Could bio-cultural *refugia* safeguard important reservoirs of traditional plant knowledge in highly industrialized countries? A case study of the White Carpathians, Czech Republic

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Introduction

• The tradition of gathering is disappearing particularly fast in developed countries and those communities in which the proximity of industrialized societies increasingly threatens the perpetuation of this knowledge, despite its antiquity and practical importance (1).

• Unfortunately, researchers adhere to studying traditional plant knowledge almost exclusively in less developed countries, despite the caution of Hadjichambis *et al*. (2), calling for more effort in industrialized countries, where remaining knowledge, although threatened, is somehow neglected.

• In the European context, the collecting of wild plants is an ancient activity, but still a living custom, although it has experienced significant change reflected by the current socio-economic situation (3).

• Czech Republic is an example of a country, which experienced intensive cultural and landscape changes during collectivization and industrialization in the communist period, leading to vast losses of traditional knowledge .

•Therefore, the aim of our study was to conduct an in-depth ethnobotanical survey documenting uses of wild foods and medicinal plants in a neglected region of the Czech Republic, using modern ethnobotanical methods.

• For our research, we chose the White Carpathians, an area located in the SE of the Czech Republic, known for its extremely high plant biodiversity (4;5) and for the persistence of traditions and folklore.

The objectives of this study were:

(1) to record the traditional plant knowledge of the Moravian people living in the White Carpathians;
(2) to determine the most culturally important plant and mushroom species, botanical families and food/ailment categories;
(3) to compare the collected data with ethnobotanical studies conducted in surrounding European regions, and
(4) to analyze the cultural importance of crop wild relatives and gathering environments.

Methodology

Study area:

• The survey was conducted in the White Carpathians **(Fig. 1, Fig. 2)**, which is a Protected Landscape Area and UNESCO Biosphere Reserve.

• From the ethnographic point of view, it is a Moravia – a region bridging Bohemia and Slovakia, with inhabitants referred as Moravians. The reserve area covers several ethnographic micro-regions (Dolňácko, Horňácko, Uherskobrodsko, Moravské Kopanice, Luhačovické Zálesí and Jižní Valašsko).

• In not too distant history, mountain regions were poor and isolated, with a tough life based on subsistence agriculture. The folk magical healing was practised until half of 20th century.

•The area is extremelly rich in intra-specific diversity of traditional fruit trees (*Malus domestica*, *Prunus domestica*, *Pyrus communis*). Beside that, there occur thermophilous woody fruit species such as *Cornus mas* and *Sorbus domestica*. The botanical world records of the local species richness are represented by 43 vascular plant species per 0.1 m^2, 109 species per 16 m^2 (4), 116 species per 25 m^2 and 131 species per 49 m^2 (5).

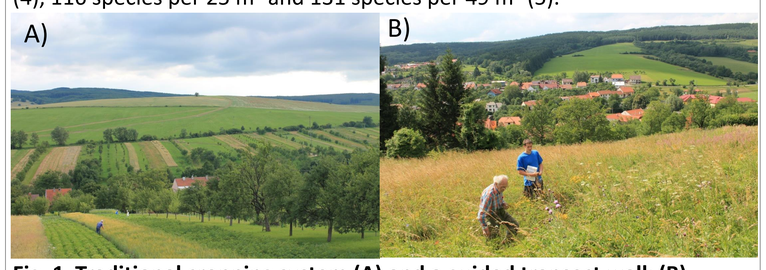

Fig. 1 Traditional cropping system (A) and a guided transect walk (B)

Data collection:

• The field work was carried out during numerous visits to the study area from June 2013 to July 2016.

• Sixty-seven custodians of knowledge from 25 villages were selected purposively, and interviewed about food, medicinal and veterinary plant uses. The ethnomycological part was conducted with a sub-sample of 36 informants. The Code of Ethics of the International Society of Ethnobiology was followed, and prior informed consent was received orally.

• The plants were collected with key informants and specimens were deposited in the herbarium of the Natural History Museum in Prague (PR).

Data analysis:

• Ethnobotanical information was structured in a form of Use-Reports (UR, the informant i, mentions the use of a species s in the use-category u).

• Plant uses were categorized into the food and ailment categories, and Cultural Importance index was calculated (6).

• Crop wild relatives were identified according to their taxonomical determination and following the methodology of Maxted *et al*. (7).

• The diversity of useful plants and their uses were compared and discussed with ethnobotanical studies from the nearest European regions.

• The linear regression was used to test whether the plant knowledge is associated with age of informants. Mann-Whitney *U* test and Kruskal-Wallis test assessed the significance of the difference of plants' cultural importance. The Jaccard similarity index was used for comparative analysis.

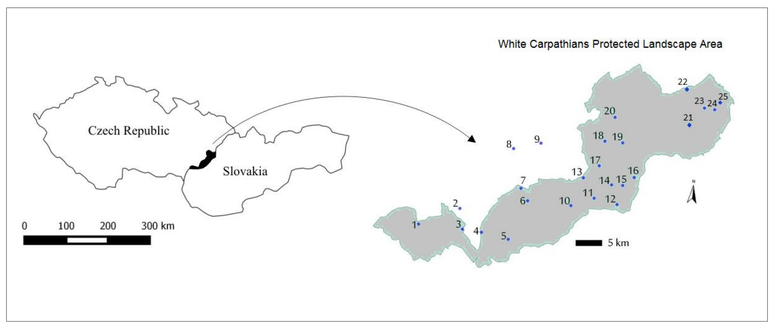

Fig. 2 White Carpathians and the studied villages

Results

• In total, 134 medicinal, 24 veterinary and 78 wild food plant taxa are used traditionally in the area, resulting together in 143 useful plant taxa. There is a significant overlap between medicinal and food plants (48%). Interestingly, 89% of wild food plants are being used also as a medicine.

• As the sampling focused on knowledgeable informants, the elderly people showed only insignificantly higher level of knowledge. For example, there is a positive, but weak relation of informant's age with the number of use reports on wild food plants (Linear regression, r=0.16, p=0.23) **(Fig. 4)**. In terms of gender, women were found to be slightly more knowledgeable, by citing more taxa and uses in most of the categories.

• The most culturally salient wild food plants are *Sambucus nigra*, *Rubus* spp., *Rosa canina* and *Urtica dioica*, respectively. The most culturally important food category is wild fruits, represented by an overwhelming 31% of all UR. The category of recreational beverages obtained the second highest cultural importance (27% of UR) and includes the highest diversity of species, predominantly due to the popularity of recreational herbal teas. Third are wild vegetables, which include 15% of UR.

• In the case of medicinal plants, the most cited ailment categories were respiratory disorders (20% of UR), followed by gastro-intestinal disorders (15%), and skeleto-muscular disorders (9%). The most culturally significant medicinal species are *Agrimonia eupatoria*, *Urtica dioica*, *Tilia cordata*/*platyphyllos* and *Hypericum perforatum*/*tetrapterum* **(Fig. 3)**

Fig. 3 Dried *Agrimonia eupatoria* -> *Tilia cordata* -> *Hyperium perforatum*

• In a veterinary domain, although rather historically, the most cited species were *Urtica dioica*, *Artemisia vulgaris* and *Linum usitatissimum*.

In addition to plants, a total of 25 mushroom folk taxa, which correspond approximately to 35 species, were documented. On average, 9 mushroom folk taxa were used by 1 informant. Mushroom species gathered by the highest number of informants were *Boletus edulis*/*reticulatus*, *Macrolepiota* spp., brown-capped *Leccinum* spp., *Agaricus campestris* and *Ammilaria* sp., respectively.

• Based on the cross-cultural comparison, the highest degree of similarity for species, genera and food uses was found with Ukrainians living in Romania.

Fig. 4 Relationship between wild food plant knowledge and the age

Key messages

➢numerous wild food plants are still gathered, predominantly wild fruits, plants for preparation of recreational beverages, and certain wild greens. The Moravian culture of wild foods represents a common temperate pattern with some elements of SE European habits (e.g. use of *Sorbus domestica*, *Cornus mas* and *Morus alba*);

➢a high diversity of medicinal plants demonstrate the persistence of rich ethnomedicinal knowledge in the area. The whole aerial part is the most prevalent part used, and an infusion is the most common mode of preparation. Currently, herbal medicaments are used complementary to a public health care system.

➢although living in a biodiverse-rich environment, inhabitants tend to use common wild plant species. While the highest number of species is gathered in anthropic environments, the most culturally important species occur rather in meadows and forests. The weedy species are not much appreciated, however, the crop wild relatives manifest high cultural value and wider assortment of food plants;

➢the Moravians in the White Carpathians showed to have utilized the greatest diversity of wild food plants across the contemporary Carpathians **(Tab. 1)**.

➢noteworthy are traditional contemporary food uses of *Impatiens parviflora*, *Glechoma hederacea*, *Allium vineale*, *Tilia* spp. (flower buds and young fruits) and *Sambucus nigra* (green flower buds), while uses of other less common food species are still remembered (*Allium scorodoprasum*, *Rumex obtusifolius*/*crispus*, *Sorbus torminalis*). In the case of medicinal plants, interesting are uses of *Laserpitium latifolium* (tincture from roots) and *Fagus sylvatica* (lard of the trunk as a base for herbal ointments).

➢apart from numerous herbs and fruits which are generally rich sources of antioxidants, certain micronutrients-rich wild vegetables could be mainstreamed within a healthy food trend (e.g. *Allium* spp., *Bellis perennis*, *Malva neglecta*, *Atriplex hortensis*, *Glechoma hederacea*);

➢a still rich reservoir of local knowledge in the White Carpathians demonstrates a need for further in-depth studies, especially in areas referred to as '*bio-cultural refugia*' (8), even in industrialized countries and societies.

Table 1. Comparison of wild food plants with studies from the Carpathians

Ethnicity, region , and country	no. of informants	no. of fruit species	no. of vegetable species	no. of species for recreational drinks	no. of taxa and genera found[a]	no. of identical species and genera[a]	no. of identical uses	Jaccard index for species and genera[a]
Ukrainians, Maramureş, Romania [9]	64	17	10	12	44 (37)	28 (27)	31	29.79 (41.54)
Czechs, Banat, Romania [10+11]	65	12	6	19	32 (24)	23 (23)	28	26.44 (41.07)
Hutsuls, Bukovina, Romania and Ukraine [12]	42	4	11	22	40 (29)	18 (23)	30	18.00 (37.70)
Moravians, White Carpathians, Czech Republic	60	24	20	30	78 (55)	N/A	N/A	N/A

[a] genera are indicated in brackets

Conclusion

The persisting knowledge of wild food plants recorded in the White Carpathians represents a remarkable cultural heritage in an area where local flora has contributed to forming a cultural identity and contributes to the local people's health and diet. The majority of species is still used contemporary to some extent. Summing up medicinal, veterinary and food plants with edible mushrooms resulted in 178 useful taxa. Thirty-two food plant taxa are in fact crop wild relatives of the European food crops. The results of this study fill the research gap on Central-Eastern European food ethnobiology. The findings may have possible implications for fostering research and promotion of neglected species, rediscovering traditional foods from local biodiversity, and the expansion of small-scale traditional, herbal and food products. The mutual reinforcement of traditional food culture and bio-cultural landscape management may strengthen ecologically and culturally oriented sustainable development of the rural areas.

Additional photos

"Repíček , všech bylin tatíček"
(*Agrimonia eupatoria*, the father of all herbs)

We would like to acknowledge all custodians of the local bio-cultural heritage, who shared their invaluable traditional plant knowledge for the present study.

Among those, for example, is a Mrs. Božena who is the author of the aforementioned proverb. She had a remarkable knowledge about 70 useful taxa:

• 42 medicinal plant taxa
• 26 wild food plant taxa
• 15 mushroom taxa
• 5 veterinary plant taxa

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