wild and loss of habitat due to physical development and land use change are the most significant threats affecting medicinal plants in Europe and Central Asia.** *("Well-established" *)*

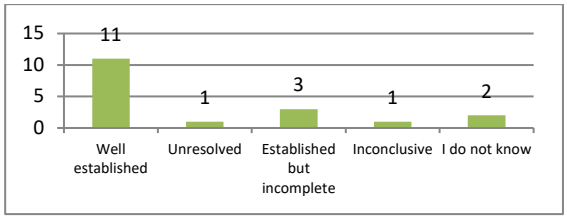



*"Whilst there was some difference of opinion expressed on this point during the expert elicitation process, we here defer to the body of peer-reviewed evidence, particularly the IUCN European Red List of Medicinal Plants plus other references cited in this section, as the basis for determining the evidence is "well-established" that medicinal plants in the region are most threatened by unsustainable harvesting and land use changes which result in loss or disturbance of habitat."

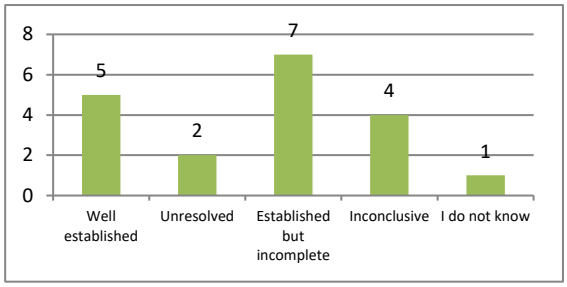
3) **Ethnobotanical research is crucial for a better understanding of the medicinal potential of medicinal plants in the ECA-region.** *("Well-established")*




4) **There is a high rate of decline of traditional medical knowledge in the ECA region.** *("well-established")*



5) **Because of increasing inward migration into the ECA region from other regions, there is an urgent need to increase understanding of traditional medicinal practices within national public health care systems.** *("Established but incomplete")*



**Key recommendations**

An initial set of four draft key recommendations was prepared and submitted to an expert panel for consideration. Below you find the consensus ranking derived from the individual expert rankings. We should note that experts sometimes disagreed substantially, so this consensus ranking should not be considered as an outcome of negotiation among experts. It was derived from processing by means of a ranking program (AURORA; (Keune, Springael, & Keyser, 2013)).

| *Ranking* | *Key message* |
|---|---|
| *1* | *1) The impact of existing conservation measures and land use strategies on medicinal plants and associated cultural diversity should be further explored.* This knowledge could help to improve planning for conservation and sustainable use of medicinal plant species. For example, in some areas the loss of medicinal plant diversity has been linked to disappearance of traditional farming systems; yet little is known about the potential for High Nature Value farmland and related agrobiodiversity conservation strategies to support sustainable management of these species. |
| | *4) Inventories of medicinal plant species, with details of their conservation status, use and related trends should be maintained at national and regional levels.* Information currently available on medicinal plants, their potential benefits, threats to their conservation and the legal basis for their collection and use in the ECA region is incomplete. Improved national efforts for collating relevant information from different sources within and across countries would support more integrated conservation planning at national, regional and international level, and help assess the various health, ecological, environmental, cultural, legal, and socio-economic aspects. |
| *2* | *2) A broader inter-disciplinary approach is required for policies and practical strategies for conservation of medicinal plant species and associated cultural diversity.* This should include development of appropriate education systems, professional assistance and aligned legislations, to ensure safe, sustainable and rational use of herbal products in order to protect human health and the biodiversity of medicinal plants. In particular, greater involvement of the health sector in policy development and implementation on issues related to traditional medicinal knowledge and medicinal plant use is important. |
| | *3) More integrated research approaches would be beneficial to better explore the potential health benefits of medicinal plant species, and related issues surrounding safety and sustainable use.* This would ideally include topical and methodological integration, e.g. experimental and ethnobotanical studies, but also collaboration between different relevant disciplines. |

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