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Edible and Tended Wild Plants, Traditional Ecological Knowledge and Agroecology

Nancy J. Turner,[1] Łukasz Jakub Łuczaj,[2] Paola Migliorini,[3] Andrea Pieroni,[3] Angelo Leandro Dreon,[4] Linda Enrica Sacchetti,[4] and Maurizio G. Paoletti[4]

[1]*School of Environmental Studies, University of Victoria, British Columbia, Canada V8P 2C9*
[2]*Department of Ecotoxicology, University of Rzeszów, Werynia, 36–100 Kolbuszowa, Poland*
[3]*University of Gastronomic Sciences, Via Amedeo di Savoia 8, I-12060 Pollenzo/Bra, Italy*
[4]*Laboratory of Agroecology and Ethnobiology, Department of Biology, University of Padova, Via G. Colombo 3, 35131 Padova, Italy*

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Address correspondence to Nancy J. Turner, School of Environmental Studies, University of Victoria, British Columbia, Canada V8W 3R4. E-mail: nturner@uvic.ca
Referee: Sally L. Benjamin, M.S., J.D., Ecologist, Science Program Development USG, Northern Prairie Wildlife Research Center, 871137th Street SE, Jamestown, ND 58401-7317.

Humans the world over have depended on wild-growing plants in their diets for hundreds of thousands of years, and many people continue to rely on these species to meet at least part of their daily nutritional needs. Wild harvested plant foods include: roots and other underground parts; shoots and leafy greens; berries and other fleshy fruits; grains, nuts and seeds; and mushrooms, lichens, algae and other species. Use of any of these species requires special cultural knowledge regarding harvesting, preparation, cooking and other forms of processing. Many were, and are, prepared and served in mixtures or combinations. In most cases, too, the species are managed, tended or manipulated in some way to increase their productivity and availability. Many of the most widely used species are categorized as weeds—species that grow and reproduce readily in disturbed or cleared land, and are common around human settlements and agricultural areas. This paper presents case examples of edible wild plant use and the roles of these species in agroecosystems from different parts of the world and discusses similarities and differences in use across different cultures and segments of society.

Keywords edible wild plants, foraging, edible weeds, root vegetables, wild berries, wild greens

I. INTRODUCTION

Humans have depended on edible wild plants, along with diverse wild insects, birds, fish, and mammals and their products, for the vast part of our history. Between approximately 20% and 30% of the plants on the planet (ca. 280,000 described species) and possibly 30% to 50% of mushroom species have some parts that have been eaten or that have been assumed to be palatable and edible (e.g., providing nutrients and generally assumed to be safe for consumption). As well, most small or very small animals such as invertebrates have been considered edible, especially in the tropics. But it is not true that all invertebrates are edible or have been chosen as food. Humans vary considerably in their food choices. For example, different human groups living in similar or only slightly different environments—especially in the tropical forests and savannas such as in Alto Orinoco, but also in rural areas—utilize quite a different basket of species.

These differences have been explained from territorial differences and different levels of availability of foods, and extreme biodiversity. These arguments, however, though valid, do not provide the overall explanation. In most cases the landscapes utilized by different ethnic groups for foraging are quite similar, and the different choices of species for food can be due to necessity or opportunity rather than through conflict in resource adoption across different groups. In addition, an attitude is suggested to allow choices from the potentially available biodiversity of a set of species that are acceptable within a group and have acquired status within small human communities over time (Paoletti, 2005; Paoletti and Dufour, 2005).

Here we have collected worldwide ideas about the assemblage of plants from the wild that are traditionally collected especially by local traditional communities in rural, forested, wetland, and montane areas. These species might be considered as "wild edibles" only if they are being collected without particular manipulation. In reality, however, as Posey (Posey and Plenderleith, 2004; Paoletti, 2004; Malaisse, 1997) and many other researchers (e.g., Anderson, 2005; Deur and Turner, 2005; Minnis and Elisens, 1999) have documented, most activities of hunter collectors (and horticulturists) in the Amazon and many other parts of the world, including temperate regions, include direct or indirect manipulation of resource species and habitats. Relying on their accumulated traditional knowledge and observations, indigenous people attend to many key plants and insects, such as ants, producing a sort of semidomestication or paradomestication process (i.e., caring for and promoting *in situ*) that is underway in most cases even if difficult to characterize. In addition, many semidomesticated crops are only locally known and would need more selection and genetic work to be promoted as domesticated crops (NAC, 1989).

Only within the last 10,000 years or so have we started to focus on domestication—genetically altering species significantly from their wild-growing ancestors—as a major process in food production. People domesticated suites of plants in different parts of the world within more or less the same time period from about 9,000 to 5,000 years ago: barley, wheat, rye, figs, and grapes from the Middle East; corn, dry beans, and tomatoes from Mexico; potatoes and peanuts from Andean South America; rice and oranges from Southeast Asia, and so forth. In most parts of the world, however, until very recently, people continued to rely on wild plants in their natural habitats to provide a major portion of their food. For example, Ötzi, a Neolithic (5,200-year-old) mountain traveler known as the "ice man," whose frozen body was found in 1991 in the Tyrolean Alps at the border of Italy and Austria, was carrying sloe plums (*Prunus spinosa*) with him. He probably also would have eaten wild hazelnuts (*Corylus avellana*), wild raspberries (*Rubus idaeus*) and fruits of the wayfaring tree (*Viburnum lantana*), as well as a variety of wild-growing greens and wild game (Dickson *et al*., 2003). Wild plant species, even for agrarian peoples or pastoralists who mainly used animal products, would have assumed a special importance during times of crop failure and famine (Turner and Davis, 1993). Some of these

are the species that we know of today as "weeds": species well adapted to disturbed conditions and often associated with human habitation. In turn, some of these weeds became the candidates for domestication: for example, mustards (*Brassica* spp.), wild carrot (*Daucus carota*), chicory (*Cichorum intybus*) and lettuce (*Lactuca* spp.).

Altogether, widely used domesticated species comprise only a fraction of the 20,000 or so plant species known to have been used as food by humans (Paoletti, 2004; Piperno and Pearsall, 1998). Canadian Indigenous peoples alone have used over 500 species of plants for food (Kuhnlein and Turner, 1991). In recent times, however, especially in urban areas of the world, most people have come to depend on fewer and fewer species to provide them with their daily nutrition. Today, only around 20 domesticated species supply up to 85% of the world's food base. Yet, the potential for more intensively using, and possibly further domesticating, a wide diversity of wild-growing plant species is immense.

In this chapter, we describe and provide examples of various categories of edible wild and tended and/or semidomesticated plants used by Indigenous and local peoples in different parts of the world. We then discuss the concept of tending and managing wild plants, fungi and algae. Many different types of edible species, while not domesticated in the sense of dramatic genetic alterations through successive selective breeding, are nonetheless enhanced in quality and productivity through directed human activities, ranging from selective harvesting and thinning, to pruning and coppicing, to controlling pests and removing competing species. Sometimes termed collectively "incipient agriculture," these practices are effective management strategies in their own right, and in some cases have been in place in a given area for millennia (Smith, 2005). Many of the species that are tended are woody or herbaceous perennials, which are "kept living" and producing sometimes over many years or even generations (Deur and Turner, 2005). The types of wild food plants in diverse ecosystems throughout the world are described next, with regional patterns and trends in edible plant groups. **"**Weeds" are another focus of this chapter. As noted previously, weedy species are well represented in the larder of edible wild-growing plants, many having long associations with humans, and serving not only to provide edible roots, greens and seeds, but also form the basis of many medicinal preparations, featuring strongly in the history of medicine (Stepp and Moerman, 2004).

Many people do not realize or appreciate the extent to which edible wild plants continue to contribute to peoples' nutritional and dietary needs, even in parts of Europe. As a demonstration of their importance, a case study of edible wild plant use in Mediterranean regional cuisine is offered, focusing on inland Southern Italy. The richness and diversity of wild foods, their contributions to local economies, and their diverse modes of preparation are emphasized. Wild food plants contribute more than nutrients; for many people and ethnic groups, the use of wild foods is a source of cultural identity, reflecting a deep and important body of knowledge about the environment, survival, and sustainable living known widely as traditional ecological knowledge. This important relationship is discussed, followed by concluding comments on the future of wild plant food use in a changing world. Along with the major sections of the chapters, we provide a series of examples of a range of important but diverse aspects of wild food use.

II. CATEGORIES OF EDIBLE WILD PLANTS

Edible wild plants include food categories familiar to everyone: "root vegetables" (including true roots and underground storage organs like bulbs, corms, tubers and rhizomes); edible greens (leaves, stems, shoots, including marine algae); fleshy fruits (berries, pomes, drupes); and grains, seeds, and nuts. Other edible products include inner bark and cambium of trees, plant-based beverages, plants used for flavoring, and edible wild mushrooms and lichens (biologically different from plants but usually considered together with them). Many of these wild foods are common and productive, as well as being highly nutritious, palatable and easily harvested. Some, such as *Rubus* spp. (raspberry relatives) and *Rosa* spp. (wild roses), yield more than one type of food, in these cases both edible fruits and edible green shoots. Wild-growing plants, together with wild-harvested fish, shellfish and game, have sustained relatively large populations for many thousands of years, from the Northwest Coast of North America to Amazonia in South America, to Eastern Africa: in fact, across every continent except Antarctica (FAO, 1988; Hedrick, 1972; Hussain, 1987; Pieroni, 2005; Kuhnlein *et al.,* 2009, in press; Balée, 1994; Szczawinski and Turner, 1978, 1980; Turner and Szczawinski, 1978, 1979; Walsh, 2009).

Examples of diverse edible wild plant genera and species used in different parts of the world are provided in Table 1, and are described in general in the following sections. Nutritional values for many wild food species can be found in Kuhnlein and Turner (1991; now available in digital form through FAO, 2009).

A. Root Vegetables (Roots, Corns, Tubers and Rhizomes)

Root vegetables, like fruits and greens, are ancient human foods. Kubiak-Martens (1996) documented the presence of tissues of two edible root genera possibly used as food by Palaeolithic and Mesolithic peoples from the site of Całowanie in the central part of the Polish Plain: arrowleaf, wapato, or "swamp potato" (*Sagittaria* sp.) and tuberous bistort (*Polygonum* sp.). Many different indigenous groups in eastern Asia and North America are known to have used species in these genera as food (especially *S. sagittifolia* and *S. latifolia*; and *P. bistorta* and *P. vivipara*) (Arnason *et al.,* 1981; Kuhnlein and Turner, 1991; Strecker, 2007). *Sagittaria latifolia* is known to have very high starch content (ca. 55.0% of dry matter), and in some parts of western North America, the tubers were the most important source of carbohydrates for indigenous peoples, and were a favoured staple food (Kuhnlein and Turner, 1991; Darby, 1996).

TABLE 1

Edible Wild-Growing Plants (and Algae, Fungi, Lichens) of the World; selected examples (after Cappelletti *et al.,* 2000; Crowe, 1981; Hedrick, 1992; Hu, 2005; Kuhnlein and Turner, 1991; Maurizio, 1927; Paoletti *et al*., 1995, Paoletti, 2004; Tanaka 1976; Turner, 1995, 1997).

Root vegetables (roots, bulbs, corms, tubers and rhizomes)

Allium spp. (onions, garlic); Liliaceae—temperate prairies, bluffs, woodlands; N Hemisphere; many species eaten, usually after cooking, throughout various parts of the world.

Amphicarpa bracteata (hog peanut); Fabaceae—deciduous woods and clearings, E N America; tuberous roots cooked and eaten by First Peoples.

Arctium lappa and other spp. (burdock); Asteraceae—woods and disturbed ground, Eurasia; introduced in N America; first-year taproot highly valued in Japan (fried); in England ingredient of homemade beer.

Arum italicum and other spp. (lords-and-ladies); Araceae—woods and hedgerows, western Europe and the Mediterranean; starch-rich tubers an important famine food throughout the area.

Argentina anserina, A. egedii (syn. *Potentilla*) (silverweed, cinquefoil); Rosaceae—moist meadows, saline marshes, tidal flats, river and lake margins, temperate and boreal regions, N America, N Europe, Asia, Himalayas; fleshy taproots cooked and eaten by N American First Peoples, and in UK, Tibet and elsewhere.

Balsamorhiza sagittata (balsamroot, or spring sunflower); Asteraceae—open woods, sagebrush steppe, and subalpine meadows, NW N America; taproots pit-cooked and eaten; also young shoots, budstalks and seeds eaten.

Bunium bulbocastanum (pignut); Apiaceae—grasslands, Eurasia; tubers eaten boiled in some parts of Europe.

Butomus umbellatus (flowering rush); Butomaceae—water margins, Eurasia; rhizomes made into flour or cooked, particularly in Siberia.

Camassia spp. (edible camas); Liliaceae—temperate woodlands, oak parklands, W N America; bulbs cooked and eaten by many Indigenous peoples as a staple; main carbohydrate is inulin, a complex sugar based on fructose units.

Campanula rapunculus (rampion); Campanulaceae—herbaceous biennial of gravelly pastures, roadsides and along hedge-banks, of Europe and UK; formerly widely grown for its edible roots, which have a pleasant sweet flavour reminiscent of walnuts (leaves also eaten); traditionally collected in Ligurian region.

Chaerophyllum bulbosum (bulbous chervil); Apiaceae—herbaceous biennial or perennial of river margins, roadsides in Eurasia, and introduced in parts of N America; tubers eaten raw throughout Eastern Europe.

Cirsium spp. (thistles); Asteraceae—herbaceous perennials of open, disturbed ground and old fields, widespread, N America and Eurasia; taproots of several spp. eaten by N American First Peoples; main carbohydrate is inulin; green stalks peeled and eaten in Spain, Portugal and elsewhere.

Claytonia spp. (spring beauty); Portulacaceae—herbaceous perennials of temperate woodlands, subalpine meadows, prairies, N America, NE Asia; corms cooked and eaten by many peoples.

Cordyline spp. (ti, cabbage tree); Laxmanniaceae, flaxlike leaves borne in tufts; cooked roots of several spp. eaten by Maori and other Polynesians; *C. terminalis* has domesticated forms that were used in molasses production and for making alcoholic beverages.

Corydalis solida (fumewort); Fumariaceae—herbaceous perennial of woods and steppe, Europe and N Asia; bulbs eaten after cooking by Kalmucks and Russians.

Dioscorea spp. (yams); Dioscoreaceae—herbaceous perennial of tropical and subtropical forests, Africa, S Asia, New Guinea, Australia; tuberous roots a very important source of nutrition for forest dwelling indigenous peoples; used after prolonged processing.

Dryopteris expansa (spiny wood fern); Dryopteridaceae—moist open forest, avalanche runs, circumpolar region; rootstocks pit-cooked or steamed and eaten by First Peoples of NW N America.

Elymus repens (couchgrass, or quackgrass); Poaceae—perennial grass of fields and river margins, widespread in Europe; rhizomes dried and powdered into flour, rich in carbohydrates; used mainly as an ingredient of bread and soups, many northern and central European countries (e.g. Poland and Germany).

Equisetum arvense (common horsetail); Equisetaceae—weedy perennial of open ground and arable fields, circumpolar; little tubers eaten throughout northern hemisphere, particularly in Russia.

Erythronium spp. (glacier lily, avalanche lily, fawn lily); Liliaceae—bulb-forming perennial of open woods and meadows, N America, E Asia; bulbs of various spp. cooked and eaten in Japan, Korea, NW N America.

Fritillaria camschatcensis, Fritillaria spp. (riceroot); Liliaceae—salt marshes, shorelines, prairies, dry open bluffs, W N America, Kamchatka; ricelike bulbs steamed and eaten by Pacific Rim First Peoples.

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Helianthus tuberosus (Jerusalem artichoke, sunchoke); Asteraceae—tuberous perennial of open woodlands, wet meadows, N America; tubers contain inulin as major carbohydrate; eaten raw and cooked.

Hedysarum alpinum (Eskimo Potato, licorice root, Indian carrot); Fabaceae—herbaceous perennial of moist open woods and meadows, Arctic and S in mountains; long roots eaten raw or cooked (WARNING, similar species are toxic).

Lathyrus tuberosus (tuberous pea) and related species e.g. *L. linifolius*; Fabaceae—herbaceous perennial of open ground, Europe; tubers eaten raw as a valued snack.

Leopoldia comosa (syn: *Muscari comosum*); Liliaceae—herbaceous perennial of arable fields, Europe; bulbs consumed since long time in the Eastern Mediterranean (after maceration in cold water for decreasing the bitterness), esp. Southern Italy, Albania, and Greece; Nowadays widely cultivated for serving these markets in Morocco and Algeria.

Lewisia rediviva (bitterroot); Portulacaceae—herbaceous perennial of open pine woods, sagebrush desert, W N America; taproots steamed and eaten by Plateau indigenous peoples.

Lilium columbianum, L. cordatum and other spp. (lilies); Liliaceae—herbaceous perennials of open woods and meadows, N America, E Asia; starchy bulbs cooked and eaten by indigenous peoples.

Lomatium spp. (biscuitroots, kous); Apiaceae—taprooted or tuberous rooted herbaceous perennials of dry plains and open wood and meadows, northwestern N America; tuberous roots cooked and eaten by indigenous peoples.

Microseris lanceolata (murnong or yam daisy); Asteraceae—taprooted herbaceous perennial of dry open plains and forest edges, widespread in Australia and Tasmania; fleshy taproots pit-roasted and eaten by Indigenous Australians.

Nelumbo nucifera and other spp. (lotus); Nelumbonaceae—rhizomatous aquatic perennial of Asia and elsewhere; fleshy rhizomes eaten as a cooked vegetable in soups and a variety of other dishes; seeds also widely eaten.

Nuphar lutea (yellow pondlily); Nymphaeaceae—rhizomatous perennial of ponds and lakes; widespread in Northern Hemisphere; fleshy rhizomes eaten by some indigenous peoples in North America and Eurasia; after cooking or other preparation.

Nymphaea spp. (waterlily); Nymphaeaceae—rhizomatous perennial of ponds and lakes; cosmopolitan genus; fleshy rhizomes eaten by indigenous people in some regions, e.g., Australia, after prolonged preparation.

Orchis spp. (orchid); Orchidaceae—herbaceous perennial of grasslands and woods; Eurasia; underground parts made into a food called *salep*; eaten mainly in SE Europe and SW Asia, also in England.

Polygonatum spp. (Solomon's seal); Convallariaceae—herbaceous rhizomatous perennial of woods and clearings; widespread in Northern Hemisphere; fleshy rhizomes cooked and eaten by indigenous peoples in North America and Eurasia, particularly in China and Japan.

Polygonum vivaparum (alpine bistort); Polygonaceae—herbaceous perennial of montane meadows and northern tundra, circumpolar; rhizomes eaten by northern First Peoples; in Eurasia also *P. bistorta* (bistort) and related spp. eaten.

Polypodium spp. (polypody); Polypodiaceae—woods, particularly on rocks or old trees, widespread in northern hemisphere; rhizome eaten raw or added as sweetener; they have a high sugar content; being the sweetest "root" of the northern hemisphere; used e.g., in Italy, Poland, Slovakia, Norway, Balkans, as well as on the western coast of North America.

Pteridium aquilinum (bracken fern); Dennstaedtiaceae—herbaceous perennial fern of meadows, open woods and clearings, widespread and ubiquitous; starchy rhizomes roasted and eaten; sometimes pounded into flour by indigenous peoples of NW N America and elsewhere (but potentially carcinogenic).

Sagittaria spp. (wapato, arrowhead); Alismataceae—herbaceous perennial of wetlands, marshes and lake edges, widespread, N America and Eurasia; starchy tubers cooked and eaten as a staple vegetable.

Stachys palustris (marsh woundwort); Lamiaceae—herbaceous perennial and arable weed of river margins and marshes, widespread in northern Europe; rhizomes dried and powdered into flour or rhizomes eaten cooked, sometimes raw; used in northern Europe (mainly in Poland) until the turn of the 19th and 20th century.

Trifolium wormskioldii (springbank clover); Fabaceae—herbaceous perennial of moist meadows and coastal regions, tidal marshes, W North America; rhizomes steamed and eaten by NW Coast First Peoples.

Typha spp. (cattail, bulrush); Typhaceae—herbaceous perennial of wetlands, lakeshores, worldwide; starchy rhizomes cooked and eaten by many people; sometimes rendered into flour (young green shoots, immature flowering spikes, seeds and pollen also eaten).

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Edible greens (leaves, stems, shoots, including marine algae)

Adansonia digitata (baobab); Malvaceae—broad-leaved tree of E Africa; one of the most important edible wild greens of African indigenous peoples.

Allium ursinum (ramsons), *A. victorialis*; Liliaceae—herbaceous perennials, found in many parts of northern Eurasia; leaves and stalks, raw, cooked or lacto-fermented; *A. ursinum* used in Europe, *A. victorialis* in Asia (Siberia, Central Asia, Korea); both species are an important ingredient of Russian cuisine, called *cheremsha*); many *Allium* spp. eaten throughout N hemisphere.

Amaranthus spp. (amaranth, pigweed); Amaranthaceae—disturbed ground, moist clearings; widespread in many parts of the world; greens eaten as a boiled vegetable, in curry, soups, etc. (seeds also edible and nutritious).

Arctium lappa (great burdock); Asteraceae—large-leaved biennial growing up to 2 m; Eurasia; young leaves and stalks eaten raw or cooked; traditionally collected in Ligurian region (taproots also eaten in Asia).

Aruncus dioicus (goatsbeard); Rosaceae—tall herbaceous perennial of moist forest edges and streamsides, Eurasia and N America; young edible stems and leaves eaten as asparagus; traditionally collected in Friuli Venezia Giulia and Veneto region.

Asparagus racemosus, Asparagus spp. (wild asparagus); Liliaceae—tall herbaceous perennials of moist open woods to dry clearings; widespread, Europe, Asia, naturalized in N America; tender young shoots eaten after cooking.

Balsamorhiza sagittata (balsamroot or spring sunflower); Asteraceae—open slopes, upland meadows, sagebrush plains, W N America; young shoots and budstalks eaten raw or cooked by First Peoples (pit-cooked taproots and seeds also edible).

Bambusa spp., *Phyllostachys* spp. and other spp. (bamboo shoots); Poaceae—tropical and subtropical forests, various parts of SE and E Asia, tree- or shrub-like grass; young shoots boiled and eaten as popular vegetable in E Asia; WARNING: some bamboo shoots contain toxic levels of cyanide-producing compounds.

Beta vulgaris (including ssp. *cicla, B. hortensis*, (spinach beet, chard); Chenopodiaceae—herbaceous annual or biennial of Europe; leaves and leaf stems eaten raw or cooked like spinach; traditionally collected in Ligurian region.

Borago officinalis (wild borage); Boraginaceae—herbaceous annual of roadsides and arable fields in Europe, naturalized in many other areas in the world; young leaves commonly used in Mediterranean cuisine; flowers also edible; traditionally collected in Ligurian region.

Bunias orientalis (warty cabbage, Turkish rocket); Brassicaceae—herbaceous perennial of northern Eurasia and introduced elsewhere; young stalks commonly eaten in Russia and Romania, raw or boiled.

Campanula trachelium (campanula); Campanulaceae—herbaceous perennial of woodlands; leaves boiled in spring; mixture called "pistic" of Friuli Venezia Giulia region.

Capsella bursa-pastoris (shepherd's purse); Brassicaceae—basal leaves highly valued for stir-fries and dumplings in Eastern Asia; young fruits eaten as children's snack in Europe; plant used as food in vegetable dish called "pistic" (Val Colvera pre Alpine zone of Friuli Venezia Giulia).

Carlina acaulis (stemless carline thistle); Asteraceae—herbaceous perennial of disturbed sites, Europe; raw and boiled blossoms; traditionally collected in Western Friuli region.

Centranthus ruber (red valerian); Valerianaceae—boiled leaves; young leaves are used for salads. The cold rootstock brew is used to treat digestive problems and anxiety. It is generally used as a heart-calming agent. The older leaves are boiled. This plant is included in the blend of Levanto's *gattafin*. Taste: bitter; traditionally collected in Ligurian region; plant included in the "preboggion" (or "prebuggiun") blend.

Chenopodium album and other species (lamb's quarters, goosefoot); Chenopodiaceae—mainly as arable weeds, Eurasia; young shoots and leaves used to be the most important wild green of eastern Europe; also eaten in E Asia. Ingredient of "pistic" and "preboggion" blend.

Cicerbita alpina (blue sow thistle); Asteraceae—eaten especially as young stem as asparagus preserved under oil or vinegar. Traditionally collected in Western Friuli.

Chenopodium bonus henricus (Good King Henry); Chenopodiaceae—Europe, W Asia, N America; roadsides; young plants, leaves cooked after snow melting; plant included in "pistic" blend.

Cichorium intybus (wild chicory); Asteraceae—roadside, Europe, N America; native to central Russia, W Asia, S Europe whorls very commonly eaten (cooked) as greens in the whole Mediterranean; leaves—raw or cooked; young leaves in salad; the roasted root is used as a substitute coffee; traditionally collected in Ligurian region; plant included in the "preboggion" blend.

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Cirsium spp. (thistles); Asteraceae—herbaceous perennials of Eurasia and N America; young leaves of numerous species eaten in S, C & E Europe and in eastern Asia. Plant included in the "preboggion" and "pistic" blend.

Crepis spp. (Hawksbeard); Asteraceae—boiled leaves traditionally collected in N Italy and consumed in soups.

Cynara cardunculus (wild artichoke); Asteraceae—arable fields, roadside, S Europe; the stalks, roots, and flower receptacles are very appreciated (boiled) in the traditional cuisine of the Mediterranean area.

Chamerion angustifolium (syn. *Epilobium angustifolium*) (fireweed); Onagraceae—widespread in disturbed ground, open woods, burns and clearings, circumpolar; young shoots, stems, flowering tops eaten.

Diplazium esculentum (vegetable fern); Athyriaceae—a fern from subtropical and tropical forests; SE Asia, Oceania; young fronds widely consumed as a vegetable, often sold in SE Asian markets.

Diplotaxis tenuifolia (perennial wall rocket); Brassicaceae—S C Europe; leaves raw used in salad.

Equisetum arvense (common horsetail); Equistaceae—widespread in moist and disturbed areas, open woods, circumpolar; young shoots eaten raw or cooked in Japan and NW N America, formerly also in Russia and Poland.

Euterpa oleracea, *Bacris gasipaes*, *Daemonorops schmidtiana* and other spp. (palm hearts); Arecaceae—tropical forests, C and S America (including Amazonia); young apical shoots eaten locally and exported as canned product.

Foeniculum vulgare (fennel); Apiaceae—young leaves and stem—eaten raw or cooked, seeds are used as a flavoring in castagnaccio cakes; traditionally collected in the Mediterranean area; in the Ligurian region plant is included in the "prebuggiun" blend.

Heracleum maximum, H. sphondylium s.l. (cow-parsnip); Apiaceae—temperate deciduous and coniferous forests, N America and Eurasia; young, peeled budstalks and leafstalks eaten by Indigenous peoples (WARNING: skin and hairs contain phototoxins, irritating to the skin when exposed to sunlight); in E Europe was widely used to make lacto-fermented soup called *barshch* or *borsh.*

Humulus lupulus (Hop); Cannabaceae—W Asia, Europe; hedgerows; sprouts cooked in the Spring mixture or with omelettes.

Hypochaeris spp. (*H. radicata, H. maculata*) (common cat's ear); Asteraceae—boiled leaves; plant included in the "preboggion" and "pistic" blends.

Hyoseris radiata (Radicchio selvatico); Asteraceae– boiled leaves; traditionally collected in Ligurian region; plant included in the "preboggion" blend.

Lactuca spp. (*L. serriola, L. perennis*) (prickly lettuce); Asteraceae - S C Europe, N Africa, Himalayas; young leaves raw or cooked.

Lamium spp. (dead nettle); Lamiaceae—small perennials or annuals, temperate forests, meadow and arable fields; used cooked, mainly in the past, Europe and Japan. In particulary *Lamium purpureum* is included in the "pistic" blend.

Lomatium nudicaule (Indian celery, barestem lomatium); Apiaceae—open bluffs, meadows, woodlands, W N America; young leaves and stalks eaten fresh or cooked; rich in vitamin C.

Leontodon hispidus (rough hawkbit) - Asteraceae—Europe, Caucasus and Iran; Ligurian use: young leaves - raw or cooked; plant included in "preboggion" and "pistic blends."

Matteuccia struthiopteris (ostrich fern); Dryopteridaceae—temperate deciduous and coniferous forests, E (and W) N America, Japan, Asia; fiddlehead shoots eaten; wild–harvested and marketed as specialty food.

Metroxylon sagu and other spp. (sago palm); Arecaceae—swampy to dry tropical forests, Malaysia and Indonesia, Papua New Guinea; starchy inner core a staple for many forest peoples. To this palm, palmworms are associated as additional harvest especially in Papua New Guinea.

Opuntia spp. (prickly pear cactus, "Indian fig"); Cactaceae—deserts and open dry lands, W and SW N America, Mexico, C America; fleshy stem segments de-spined, cooked and eaten (fruits also eaten fresh and raw or as preserves, both in the Americas and naturalized in the Mediterranean region).

Origanum heracleuticum (wild oregano); Lamiaceae—arable fields in S Europe; flowering tops gathered during the summer and used worldwide as a seasoning for the real Italian pizza.

Ornithogalum pyrenaicum (Bath asparagus); Liliaceae—woods and scrub; S Europe; leaves and blossoms boiled in the spring mixture; traditionally collected in Friuli Venezia Giulia region.

Oxyria digyna (mountain sorrel); Polygonaceae—rocky upland sites, circumpolar regions; leaves eaten raw and cooked; rich in vitamin C, acidic due to oxalic acid.

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TABLE 1
Edible Wild-Growing Plants (and Algae, Fungi, Lichens) of the World; selected examples (after Cappelletti *et al.,* 2000; Crowe, 1981; Hedrick, 1992; Hu, 2005; Kuhnlein and Turner, 1991; Maurizio, 1927; Paoletti *et al*., 1995, Paoletti, 2004; Tanaka 1976; Turner, 1995, 1997). *(Continued)*

Palmaria palmata (red seaweed, dulse); Rhodymeniaceae—temperate coastline, N temperate zone; whole plant harvested, dried, eaten raw as a snack, or cooked in soup.

Papaver somniferum (opium poppy); Papaveraceae—young plants, leaves cooked in the spring mixture; plant included in the "pistic" blend.

Papaver rhoeas (corn poppy); Papaveraceae—Europe, N Africa, Asia; boiled leave; traditionally collected in Ligurian region and ingredient of "preboggion."

Petasites japonicus (Japanese coltsfoot, fuki); Asteraceae—moist deciduous forests, Japan, Sakhalin Islands; leafstalks boiled, peeled, eaten as a springtime green as side dish or in soup.

Phyteuma spicatum (Spiked rampion); Campanulaceae—leaves and blossoms boiled in the spring mixture; traditionally collected in Friuli Venezia Giulia region.

Porphyra abbottiae (red laver seaweed) and *Porphyra* spp.; Porphyraceae—rocky coastline, intertidal zone, W coast of N America (*P. abbottiae*) and N and S temperate zones; harvested dried and served as snack, in soup or dishes with fish eggs; considered a health food.

Ranunculus ficaria (lesser celandine); Ranunculaceae—woods and hedges, mainly in Europe; young leaves eaten raw or as potherb in central Europe (e.g. Slovakia, Romania, Ukraine); boiled leaves in the spring mixture "pistic" (Friuli Venezia Giulia region) and "preboggion" (Ligurian region).

Reichardia picroides (French scorzonera); Asteraceae—S Europe; leaves eaten raw in salads or cooked; traditionally collected in Ligurian region; plant included in the "preboggion" blend.

Rubus spp. (thimbleberry, salmonberry); Rosaceae—W N America, moist, open woodlands and clearings, young shoots harvested in spring, peeled and eaten with oil or fish eggs by NW Coast First Peoples.

Rumex arcticus and other *Rumex* spp. (sourdock, wild rhubarb); Polygonaceae—clearings, disturbed ground, circumboreal, northern regions; leaves and stems eaten, fermented, boiled, fresh by Inuit and other First Peoples.

Ruscus aculeatus (butcher's broom); Liliaceae—W S Europe; shoots boiled or preserved under oil.

Salix alexensis, *S. pulchra* (Alaska willow, sura willow); Salicaceae—moist rocky ground, circumpolar, northern taiga and tundra; leaves and shoots eaten by Inuit as fresh green; rich in Vitamin C.

Sanguisorba minor (salad burnet); Rosaceae—Mediterranean countries, Asia Minor, Iraq, Iran, Afghanistan, cultivated in Europe; boiled leaves or leaf salad; taste: slightly bitter; traditionally collected in Ligurian region.

Silene vulgaris (bladder campion); Caryophyllaceae—N Africa, Asia, arable fields, Europe. The young shoots are appreciated (boiled) in the cuisine of Southern Europe; Ligurian use : boiled leaves or leaf salad; plant of the "preboggion" blend; boiled sprouts or leaves in the spring mixture "pistic".

Scolymus hispanicus (Spanish oyster thistle); Asteraceae—arable fields, roadside, Europe; the midribs boiled and eaten as artichokes in many areas in the Mediterranean.

Sonchus oleraceus (sow thistle); Asteraceae—roadside Europe, N Africa, Asia; young leaves very commonly eaten (generally cooked) as greens in the Mediterranean; tender leaflets are used in salads or boiled. Taste: slightly bitter, with hazelnut flavor; traditionally collected in Ligurian region; boiled leaves in "pistic."

Sonchus asper (prickly sow thistle); Asteraceae—Eurasia, Africa; leaves boiled in "pistic" blend.

Stanleya pinnata (prince's plume); Brassicaceae—tall subshrub of desert regions of SW N America; young leaves eaten as greens by indigenous peoples of Great Basin.

Stellaria media (chickweed); Caryophyllaceae—a small annual of arable fields; young plants eaten in soups and as potherb by farming communities of Eurasia, mainly in the past; ingredient of "pistic."

Taraxacum officinalis (dandelion); Asteraceae—Leaves raw and cooked; traditionally collected in Liguria.

Tragopogon pratensis (goat's beard); Asteraceae—Europe, Caucasus, Siberia, Iran; meadows, dunes, roadsides; leaves, root and stem; young leaves raw or boiled.

Ulmus spp. (elm); Ulmaceae—trees from northern hemisphere; leaves used in many regions as famine food; young fruits used as a green vegetable in China.

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Urtica dioica (stinging nettle); Urticaceae—temperate coniferous and deciduous forests and nearby clearings, N Temperate region; young shoots eaten as potherb, used to make tea, sauce.

Valerianella spp. (wild corn salad); Valerianaceae –arable fields in Europe, N Africa, and W Asia; leaves very appreciated in salads in many local cuisines.

Berries and other fleshy fruits

Actinidia spp. (kiwi, Chinese gooseberry); Actinidiaceae—many species, of warm temperate and subtropical forests, SW China, E Asia; introduced to New Zealand in early 1900s; flavorful, fleshy fruits eaten, some (kiwifruit) cultivated; most with wild–collected fruits.

Adansonia digitata (baobab); Malvaceae—E Africa; fleshy fruits valued throughout Africa; raw or the pup used to make beverages; oil from seeds.

Amelanchier alnifolia (Saskatoon berry, serviceberry, Juneberry); Rosaceae—deciduous shrub of open woods, slopes and clearings, W N America; other spp. in E N America; pomes sweet and juicy, eaten fresh, cooked, dried; some forms now under cultivation in W Canada.

Amelanchier ovalis (Snowy mespilus); Rosaceae—C S Europe; fruits eaten raw.

Bactris gasipaes (peach palm); Arecaceae—a tropical palm; S and Central America; fruits widely eaten throughout the area, one of the most important fruits of many forest–dwelling groups, e.g., Huaorani in Ecuador.

Berberis vulgaris (barberry); Berberidaceae—N Europe; roadsides; sprouts, leaves and fruits raw or cooked.

Celtis spp. (hackberry); Cannabaceae—trees, deciduous forests, often along rivers, a few dozen species, mainly in warmer temperate parts of Northern Hemisphere; locally eaten raw in N. America, southern Europe and E Asia.

Cornus spp. (dogwood); Cornaceae—shrubs, forests and scrub, northern hemisphere, some species of the genus bear tasty fruits used locally (e.g. *C. mas* in SE Europe and Caucasus, *C. canadensis, C. suecica, C. kousa*), while others are bitter or even slightly toxic (*C. alba, C. stolonifera*).

Cornus mas (Cornelian cherry); Cornaceae—Europe; fruits raw, fermented in water to produce an alcoholic wine and vinegar.

Crataegus spp. (hawthorn); Rosaceae—deciduous shrub, most temperate regions of the world; fruits eaten raw or processed worldwide.

Dillenia indica (elephant apple); Dilleniaceae—a tree from forests of S and SE Asia; its tart fruits are often used in curries or as condiment in SE Asia.

Duguetia lepidota (yara yara); Annonaceae—Amazonia (Alto Orinoco) deciduous tropical forests; sweet fruits eaten.

Elaeagnus spp. (silverberry, oleaster); Elaeagnaceae—northern hemisphere, mainly in Asia; mealy, sweetish fruits eaten locally.

Empetrum nigrum (crowberry, blackberry); Empetraceae—low–growing shrub of tundra, alpine, open boreal forest and muskeg, circumpolar; berries eaten raw, preserved by Inuit and other northern First Peoples; important emergency food.

Ficus carica and other *Ficus* spp. (figs); Moraceae—deciduous or evergreen trees of warm temperate, tropical and subtropical forests; over 1000 spp., *F. carica* one of oldest Mediterranean fruit crops, cultivated throughout Mediterranean, Middle East, U.S.; many spp. wild harvested; many species of *Ficus* are attractive crops in subtropical regions as they fruit a few times a year.

Fragaria spp. (strawberries); Rosaceae—herbaceous perennials of temperate woodlands, shorelines and clearings, Europe, Asia, N America; hybridized in Europe from two N American spp.; domesticated forms now widely cultivated in temperate regions; sweet, juicy berries widely eaten wherever they occur, fresh or in preserves.

Gaultheria shallon (salal); Ericaceae—evergreen shrub of temperate rainforest, W N America; sweet juicy berries harvested from wild by indigenous peoples, eaten raw, or cooked and dried for winter use; used to sweeten other berries.

Hippophae rhamnoides, H. salicifolia (sea buckthorn); Elaeagnaceae—large shrubs; sea and river edges, cliffs, scrub, Eurasia; acid, aromatic fruits are used for making jellies, jams and vinegar, or as an addition to sauces, in N Europe, Russia, China and Nepal.

Juniperus communis and other spp. (juniper); Cupressaceae—evergreen shrubs and trees, northern hemiphere; fleshy pseudo–fruits were eaten in small quantities by Native Americans and in Eurasia; sometimes used as spice (Germany, Italy, Poland); in northern Europe a kind of beer was brewed from them, e.g., in Poland, France, and Estonia.

Lonicera spp. (honeysuckle); Caprifoliaceae—deciduous or evergreen shrubs and vines; northern hemisphere; fleshy fruits of a few species are used as raw, as food, e.g., *Lonicera coerulea, L. angustifolia,* however most species from the genus are toxic.

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Lonicera caprifolium (Honeysuckle); Caprifoliaceae—Europe; fruits raw, known as St. John's grapes.

Malus fusca and related spp. (wild crabapple); Rosaceae—deciduous tree of temperate regions, moist shorelines and swampy areas to open woods, 25–30 wild species of apples and crabapples in Europe, Asia and N America; small, tart fruits harvested by First Peoples in NW N America.

Mauritia flexuosa (moriche palm, morete); Arecaceae—a palm of tropical swamps; S America; fruits important locally, e.g., for Huaorani hunter–gatherers.

Monstera deliciosa (ceriman); Araceae—evergreen vine of tropical rainforests, Mexico; distributed widely throughout tropics; cone–like fruit eaten when fully ripe.

Nephelium lappaceum and related spp. (rambutan); Sapindaceae—broad–leaved trees of tropical rainforest, SE Asia, Malaysia, Indonesia, Thailand, Philippines; around 35 species, some wild harvested.

Passiflora spp. (passionfruit, granadilla); Passifloraceae—climbing vines of tropical forests, Brazil, tropical America; many spp. with small, flavorful fruits, eaten raw, cooked or as beverage or preserves; some spp. cultivated, others harvested from wild.

Prunus virginiana, P. pensylvanica, P. avium, P. padus and other spp. (wild cherries, choke cherries); Rosaceae—deciduous trees of temperate deciduous or mixed forests, Europe, Caucasas, N Turkey, other spp. in N America, Asia; some spp. domesticated, widely grown in temperate regions as dessert fruit, some spp. harvested from wild.

Prunus spinosa and other spp. (wild plums); Rosaceae—deciduous trees of temperate deciduous forests, various spp. from Europe, N America, China; some spp. domesticated, widely grown in temperate regions as dessert fruit and for prunes and preserves, sometimes harvested from wild.

Psidium guajava (guava); Myrtaceae—broad-leaved tree of tropical and subtropical rainforests, C America; shrub or small tree; widespread as popular tropical fruit, growing wild and cultivated; used for jams and preserves; other spp. used as well.

Ribes spp. (gooseberries); Grossulariaceae—deciduous shrubs of temperate woodlands, Europe, Asia, America; various species widely grown as a soft fruit in temperate areas, eaten raw or usually cooked, preserved; many wild–harvested species.

Ribes spp. (currants); Grossulariaceae—shrubs, understorey of deciduous and boreal forests; circumboreal; fruits eaten raw or in preserves; used locally by indigenous people of N America and Eurasia, as well as in modern cuisine.

Rosa acicularis, R. canina, Rosa rugosa and related spp. (wild rose, hips); Roseaceae—deciduous shrubs of temperate regions, open woods and moist areas, W N America, with other species circumboreal, in N America, Eurasia; hips cooked into sauce, syrup, or used to make beverage tea; must be strained to remove irritating hairs from seeds; widely used as food and famine food.

Rubus chamaemorus (bakeapple, cloudberry, salmonberry); Rosaceae—low sub–shrubs of open muskeg or peat bogs of boreal forests, dioecious, circumboreal; berries harvested in quantity and sometimes marketed (Scandenavia, Newfoundland); eaten raw, cooked or preserved, and also made into a drink; rich in Vitamin C.

Rubus arcticus and related spp. (nagoonberry, lagoonberry); Rosaceae—low sub–shrubs of open muskeg or peat bogs of boreal forests, circumboreal; highly flavoured berries a favorite food of northern peoples, eaten fresh or preserved.

Rubus idaeus and other spp. (raspberries); Rosaceae—deciduous shrubs of temperate coniferous and deciduous woodlands, along creeks and rocky slopes, Europe, W Asia, N America; widely grown as a soft fruit in temperate areas; many spp. harvested from wild and eaten fresh, cooked, or preserved.

Rubus spp. subgenus *Rubus* (blackberries); Rosaceae—deciduous or evergreen shrubs of temperate and montane woodlands, Europe, Asia, N America; cultivated on limited basis; berries of many spp. harvested from wild, eaten fresh, cooked, or preserved.

Sambucus spp. (elderberries); Caprifoliaceae—deciduous shrubs and small trees of moist open woods and forest edges, widespread in N Hemisphere; small clustered, somewhat tart berries usually cooked as sauce or used for wine and other beverages.

Shepherdia canadensis (soapberry); Elaeagnaceae—deciduous shrub of open coniferous woods, across temperate N America; small somewhat bitter berries picked fresh, dried and preserved; mashed and whipped with water into a frothy confection (contains saponins), served at feasts and social occasions by NW N American First Peoples; also used to make a lemonade-like beverage.

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Solanum spp. (ground cherry); Solanaceae—herbaceous annuals or perennials of open disturbed ground and moist clearings; many species occurring in N, C and S America; tart, juicy berries surrounded by papery sheath, eaten raw or cooked; some species under cultivation.

Solanum stramonifolium (tupirillo; paja; cocconilla); Solanaceae—Sez. *lasiocarpa*; frequent in savannas, ecotones, forest opening, and along riverbanks, tolerant the different type of soils; the fruit is eaten fresh.

Solanum sessiliflorum (cocona, tupiro, chipe chipe); Solanaceae—Sez. *lasiocarpa*; frequent in upper Amazon Basin of Colombia, Ecuador and Perù, cultivated in the "conuco" and along the Amazon and Orinoco River of Venezuela and Brazil; the fruit is eaten fresh, in vegetable salad, marmalade but the most important use is juice.

Spondias spp. (hog plum); Anacardiaceae—deciduous trees of tropical S America and Asia; several species of fruits used as food locally in both continents.

Vaccinium spp. (blueberries, huckleberries, bilberries, cranberries); Ericaceae—deciduous (or sometimes evergreen) shrubs of northern boreal and temperate coniferous and deciduous forests, Europe, N America, deciduous or sometimes evergreen shrubs; various domesticated species grown in N America, Europe, Australia, New Zealand; wild species commonly harvested and eaten fresh, cooked or dried in cakes; favorites in pies.

Vaccinium vitis–idaea (lingonberry, mountain cranberry, lowbush cranberry); Ericaceae—low evergreen shrub of boreal and montane coniferous forests, acid peat bogs and muskegs; circumpolar; cool temperate and northern regions; tart berries cooked for sauce; beverages; stored under water over winter; harvested commercially in Scandinavia.

Vaccinium caespitosum and other *Vaccinium* species (dwarf blueberry and other blueberries); Ericaceae—low, deciduous shrub of open forests and rocky mountaintops and lakeshores, temperate regions; circumpolar; berries harvested in quantity and eaten raw, cooked or dried by people throughout its range.

Vaccinium oxycoccos and related spp. (bog cranberry); Ericaceae—low creeping vines of acid peat bogs and muskegs; circumpolar; cool temperate and northern regions; tart berries cooked for sauce; beverages; stored under water over winter.

Viburnum edule and related spp. (highbush cranberry); Caprifoliaceae—deciduous shrubs of moist forests, lake edges and creeks; circumpolar; tart berries cooked and eaten, considered high value feast and trade food, often eaten with grease by First Peoples; also emergency food, remaining on the bushes overwinter.

Grains, seeds and nuts

Amaranthus spp. (amaranth); Amaranthaceae—disturbed ground, moist clearings; widespread in many parts of the world; seeds eaten as parched or ground "grain", rich in protein (greens also eaten); some cultivated spp.

Araucaria araucana and *A. angustifolia* (araucaria, monkeypuzzle); Araucariaceae—evergreen trees of S temperate coniferous forest, two spp. in Chile, Brazil, Australia, evergreen trees; seed kernels eaten locally by indigenous peoples.

Bertholletia excelsa (Brazil nut); Lecythidaceae—large, broad–leaved trees of tropical rainforest, Amazonia, S America; thick–shelled, oily nuts harvested wild from Brazil and other S American countries; most exported to U.S. and Europe.

Carum carvi (Caraway); Apiaceae—Europe; arable land; leaves boiled in the spring mixture; plant included in the "pistic" blend; shoots, achenes and sprouts raw as spices in salads or cooked in the spring blend.

Carya illinoensis and related spp. (pecan, hickory nuts); Juglandaceae—deciduous trees of temperate and warm hardwood forests, E and SE United States and Mexico; nuts eaten by First Peoples; now pecan is a major wild and plantation crop; also grown in Australia, Brazil, S Africa.

Castanea sativa and other spp. (chestnut); Fagaceae—deciduous trees of Mediterranean and temperate hardwood forests, S Europe, Turkey; other spp. in E North America, E Asia, deciduous tree; domesticated and grown in S Europe, also harvested from wild growing trees; nuts contains starch and high quality protein; eaten as flour, bread, porridge, sweetmeats.

Corylus spp. (filbert, or hazelnut); Betulaceae—deciduous tall shrubs of temperate forests, Asia Minor, SE Europe, N America; cultivated in England and North America, also wild harvested for millennia; nuts used in baking and confections.

Fagus grandifolia, F. sylvatica (beechnut); Fagaceae—deciduous trees of temperate forests, E N America, Europe; nuts gathered from the wild and eaten locally, raw or roasted.

Foeniculum vulgare (fennel); Apiaceae—leaves and stems eaten raw or cooked, seeds are used as a flavoring in castagnaccio cakes; traditionally collected in Ligurian region.

Glyceria fluitans (water mannagrass); Poaceae—herbaceous perennial, water margins; mainly in Europe; grains gathered in eastern Europe (mainly in Poland) to make highly valued and expensive bread.

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Juglans (walnut); Juglandaceae—trees, decidous temperate and subtropical forests of northern hemisphere; kernels of nuts are valued food in many parts of the world.

Mentzelia albicaulis (white–stemmed blazing star); Loasaceae—herbaceous flowering plants of drylands in W N America; seeds gathered, parched and eaten by Indigenous peoples of the Great Basin and California.

Myrrhis odorata (Sweet Cicely); Asteraceae - seeds and young leaves used as spices, elixir, in salads and soups.

Pinus pinea, *P. sibirica, P. edulis*, *P. cembra, P. koraensis* and other spp. (pine nuts); Pinaceae—evergreen coniferous trees of various species in dryland temperate and sub–boreal coniferous forests, various species native to SW United States, Europe, Asia, Russia, evergreen trees; seeds high fat, high–protein, eaten by many groups of Indigenous Peoples; eaten and exported worldwide as specialty foods.

Quercus spp. (oak/acorns); Fagaceae—deciduous or evergreen trees of temperate dryland forests of Europe, Asia, N and C America; acorns eaten in large quantities by N American indigenous peoples; usually pounded into meal and leached to remove tannins before consuming; widely used in Eurasia as famine food.

Trapa natans, T. bicornis etc. (water caltrop); Trapaceae—annual plants of lakes and ditches; warmer temperate and subtropical parts of Eurasia; fruits important part of human nutrition throughout Europe in prehistoric times; still widely eaten in Asia.

Other edible plants and plant substances, mushrooms, lichens, and algae

Acacia senegal and other spp. (gum arabic); Fabaceae—deciduous trees of dry tropical forest/ savanna, W Africa; other spp. found in arid regions of all continents, wild and plantation harvested gum used in food industry for texture, stabilizer in confections, beverages; also in cosmetics, medicinal products.

Acer saccharum and other spp. (sugar maple); Aceraceae—deciduous trees of temperate hardwood forest, SE Canada, NE United States; sap harvested in quantity and rendered into syrup and sugar; commercial product.

Aniba rosaeodora (bois de rose); Lauraceae—tropical rainforest, Amazonia, Brazil, Peru; essential oil distilled from bark and fruit, used as flavor ingredient in many processed foods and beverages.

Arenga pinnata and other spp. (sugar or gomuti palm); Arecaceae—tree palm of tropical forests, Annam, SE Asia, Philippines; wild and plantation trees yield sap, rendered into sugar.

Armillariella spp. (honey fungus); Marasmiaceae—a brownish parasitic fungus, fruiting bodies appear in large groups on dead wood, circumboreal; eaten in boiled or pickled dishes, mainly in Slavic countries, also in China.

Armoracia rusticana (horseradish); Brassicaceae—pungent root used as a condiment for meat and other dishes in Europe.

Betula spp. (birch); Betulaceae—tree of temperate forests, circumpolar; sap collected in spring, drunk raw, fermented or concentrated; used, e.g., in Alaska, Russia, Ukraine.

Boletus edulis and other spp. (edible bolete, or cep); Boletaceae—mushrooms of temperate deciduous and coniferous forest, throughout northern hemisphere; especially E Europe, also S America in pine plantations; highly valued and widely gathered, especially in Poland and E Europe, and Italy.

Cantharellus cibarius and other spp. (chanterelles); Cantharellaceae—mushrooms of temperate coniferous forest, throughout northern hemisphere; highly valued and widely gathered; large quantities exported from British Columbia and US Pacific NW.

Caryota urens (fishtail palm); Arecaceae—a monocarpous palm, subtropical forests; India to Malay Peninsula; starchy pith used to make flour; sap made into sugar.

Eugeissona utilis and other spp. (sago palms); Arecaceae; — palms from tropical forests; Borneo and Malay Peninsula; the starchy pith is the staple food of Penan hunter–gatherers in Borneo.

Gaultheria procumbens (wintergreen); Ericaceae—low evergreen shrub of temperate deciduous forest, E N America; leaves, berries used as flavoring for tea, candy, gums, toothpaste.

Ilex paraguariensis (yerba maté); Aquifoliaceae—small evergreen tree of tropical forests, S America, primarily Paraguay, Uruguay, S Brazil, Argentina; leaves a popular, caffeine–containing S American beverage; used medicinally as stimulant for fatigue, depression, pains.

Juniperus communis and other spp. (junipers); Cupressaceae—low, evergreen coniferous shrub to small tree, temperate and boreal coniferous forests, northern hemisphere; "berries" used as flavoring for gin and meat dishes; in Poland fermented into beer.

Lactarius deliciosus s.l. (saffron milk cap); Russulaceae—orange mushrooms growing under conifers in Eurasia and Africa; used in the traditional cuisine of E Europe, N Africa, Spain, France and parts of China.

Ledum spp. (syn. *Rhododendron* spp.) (Labrador–tea, trapper's tea); Ericaceae—evergreen broad–leaved shrub of acidic peat bogs and muskeg, circumpolar; leaves harvested and used as beverage tea widely across boreal and temperate N America.

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Leptospermum scoparium (manuka, or tea tree); Myrta acea shrubs or tall trees of New Zealand forests; sugary gum eaten by Maori and highly regards; leaves used as a tea, similar to green tea.
Manilkara zapota (chicle, sapodilla); Sapotaceae—broad–leaved tree of tropical forests, Mexico, C America; latex from wild trees used as gum base in chewing gum.
Mentha arvensis and related spp. (wild mints); Lamiaceae—herbaceous perennials of temperate regions, moist prairies and slopes; leaves widely used as beverages and flavorings.
Morchella spp. (morels); Morchellaceae—mushrooms of temperate deciduous and coniferous forest, throughout northern hemisphere; also *Australcedrus chilensis* forests of Argentine, Chile; highly valued and widely gathered and exported as specialty food.
Parkia speciosa, P. africana; Fabaceae—both green and mature seeds and the fleshy pulp surrounding them are used in various vegetable dishes in S, SE Asia and parts of Africa.
Picea glauca, P. mariana and related spp. (spruce); Pinaceae—evergreen trees of N temperate and boreal regions; hard old sap/pitch chewed like gum, boughs used for beverage, rich in Vitamin C.
Pinus spp. (pines); Pinaceae—evergreen coniferous trees of N temperate regions, Mediterranean, Middle East; inner bark removed in spring and eaten by many local and Indigenous peoples in the past.
Pleurotus ostreatus and other spp. (oyster mushrooms); Pleurotaceae—mushroom growing on living and rotting wood in temperate deciduous and coniferous forest, throughout northern hemisphere; highly valued and widely gathered and exported as specialty food, also cultured.
Phoenix sylvestris (wild date palm); Arecaceae—palm tree of tropical forests, India; sap rendered into sugar.
Polypodium glycyrrhiza (licorice fern); Polypodiaceae—small patch–forming fern of rocky outcrops and tree trunks, W N America; rhizomes used as sweetener and flavouring by Indigenous peoples.
Prosopis glandulosa (honey mesquite); Fabaceae—tall shrub of desert regions; SW N America and N Mexico; pods harvested, pounded into meal and eaten (seeds actually discarded).
Sassafras albidum (sassafras); Sassafrasaceae—deciduous tree of temperate hardwood forest, E N America; bark from wild trees long used as flavoring for soups and confections and as beverage tea.
Tricholoma matsutake, *T. magnivelare* (pine mushrooms, matsutake); Tricholomataceae—mushrooms of temperate coniferous forests, various spp. throughout northern hemisphere, prized especially in Japan; large quantities exported from NW N America to Asia.
Tuber melanosporum, T. aestivum and other spp. (truffles)—subterranean fungi of deciduous woodlands, especially beech woods, France, Italy, U.K.; high value food and condiment in European (especially Italian and French) cuisine.
Wasabia japonica (wasabi); Brassicaceae—pungent root of this and related spp. used as a condiment in Japan and Korea.

Flowers

Bassia latifolia (mohua); Sapotaceae—a tree, E India; the succulent flowers fall by night in large quantities from the tree, are gathered early in the morning, dried in the sun and sold in the bazaars as an important article of food; also important food of Chenchu hunter–gatherers.
Centaurea cyanus (cornflower); Asteraceae—Europe; flowers raw or cooked.
Sambucus nigra (black elder); Caprifoliaceae—a large shrub; deciduous temperate forests of Eurasia; flowers used to make cordials, syrups, wines, or fried in batter in many European countries.
Hemerocallis (day lily); Liliaceae—perennials, grasslands and rocky outcrops, mainly in Asia; fleshy flower petals of many species used raw or dried as a vegetable in E Asian cuisine, most commonly in China.
Taraxacum officinale (dandelion); Asteraceae—perennial of Eurasian origin, now cosmopolitan in meadows and lawns, in Poland flowers are boiled with sugar to produce honey-like substance.
Sesbania grandiflora; Fabaceae—a small tree, SE Asia, flowers widely used as a vegetable.

Polygonum tubers were also known as an emergency food in Scandinavia, Switzerland and Germany (Eidlitz, 1969). *Polygonum* species have a particularly high vitamin C and carotene content. For example, *P*. *bistorta* has 158 mg vitamin C per 100 g fresh weight (Kuhnlein and Turner, 1991). Other major root vegetables, many of them still being used but to a lesser extent than in the past, include certain ferns (e.g., *Dryopteris expansa*, wood fern), and flowering plants in the arum family

(Araceae), sedge family (Cyperaceae), lily family (Liliaceae), cattail family (Typhaceae), celery family (Apiaceae), aster family (Asteraceae), legume family (Fabaceae), purslane family (Portulacaceae) and nightshade family (Solanaceae), among many others. Some of these families (e.g., Liliaceae, Apiaceae, Solanaceae) also contain highly toxic metabolites and some need special preparation to render them edible (cf. Johns and Kubo, 1988). People harvesting wild roots (and any wild growing species) for food need to be extremely careful in identifying and preparing them (Turner and Von Aderkas, 2009). There is yet another concern about harvesting underground organs of wild plants from natural ecosystems: some of them are slow growing species (e.g., *Corydalis, Lilium, Erythronium, Polygonatum*) growing in high competition environments and harvesting larger amounts may endanger local populations.

As major storage organs of plants, root vegetables typically contain carbohydrates that are usually at their highest density at the end of the leaf-growing season, before new shoots appear. Carbohydrates can be present in a variety of forms and flavors, and may not always be readily digestible for humans. Some traditional root vegetables, like camas bulbs (*Camassia* spp.) and onions (*Allium* spp.) in Liliaceae, and balsamroot (*Balsamorhiza sagittata*) and thistles (*Cirsium* spp.) in Asteraceae, contain large proportions of inulin, a complex carbohydrate that becomes sweet upon cooking due to a partial conversion to the sugar fructose. Some of these species are traditionally cooked in underground pits, or earth ovens, flavored with various types of plants that also apparently enhance their conversion to fructose and fructans (Peacock, 1998; Konlande and Robson, 1972). Many other root vegetables can also be pit-cooked, and this is an excellent method of preparing them for a feast or for drying for storage. If the skin of root vegetables is consumed, it can be a good source of mineral nutrients. Usually, root vegetables provide only small amounts of vitamins in a 100-gram portion. They are typically eaten with fish, meat or fat of some type (Kuhnlein and Turner, 1991).

B. Edible Greens (Leaves, Stems, Shoots, Including Marine Algae)

Hundreds of different wild plant species produce tender, edible shoots and leaves, especially in the spring or at the beginning of their growing season. Potentially a high percentage of a flora yields edible greens. Out of Polish vascular plant flora (3,000 species) at least a third was used as wild greens in some country of the world. Some, like thimbleberry and its relatives (*Rubus parviflorus, Rubus* spp.) and cow-parsnip (*Heracleum maximum*), can be eaten raw, after being peeled, whereas others, like stinging nettles (*Urtica dioica*), must be steamed or cooked in some way. Many green shoots, such as fireweed (*Chamerion angustifolium*) and horsetails (*Equisetum* spp.), as well as those mentioned previously, grow from branching rhizomes and form extensive patches. They can often be harvested several times over a season, in a manner similar to asparagus (*Asparagus officinalis*—which also has wild-harvested relatives). Other types of leafy edible greens, like lambsquarters (*Chenopodium* spp.), amaranths (*Amaranthus* spp.), purslane (*Portulaca oleracea*) and mustards (*Brassica* spp., *Sisymbrium* spp. and others), are weedy annuals, often growing in disturbed ground. In Mediterranean Italy several assemblages of especially spring tender leaves are collected under collective names such as ***pistic*** or ***litum***, ***frita*** in Northeastern Italy (Paoletti *et al.,*1995; Dreon and Paoletti, 2009) or ***prebuggiun or preboggion***) in Liguria (Bisio and Minuto, 1997, 1999).

In the Southwest United States and Central America (as well as in other places), these weedy greens, called ***quelites***, are left growing amongst cultivated crops like maize and squash, providing the farmers with a greater variety of food from the same site, and thus a wider range of nutrients. (Bye, 1981) Most edible wild greens have high moisture content, and contain carotene and other vitamins (vitamin C and folic acid) and minerals such as iron, calcium, magnesium, are also high in antioxidants, etc. (Kuhnlein and Turner, 1991; Sacchetti *et al*., 2009).

Marine algae, or seaweeds (now considered to be in their own kingdom, but included here with edible greens), have been used by virtually all coastal peoples, and are sometimes traded to interior regions. Still widely used at present in many parts of the world, they are rich sources of vitamins and several minerals, particularly iodine. Some algal species can be difficult to digest unless specially processed. A few species, like Japanese ***nori*** (*Porphyra* spp.), have been domesticated and are produced commercially, but in most cases, people are still using wild-growing species (Turner, 2003). As with the root vegetables, some edible wild greens have toxic look-alikes, and people have been seriously poisoned, for example, by mistaking the highly poisonous false hellebore (*Veratrum viride*) for the edible shoots of false Solomon's-seal (*Maianthemum racemosum*) (Turner and Von Aderkas, 2009). Many edible greens are particularly important for their vitamin C content in the spring, and can be used to prevent and alleviate scurvy.

C. Berries and Other Fleshy Fruits

Wild berries and other fleshy fruits (including drupes, pomes, and aggregate fruits) are perhaps the most favored group of edible wild plants, and probably the most frequently used today, at least by contemporary Indigenous people of Canada (Kuhnlein and Turner, 1991). They include very sweet and juicy species like wild strawberries (*Fragaria* spp.), Saskatoon berries (*Amelanchier alnifolia*), blueberries and huckleberries (*Vaccinium* spp.), salal berries (*Gaultheria shallon*), blackberries and raspberries and their relatives (*Rubus* spp.). Other types are more tart, but nevertheless flavorful: crabapples (*Malus* spp.), wild cherries and plums (*Prunus* spp.), gooseberries and currants (*Ribes* spp.), lingonberries (*Vaccinium vitis-idaea*), bog cranberries (*Vaccinium oxycoccos* and related species), and highbush cranberries (*Viburnum* spp.). Many of these are the wild ancestors of diverse cultivated fruits, and some, like lingonberry and

cloudberry, or bakeapple (*Rubus chamaemorus*) from the boreal forests and muskegs, are used commercially as wild-harvested species. Some fruits, like kinnikinnick berries (*Arctostaphylos uva-ursi*), rose hips (*Rosa* spp.), and crowberries (*Empetrum nigrum*) are little eaten today, but are still important in some situations, such as for those stranded in remote areas in the wintertime, since they remain on the plants over the winter. One very special wild fruit for Indigenous Peoples in western North America is called soapberry (*Shepherdia canadensis*; Elaeagnaceae). It contains small amounts of saponin, a natural detergent, and can be whipped with water and a bit of sweetener into a frothy confection resembling whipped egg whites, and is still eaten today as a special treat (Turner and Burton, 2010). Most wild fruits are good sources of ascorbic acid (Vitamin C); some, such as rose hips, are exceptionally high in this important nutrient. Cranberries and wild blueberries are now recognized for their antioxidant flavonoids, which have therapeutic properties and are used as nutriceuticals (McCune, 1999). Fruits can also contain unexpectedly high amounts of other nutrients such as calcium, vitamin A as carotene, and folic acid (Kuhnlein and Turner, 1991).

D. Grains, Seeds, and Nuts

Edible wild seeds, nuts and grains include wild-rice (*Zizania aquatica* and related spp.), amaranth (*Amaranthus* spp.), oak acorns (*Quercus* spp.), hazelnuts (*Corylus* spp.), black walnuts (*Juglans nigra*), hickory nuts (*Carya* spp.), wild sunflower (*Helianthus* spp.) and pine seeds (*Pinus* spp.), among numerous other species. Some types, like acorns, must be thoroughly processed by leaching and cooking to remove bitter-tasting tannins before they are edible. (Some species of oaks, such as the "white oak" group, have acorns with much lower levels of tannins.) Nuts have hard outer shells that must be cracked off to extract the edible kernels. Some also have spiny or prickly husks that have to be removed. In the past, people have sought nuts and seeds, already dehusked, from the caches of small mammals.

Wild grains, the one-seeded fruits of grasses (Poaceae), are similar in their nutritional properties to many domesticated types. (The grass family includes some of our most important worldwide economic plants, such as wheat, barley, rye, maize, rice, and other cereal grains, bamboo, and sugar cane.) After harvesting, grains usually require threshing to remove their outer covering, or chaff, and then the kernels can be parched and ground into an energy-rich meal. Many different peoples have harvested and sometimes tended wild grasses for their grains. For example, sea lyme grass, or strand-wheat *(Elymus arenarius*) was a cereal grain of the Vikings. Its carbonized grains occur in Viking archaeological sites of Iceland and Greenland, and it was introduced long ago by Vikings to Newfoundland in eastern Canada. The Timbisha Shoshone of the American Great Basin, as well as the Kumeyaay of California and other Indigenous Peoples, sometimes broadcast grains of rice-grass (*Achnatherum hymenoides*; syn. *Oryzopsis*) and other grass species in recently inundated river edges or moist hollows, and also occasionally burned over grasslands to maintain open habitats for grasses and other prairie species (Fowler, 2000). Other wild grass species used for their grains include blue grama (*Bouteloua gracilis*), Canada wild rye (*Elymus canadensis*), June grass (*Koeleria cristata*), muhly (*Muhlenbergia* spp.), panic grass (*Panicum* spp.), and sand drop-seed (*Sporobolus cryptandrus*) (Kindscher, 1987).

Wild-rice is probably the best known wild-harvested grain in North America. Along with sunflower (*Helianthus annuus*) it is one of the truly North American grains that has gained commercial importance in world markets. It has been harvested by many Indigenous Peoples of eastern North America since prehistoric times. One group, the Menominee, is named after this grain, which is called "***menoomin.***" Some people traditionally sowed the wild-rice, whereas others let it seed itself naturally. It grows in standing water along the edges of quiet rivers and lakes. The grains are harvested from the water, with people—usually women—hitting the fruiting heads with a stick to knock the grains off into the bottom of the canoe. The harvested grain is dried on mats or over a fire, the hulls thrashed off by trampling, then the hulled grains winnowed by tossing them on a tray in the breeze or by fanning them, to separate out the chaff. The grain can then be stored in sacks or underground caches for future use, or for trade or sale. Wild-rice can be prepared and served in many different ways. Often it was cooked in soups, or boiled with meat, fish, roe, or with blueberries or other fruits. One favorite dish is wild-rice, corn, and fish boiled together. The cooked grain can also be eaten plain, boiled or steamed, and eaten with sweets such as maple sugar (Jenks, 1977; Kuhnlein and Turner, 1991; Nabhan, 1989). Wild-rice is now being marketed by some Indigenous groups, such as the Anishenaabe (Ojibwa), and has been made famous as a Slow Food Presidium product through the work of Anishinaabe activist Winona Laduke, founding director of the White Earth Land Recovery Project in Minnesota, USA (http://nativeharvest.com/).

Nuts, seeds, and grains are generally known to be good sources of protein, fat, carbohydrates, vitamins, and minerals. In some cases, oil can be rendered from various seeds and nuts, making them particularly good energy sources. Nuts are also good sources of minerals, such as iron, the B-vitamins, and amino acids. Cooking tends to enhance their digestibility and nutrient availability.

E. Other Edible Plants, Mushrooms, Lichens, and Algae

Other wild species used as food include dozens of marine algae, numerous edible fungi, a few species of lichens, the inner bark, cambium and liquid sap of trees, including the famous sugar maple (*Acer saccharum* and other spp.). Few studies have been done on the nutrient content of wild mushrooms, but wild species are probably comparable in their nutrients to commercially available types (Kuhnlein and Turner, 1991). They contain small amounts of sugar and large amounts of microelements.

The mushrooms of the family Boletaceae, commonly harvested in many countries, contain proportionally high amounts of protein. Among the best known wild-harvested fungi are truffles (*Tuber melanosporum, T. aestivum* and other spp.), which are a high-value food and condiment, especially associated with French and Italian cuisine. These subterranean spore-bearing organs are sought by specially trained dogs, or sometimes pigs, from the beech and other forests of several European countries. In Japan, matsutake (*Tricholoma matsutake*) and its North American counterpart, *T. magnivelare*, are similarly highly valued fungi, mainly of conifer forests, whose harvest is both commercial and a culturally valued activity. Many people, especially in parts of Europe, Russia and North America, enjoy harvesting wild mushrooms like chanterelles (*Cantharellus*) and morels (*Morchella*) as a recreational activity.

Edible inner bark tissues include those of conifers like hemlock (*Tsuga* spp.), spruce (*Picea* spp.), firs (*Abies* spp.) and pines (*Pinus* spp.), as well as cottonwood (*Populus balsamifera*), alders (*Alnus* spp.) and other deciduous trees (Turner *et al.*, 2010). These tissues were harvested by removing patches of bark from living trees, usually in the springtime, and scraping the edible tissue from the inside of the bark or the outside of the wood. There is little documentation of nutrient content of these foods, but many are sweet tasting, and probably have a high sap content, and therefore high energy values in the form of sugars.

Many plants are also used to make beverage teas. Some of these, like Labrador tea (*Ledum palustre* and related spp.; Ericaceae), field mint (*Mentha arvensis*; Lamiaceae) and yerba buena (*Satureja douglasii*; Lamiaceae), are highly aromatic. Teas from plants are often taken as medicines or tonics as well as regular beverages. Many aromatic plants are also used to sweeten or to flavour other beverages and foods during processing or cooking. For example, salal leaves (*Gaultheria shallon*) are used in pit-cooking root vegetables in western North America (Turner, 1995). Several species of the mint family (Lamiaceae) are used as culinary herbs in soups and stews, as are some species of the celery family (Apiaceae) such as Indian celery (*Lomatium nudicaule*) greens and seeds. Some of these plants, as well as some aromatic plants in the aster family (Asteraceae; e.g., *Artemisia* spp.), have also functioned as preservatives for meat and fish. Flower petals and nectars are sometimes sought, especially by children, and people also chew the gums or resins of a number of different trees for pleasure. Flowers are high moisture-containing foods, usually low in protein and fat, but some can be remarkably rich in vitamin A as carotene or vitamin C.

III. TENDING AND MANAGING WILD PLANTS

Many edible wild plants are "pioneer" species, well adapted to disturbance from forest fires, floods, soil disruption and browsing by animals. Ancient humans, as well as our Neanderthal and primate relatives, must have observed the enhanced growth of leafy plants in floodplains or wetlands, the high productivity of berry bushes and strawberries following forest fires (Boyd, 1999; Paoletti *et al.*, 2007), or the ability of wild fruit trees and bushes to produce more fruit in succeeding years when their branches are broken back. Studying the habits of bears, monkeys and other animals must have been especially helpful for humans learning about edible species—how to harvest them, and how their productivity and quality could be promoted through small-scale disturbance. In fact, some of the earliest human foods are the same as those sought by other omnivores: inner bark of trees, various types of greens, starchy roots, seeds and grains, and sweet-tasting, juicy fruits. Furthermore, humans may have developed methods of storing seeds, nuts, roots and fruits based on watching squirrels and other rodents, as well as various birds, caching their winter food supplies. Humans have learned to exploit some of these animal caches to obtain ready-harvested food.

The knowledge that Indigenous peoples and others long-resident in particular places have acquired and developed about their environments and ways of using their resources sustainably is part of a complex system, commonly termed "Traditional Ecological Knowledge." Traditional Ecological Knowledge, or TEK, is defined as "A cumulative body of knowledge, practice, and belief, evolving by adaptive processes and handed down through generations by cultural transmission, about the relationship of living beings (including humans) with one another and with their environment" (Berkes, 2008). This knowledge system incorporates, for many peoples, practical knowledge relating to sustainable use of plant resources, including edible wild species. This practical knowledge is embedded in particular worldviews or belief systems that often place humans *within* (rather than superior to) other species, and therefore foster greater care for other species. For example in harvesting bark from trees, people are often careful to harvest bark only partially around the trunk so as not to kill the tree, since it is seen not just as a resource, but as a living being, to be respected and preserved if at all possible (Turner *et al.*, 2009). The first berries and greens of the season are sometimes recognized and celebrated with a "First Foods" ceremony and a feast, such as the special ceremony for the black huckleberries (*Vaccinium membranaceum*) held by the Okanagan and other Indigenous Peoples of the Interior Plateau of western North America. Traditional Ecological Knowledge systems also incorporate means of communicating and transmitting environmental knowledge including information on the harvesting, processing and sustainable use of edible plants, their seasons and cycles of production, their habitats and their use by other species.

People have developed many different strategies for maintaining and enhancing these foods (Anderson, 2005; Deur and Turner, 2005). Some of these techniques include: clearing and burning areas to create more open and patchy environments to promote a higher diversity and greater productivity of key species, such as with camas (*Camassia* spp.), huckleberries (*Vaccinium* spp.) and wild raspberries and their relatives (*Rubus* spp.); partial and selective harvesting, especially of inner bark of trees, root vegetables and wild greens; pruning and coppicing (cutting back to the ground level) of certain species like

oaks (*Quercus* spp.), blueberries (*Vaccinium* spp.), salmonberries (*Rubus spectabilis*) and hazelnuts (*Corylus* spp.); fertilizing and mulching with various organic remains; and habitat modification, such as digging, weeding, thinning and replanting in the traditional root gardens of the estuarine tidal marshes along the Northwest Coast of North America (to produce larger quantities of northern riceroot (*Fritillaria camschatcensis*), silverweed (*Argentina egedii*) and springbank clover (*Trifolium wormskjoldii*); and focused ownership and stewardship of productive patches (Balée, 1994; Dear and Turner, 2005; Turner *et al*., 2005; Turner *et al*., 2009). Seedlings of wild fruit trees are often left in field margins or specially protected in the forest. For example in the Carpathians, wild cherry (*Prunus avium*) trees were often spared from cutting for fuel and left in at the edges of fields where other species of trees were not allowed to grow (Marciniak, 2008). In lowland Poland wild pears (*Pyrus pyraster*) had a similar role, as did Pacific crabapple trees on the Northwest Coast of North America (Turner and Peacock, 2005). In the Amazon several wild plants are protected and their dissemination facilitated by spitting the seeds of fruits along the tracks in the forest, increasing the probability of the dissemination of selected fruit plants such as *Paurouma cercopifolia* or *Duguetia lepidota* (Paoletti, 2004) in places accessible to villagers.

The end result of these practices is an entire set of different edible plant species that can be considered partially domesticated (semi-domesticated), or at least that live in habitats that are tended, or domesticated: "*ethnoecosystems*." One could argue that such habitats are simply a stage in a "progression" to domestication and more intensive agriculture, yet many of these ethnoecosystems have remained in place as stable and productive systems for thousands of years, and are best regarded simply as another form of cultivation in a wide range of different practices and strategies of food production (Deur and Turner, 2005).

Many Indigenous and local peoples around the world still harvest and depend upon edible wild species (Kuhnlein *et al*., 2009, in press). However, even in relatively remote regions like the Canadian Arctic, indigenous dietary constituents are being displaced with marketed foods. Research is showing that diets of highly processed foods, with excessive refined carbohydrates and saturated fats are not healthy; combined with changes in peoples' lifestyles, they are leading to high rates of obesity, diabetes, and heart disease, particularly in Indigenous populations (Kuhnlein *et al*., 2009).

Some may think that wild-growing foods are no longer relevant for modern humans. However, there are many reasons why we need to retain the rich knowledge of the food systems of Indigenous peoples and of those who were the ancestors of all of us. Furthermore, many locally growing foods are central to people's cultures and cultural identity and in these cases their use is essential for spiritual and emotional, as well as physical health. Harvesting and preparing wild foods can bring tremendous pleasure to any group of people, for example, in family harvesting expeditions for wild berries, mushrooms or edible seaweeds. Extra harvests can be preserved and stored for later use, to be shared at family gatherings or as gifts. These wild foods also provide dietary diversity, which is important for good nutrition (Kuhnlein *et al*., 2006; 2009; in press). Furthermore, at times of emergency, such as for hikers or others stranded in remote places without access to other food, wild foods can still save lives. Wild species also serve as fundamental sources for genetic research and the development of new domesticated crops.

Perhaps most importantly, continued knowledge and use of edible wild species keeps us connected to our environments, and therefore promotes ecological awareness and ecological integrity. Ethnoecosystems are generally high in biological diversity, and serve as indicators for a healthy environment, with intact, diverse and resilient relationships between humans and other species. They contribute to both ecological and social sustainability. In short, understanding the ways in which indigenous and local peoples manage, maintain and enhance many wild-growing species, working with natural processes and natural interconnections (Senos *et al*., 2006), can help all of us to sustain and restore our critically important environments and habitats.

IV. WILD FOOD PLANTS IN DIFFERENT ECOSYSTEMS

Main types of food plants (e.g., those yielding edible leaves, fruits, or starchy underground parts) can be found in all types of ecosystems. However, the proportions across edible lifeforms are different. Temperate deciduous forests and steppes yield large quantities of succulent green shoots in spring, whereas in arid ecosystems plants to protect themselves from herbivores a greater extent by producing alkaloids and other chemical deterrents and such armour as prickles and thorns. Thus, even in a rainy season they are likely to be less palatable than species growing in ecosystems with more rainfall. In southern Europe, many bitter-tasting Asteraceae species have been eaten in rural communities (e.g., *Leontodon, Cichorium, Hypochaeris, Sonchus*), whereas these same species were usually passed by as edible plants further north in Europe, where there was usually a sufficient supply of less bitter green shoots and leaves of plants (e.g., *Urtica, Chenopodium, Aegopodium*) to be found in the grasslands and fields. This difference in use of bitter tasting plants may represent a cultural choice, but the primary underlying reason for variation may be the availability of green shoots in a particular landscape.

In the tropics, although there is enough moisture, the leaves of most plants are large, hard, and waxy. In Amazon, leaves of plants play a minor role in human nutrition, whereas in Southeast Asia many different green vegetables are utilized. However these are mainly of plants growing in disturbed sites or wetlands, as these species generally have more delicate, succulent leaves. Actually, the utilization of aquatic plants has yet another advantage: many genera of aquatic plants (e.g., *Typha, Sagittaria, Schoenoplectus*) have very broad geographical ranges.

Plants with parts high in carbohydrates are particularly important in the history of human nutrition. A major source of food energy, they have been vital for survival of many hunter-gatherer groups, just as they are for agrarian peoples. Underground storage organs such as true roots, bulbs, rhizomes and tubers that are rich in starch or inulin should be mentioned at the outset. They are particularly abundant in biota displaying strong seasonal dynamics, e.g., savannah, steppes, and temperate forests. Thus, underground storage organs have been important staples for many peoples of North America, Siberia, and Central Asia, as well as hunter-gatherers of the Kalahari. In tropical forests where little biomass is stored underground the starch-rich staples generally occur above ground, for example in the pith of palms and cycads. "The heart of the palm" and sago are among the most important plant staples for forest-dwellers of the tropics. As with green shoots, aquatic ecosystems yield underground starchy organs everywhere in the world, and such genera as *Typha, Nuphar, Nymphaea, Trapa, Scirpus, Schoenoplectus, Nelumbo* and/or *Sagittaria* have been widely utilized across different climatic zones. Their ubiquity may have made aquatic and marsh plants a particularly attractive kind of wild food. For foraging bands arriving from a different area, these plants would have represented a reservoir of already recognized food. Aquatic ecosystems are also most productive. Harvesting aquatic plants may thus be more efficient than harvesting from other ecosystems (Szymański, 2008), ultimately enhancing the importance of these species. One of the most productive wild food plants is cattail or bulrush (*Typha*). *Typha* species were utilized by such broad spectra of cultures as: Native North Americans, Indigenous peoples of Siberia, Chinese, Thai, Cossacks, Egyptians, and the Tuaregs of the Sahara. The starchy rhizomes of waterlilies from the family Nymphaeaceae were also an important source of nutrition, at least in times of famine, for Native Americans, inhabitants of Polesie region between Belarus and Ukraine, and Australian Aborigines (Hedrick, 1972).

Plants yielding dry fruits and seeds were relatively more important in traditional economies than fleshy fruits. They were easier to store and contain larger amounts of fats, proteins and starch, as compared with the higher quantities of simple sugars in fleshy fruits. Thus, seeds and nuts were a more "filling source" of food, allowing them to become staples, rather than snacks, additives or famine foods. Dry fruits and seeds capable of sustaining human populations can be found in various biomes: dry and wet, hot and cold. Specialized Indigenous economies evolved around utilizing the most productive of these seeds, e.g., *Zizania aquatica, Quercus* spp., *Pinus* spp., *Carya* spp. in North America, *Trapa natans* in prehistoric Europe, and *Corylus* spp. in both "Old" and "New" Worlds.

The use of many of these wild foods, as noted earlier, has declined dramatically in many parts of the world. Is it possible to go back to gathering some of these wild-harvested foods that were so important to peoples of the past? In theory, yes. But their productivity is usually a fraction of that of modern crops, and many of the habitats where they once occurred in abundance have been eroded by urban and industrial development. Thus, special consideration should be taken concerning, for example, their conservation. Wild plants also generally have higher concentrations of alkaloids and other plant metabolism products, which make them good candidates as "nutriceuticals," to be eaten in small amounts as herbal medicines. In the Mediterranean region the wild collected plants have a very high antioxidant content making them an important defense against cancer and cardiovascular diseases (Vanzani *et al*., 2010, Sacchetti *et al.*, 2009). However, these same phytochemicals may pose hazards to health when larger amounts are consumed (Turner and Von Aderkas, 2009).

In the history of human science there have been many scholars who tried to popularize the use of "new crops" of wild origin. Undernourishment has been a universal phenomenon right up to the present day, and many attempts have been made to alleviate it. As Maurizio (1927) reports, German and Austrian authorities organized large-scale wild food plant collection schemes during World War I. Even soldiers were fed *Typha* products. However, after the war the population reverted to "normal" nutrition. This attitude can be explained by the so-called *optimum foraging model.* A given population uses a resource which is most nutritious and common. Once this resource becomes scarcer the people switch to the next in terms of harvesting opportunities and caloric efficiency. In North America large tracts of deciduous forests are used for sugar maple production, mainly from *Acer saccharum*. In Europe the utilization of tree sap has been recorded in most countries and in the Austro-Hungarian Empire attempts were even made to produce sugar on an industrial scale from European maple species (probably mainly *Acer pseudoplatanus*). However these efforts were abandoned. Why? Probably this was due to a few factors working together. In North America sugar maple is a dominant species in many areas, whereas in European forests maples usually form only an admixture. Secondly, the sugar content in maples other than *Acer saccharum* is generally lower. Thirdly, Europe is a densely populated continent, and fuel wood has a higher value than in more sparsely populated America. For all of these reasons, commercial maple sugar and maple syrup production in Europe has not been successful.

A. Basic Patterns of Utilization of Wild Food Plants in the World

The use of all parts of plants (fruits, flowers, shoots, underground organs) is documented in all major climatic zones. However, the proportion of species utilized in different ecosystems may differ depending on the spectrum of life forms in a given climatic zone (e.g., more underground organs would be utilized in savannahs than in tropical rainforest ecosystems).

The kinds of edible plant organs used have changed across human history. Foragers used primarily starchy organs and fruits. They had access to large tracts of land, so could restrict

themselves to using the most nutritious species. Agriculturalists have used relatively more green parts of plants as they usually have had access to smaller patches of vegetation, sometimes only their own fields. In this case, weeds growing in fields would be a primary type of wild food plants used (e.g., *quelites*, described earlier).

The pattern of the use of wild food plants is strongly affected by culture. For example, in the Amazon or in Eastern Europe wild green vegetables play a minor role, whereas in East Asia and India, they are highly prized and large numbers of species are used.

Aquatic and marsh habitats are ecosystems both particularly rich in edible plants and particularly productive; they produce a notable proportion of wild plant foods in many parts of the world.

V. WEEDS: ROLES IN CULTURES AND AGROECOSYSTEMS

Farming activity implies a simplification of the environmental structure and diversity, replacing the natural ecosystem's biodiversity with a limited number of crops and domestic animals, sometimes only single species (Altieri, 1987). Agriculture has also had a major influence on the evolution of weedy species—those particularly adapted to disturbed conditions with a high capability for colonization of newly cleared but potentially productive ground, and of high rates of reproduction and the ability to maintain their abundance under repeatedly disturbed conditions (Mohler, 2001). From an ecological point of view, weeds are the pioneers of secondary succession (Bunting, 1960). Agricultural activities have kept plant community succession in its early stages, and the environmental simplification that has characterized modern agriculture systems creates specialized habitats that favour the selection of highly competitive weeds. These species are able to adapt and survive under conditions of maximum disturbance. They often invade and colonize arable fields and can exploit ecological niches left open in croplands.

A. What Are Weeds in Conventional and Ecological Agriculture?

Commonly defined, *weeds* are plants that grow in places where they are not wanted and, because they often interfere with the growth of desired cultivated plants (as well as with some desired native plants, in the case of introduced weeds), they sometimes need to be controlled or managed. Weeds are a major source of competition with crops for light, water, air, and nutrients (Pfeiffer, 1970), and in conventional cropping systems most weeds are considered to be detrimental, because of this competition as well as sometimes hosting insect pests and plant diseases, thereby reducing yields and quality of crops. Today, about 250 plant species are universally considered weeds and the USDA Natural Resources Conservation Services counts 661 records in the "Federal and State Invasive and Noxious Weeds" database (http://plants.usda.gov/java/noxComposite). Thus, it is not surprising that in the 2004 global sales of agrochemicals amounting to US$32,6 billion (Euro 26,785), herbicides accounted for 45.4% of the total pesticide market (Agrow, 2005), and the consumption of herbicides in 2001 was 118.286 tonnes in the European Union (FAO, 2009).

However, weeds can also have a positive effect in agroecosystems. In ecological and organic agriculture, weeds are not controlled with chemical herbicides but through a "systems approach," in which weed management and agriculture are considered as part of the milieu of interactions that may be categorized as social, economic, and environmental (Swanton and Murphy, 1996). The goal of the ecological agriculture is not to eliminate weeds but to manage them. In fact, in balanced and complex ecosystems weeds do not exist as negative entities, as they are part its components. In the EU organic regulation and IFOAM norms, weed management is based on prevention methods: "The prevention of damage caused by pests, diseases and weeds shall rely primarily on the protection of natural enemies, the choice of species and varieties, crop rotation, cultivation techniques and processes heat" (from Reg CEE 834/07 art. 12 g). "Organic farming systems apply biological and cultural means to prevent unacceptable losses from pests, diseases and weeds. They use crops and varieties that are well-adapted to the environment and a balanced fertility program to maintain fertile soils with high biological activity, locally adapted rotations, companion planting, green manures, and other recognized organic practices as described in these standards" (from IFOAM Basic Standards 2005, 4.5 Pest, Disease, Weed, and Growth Management, General Principles).

Increasing crop species diversity *per se* may suppress weeds. Differences in height, canopy thickness, rooting zone and phenology are likely to influence crop and weed interactions. Concerning the weed flora in the field, a more equilibrated community tends to evolve in time under organic management. A long-term study comparing organic vs. conventional agriculture in Tuscany showed that in organically managed agroecosystems the biodiversity of weeds measured with Shannon index (Shannon and Weaver, 1963), both for weed density (number of plants m^{-2}) and biomass (g m^{-2}) of each species, increased over time since conversion from conventional methods and was higher in organic farming systems than in conventional systems treated with chemical herbicides, which resulted in a maximum discrepancy for the weeds' biodiversity (Migliorini and Vazzana, 2007).

B. The Ecological Role of Weeds

Weeds often have some negative effects on crops. Furthermore, some weeds—especially those that are introduced and invade the niches of corresponding native species—are noxious and harmful to many indigenous species and natural habitats. Much has been written about the harmful effects of weeds when introduced as invasive aliens (Crosby, 1986). Nevertheless, many weeds are important biological components of

agroecosystems that may actually benefit crop plant communities. Natural habitats host wild populations of cultivated plant ancestors that often contain useful genes absent in the pool gene of their domesticated counterparts. As wild relatives of cultivated plants, many weeds can be considered important sources of biodiversity (genetic and species diversity) (Hammer *et al.*, 1997). Weeds are also key components of field margins (hedges, margin strips and semi-natural habitats associated with boundaries and ditches), the presence of which is very important ecologically. These edge habitats improve overall biodiversity and provide habitat, refuge, food and corridors for the movement of the different species of organisms in the area (Lazzerini *et al*., 2007).

Weeds can also protect against soil erosion as a natural cover crop (Gliessman *et al*., 1981). The cover of the spontaneous vegetation improves infiltration, enriches the soil water reserves, and reduces run-off of pesticides and excess nutrients (Swanton and Weise, 1991), as well as increasing soil quality through promoting microbial activity and diversity (Moreno *et al*., 2009). There may also be increased efficiency in nutrient cycling, with greater numbers and diversity of interacting organisms (Clements *et al.,* 1994). Weeds can act as "catch crops," taking up nutrients, preventing nutrient leaching and increasing overall soil quality and fertility. They are also a relatively important source of organic matter, carbon and nitrogen input in the soil when their residues and dead roots enter in the soil process of decomposition (mineralization) and building activity (humification).

Spontaneous flora is dependent on the ecological environment and is good indicator in monitoring environmental parameters like soil quality. In particular, some groups of plants are typical of acidic or sub-acidic soils (e.g., *Rumex acetosella, Anthemis arvensis, Stachys arvensis*), others of calcareous soils (e.g., *Adonis aestivialis, Nigella arvensis, Papaver rhoeas, Ranunculus arvensis, Sinapis arvensis, Veronica polita, Euphorbia cyparissias, Bromus arvensis*), others of nutrient-rich soils (e.g., *Amaranthus* spp., *Chenopodium* spp., *Euphorbia* spp., *Fumaria officinalis, Galium aparine, Mercurialis annua, Rumex obtusifolius, Sonchus* spp., *Solanum nigrum, Stellaria media, Urtica dioica*), of moist soils (e.g., *Equisetum* spp., *Mentha* spp., *Tussilago farfara, Poa trivialis*), or of salty soils (e.g., *Chenopodium* spp., *Atriplex* spp.). Other species tend to be broadly tolerant of a range of soil types (e.g,. *Cirsum arvense, Chenopodium album, Sinapis arvensis, Fallopia convolvolus*). In a biodynamic approach, weeds having specific effects on environments are called "dynamic" (Pfiffer, 1950). Stinging nettle (*Urtica dioica*) is one of these, as it enhances resistance and enriches nutrients in nearby plants, and stimulates the formation of humus in the soil. Other dynamic weeds include Scotch grass (*Cynodon dactylon),* Autumn hawkbit (*Leontodon autumnalis*) and field horsetail (*Equisetum arvensis*). Weeds can also have an allelopathic effect on the development of other more noxious weeds (Weston, 1996; Anaya, 1999; Singh *et al.,* 2003; Batish *et al.,* 2006).

As pioneer species, weeds tend to create more stable environments through helping to develop more complex communities and increasing the competition within ecosystems. Scientific evidence shows that there are significant interactions between crops, weeds and insects (Altieri and Nicholls, 2004). Cropping systems affect both weed diversity and the density of the populations of insect pests and their regulators. In particular, some weeds at their flowering stage (e.g., those of families Apiaceae, Fabaceae, Asteraceae) play an important ecological role by providing shelter and nourishment to a complex of arthropod natural regulators of pest populations (Altieri, Schoonhoven and Doll, 1977; Altieri and Whithcomb, 1979, 1980). Weeds serve as important habitat for beneficial insects, predators and parasitoides and also as alternative sources of pollen and nectar (Altieri and Whitcomb, 1979). Weeds also provide, together with crop residues, a living mulch that contributes to the detritus food web. By reducing weeds with fire or a broad spectrum herbicides it is possible to stimulate detritivores in shifting their food preference from organic dead insufficient residues to cotyledons of cereal crops (Paoletti *et al.,* 2007a). Thus, weeds can be seen from different perspectives depending on the cultural approach, environmental condition and geographical area. In the past, as well as today in some countries, many of these weedy plants are significant sources of food, fodder, fibre and medicine (Liebmann, 2001).

VI. WEEDS IN LOCAL CUISINES

In many areas in Italy and other parts of the world weeds are still gathered, especially during the spring season, mainly by the oldest female members of the communities and in rural areas (Pieroni, 1999). We will briefly illustrate in the following sections four case studies focusing on four archaic weed-based soups in Eastern Europe and Northern Italy. Weeds—and wild growing plants in general—are also sometimes used in the production of alcoholic beverages, either as flavorings, or as major ingredients, such as in dandelion wine (Szczawinski and Turner, 1978).

A. The Original Borsch

Nowadays the Russian name ***borsh*** and Polish ***barszcz*** designate a kind of vegetable soup, specifically one made with beetroots (*Beta vulgaris*). However in the past this name applied mainly to a soup made from the young shoots of hogweed, or cow-parsnip (*Heracleum sphondylium*) which in Polish bears the name ***barszcz*** and in Russian ***barshchevnikh***.

How did it happen that this shift in the meaning of the name arose? This issue fascinated professor Józef Rostafiński, a Polish botanist from Cracow, who in 1916 published a treatise on the history of the shift from eating *Heracleum* to eating beetroots. Hogweed is reported as an important food plant in Poland in the sixteenth century. In the herbal of Marcin z Urzędowa (1595) we can read: "Whoever eats hogweed, moistens his living.. . . When they make it sour in the Polish way, it is good to drink

in fevers, thirst, as it alleviates thirst and cholera and it induces greed for food with its spice.. . . Garnished with egg and butter, it is good to eat on the days when they do not eat meat soup, as it works in the same way."

The use of this plant in Poland and Lithuania was also mentioned (as *Spondylium*) in John Gerarde's English herbal published in 1597. Another old account comes from Syrennius (1613): "Hogweed is familiar to everyone in our country, in Ruthenia, Lithuania and Żmudź.. . . It is useful as medicine and for food is very tasty. Both roots and leaves. However the root is more useful as medicine and leaves as food.. . . Leaves are commonly gathered in May.. . . Soup made with it, as it is made in our country, Lithuania and Ruthenia, is tasty and graceful. Either cooked on its own or with chicken or other ingredients such as eggs, cream, millet." Hogweed was the main lacto-fermented soup of Slavic nations. Hogweed's young leaves and stalks were covered with warm water and left for a few days to become sour. In favorable conditions two or three days is usually enough for the process. According to a seventeenth century archival menu, hogweed soup was served for the professors of Jagiellonian University in Cracow every Wednesday during the period of Lent and they also ate it as the main soup at Easter (Karbowiak, 1900). What is interesting is that it was called "***barszcz*** made of ***barszcz***", suggesting that another kind of ***barszcz*** soup was made with other plants, probably beetroots, which were gradually becoming popular as a vegetable (Rostafiński, 1916). Step by step, beetroots eventually completely eradicated the hogweed in this soup.

In the 18th century hogweed **barszcz** was already a rare food for poorer people only. For example Ładowski wrote that ". . . the vulgar people use hogweed to make a soup called ***Barszcz***" (Ładowski, 1783). In the same period Jundziłł (1799) gave a description of its use in Lithuania, which was probably identical to its use in Poland: "They collect young leaves, ferment them in the same fashion as other vegetables and they are frequently eaten by village people. Or, dried in the shade like celery, they are kept for further use." The sudden decline of the use of *Heracleum* in the 18th century is documented by the fact that hogweed soup is not listed in Kluk in his plant dictionary (1786). This is surprising, as Kluk was very interested in food plants and he lived in northeastern Poland, in an area adjacent to Lithuania.

According to Rostafiński hogweed soup ceased to be made in Poland in the eighteenth or nineteenth century and the last record of its use in adjacent Lithuania comes from 1845. However, Moszyński witnessed it still being made in Russia in the twentieth century, in fact is still made in some parts of the former Soviet Union nowadays, particularly in Kamtchatka. The use of hogweed was also frequently mentioned by Moszyński's informants in Belarus (Rostafiński's, query in 1883) (Łuczaj, 2008a). In fact hogweed soup was still occasionally, though rarely, made in southern Poland even up until the early twentieth century in a few villages of the Beskidy Mountains (Łuczaj and Szymański, 2007; Łuczaj, 2008b).

A plant that disappeared from the Polish menu even earlier is a relative of hogweed—ground elder, *Aegopodium podagraria.* Ground elder was sold in the market of Cracow in medieval times but later came into disuse (Maurizio, 1927). Its consumption in the past was documented in only a few villages (Łuczaj, 2008a; Pirożnikow, 2008). However its consumption in Belarus was widespread, at least until the end of the nineteenth century. The relatively small cultural importance of *Aegopodium* must be Poles' cultural choice as this wild vegetable is widespread and abundant and was commonly used in some other European countries (Hedrick, 1919).

In the Ukraine, the name "green *borsh*" designates any soup made of green vegetables, e.g., *Rumex acetosa, Chenopodium album* and *Urtica dioica,* which indicates that in the past mixed soups of many species of wild vegetables could have been more common everywhere. The above-mentioned wild plants are still occasionally sold in Ukrainian markets (information from a few Ukrainian botanists). In some parts of Ukraine (e.g., in the Uman area) the use of *Aegopodium podagraria* for green *borsh* also still occurs (Kuzemko, 2008).

In many areas in Italy and other parts of the world weeds are still gathered, especially during the spring season, mainly by the oldest female members of the communities and in rural areas (Pieroni, 1999). We will briefly illustrate in the following sections three case studies focusing on three archaic weed-based soups in Northern Italy. Weeds—and wild growing plants in general—are also sometimes used in the production of alcoholic beverages, either as flavorings, or as major ingredients, such as in dandelion wine (Szczawinski and Turner, 1978).

B. "Pistic": A Blend of Potherbs

The native populations of Friuli Venezia Giulia have always been tapping, to various degrees, the considerable local resources of vascular plants, consisting of approximately 3,380 entities (Poldini *et al.*, 2005), in order to assemble and integrate their food stock from season to season. Phytoalimurgia has had followers in Friuli Venezia Giulia as well as in other Italian regions, both in the past and in more recent years. A preliminary survey (Paoletti *et al*., 1995) carried out in western Friuli has allowed to rediscover the custom to gather wild vernal potherbs to prepare a special dish that is known under different names depending on its area of origin: ***pistic*** (Val Colvera, in the Prealps of Friuli Venezia Giulia), ***frita*** (Carnia), ***lidùm*** (Cividale del Friuli).This preparation consists of more than 62 potherbs gathered in field margins, hay meadows, woodlands, and in the wild; these herbs occur more typically in spring. Most potherbs included in the ***pistic*** are boiled; some are also eaten raw in green salads or pan-fried with butter or lard or used in omelettes. The conclusions of this early research unveiled the pre-Roman Celtic origin of ***pistic***, which has been confirmed by etymological studies about the names of some of the potherbs blended in this dish.

However, the revived interest in wild edible vegetable species led us to undertake further research into the current knowledge

about this topic in the Carnic Prealps and in the Upper Friulian Plain. This knowledge is still widespread in the area under investigation and was not reported in previous studies. From the initial interviews with informants to draft a simple list of the potherbs gathered for dietary purposes, also with the aim of preserving and safeguarding the local knowledge about edible plants, it was finally possible to make an assumption about what the possible origin of such dietary customs could be. The ecology of the adopted vegetable species and the archaeobotanical research work published for the Friulian area and the Alps in general lead investigators to assume that most of the plants that are still consumed for dietary purposes have been so since very ancient times and that new knowledge about the species used or about any different uses of them has developed over the decades. In this respect, a very special example is offered by *Crambe tataria SebeòK*, an adventitious naturalized Brassicaceous plant found in the Magredi of the western Upper Friulian Plain, the only Italian site known to host this species. Recent research (Cassola Guida, 2006) assumes that this species was already present in the Early/Middle Bronze Age (see Table 2).

C. *"Prebuggiun"*: Wild Herbs Used as Food in Liguria Region, Italy

In Liguria the tradition of eating ***prebuggiun*** has very ancient origins and is widespread in the entire territory of Genoa, in particular in the eastern part of this province. It consists of a "mixture of wild or semi-domesticated potherbs collected in cultivated and abandoned fields and used, after boiling, for soups, filling for pies, omelettes and vegetable raviolis (the typical pansotti) or simply as a side-dish" (Bisio and Minuto, 1999). Actually, this tradition is popular throughout the Liguria region, though under different names. At Levanto, for example, it is simply called '***gattafin,***' whereas it is plainly referred to as '***erbette***' in the western part of the region. In their attempts to investigate this tradition, scientists have often been able to record only the vernacular names for the herbs used, which are different in the various areas of origin, and have been confronted with rather "individualized" plant collections, based on the collector's personal experience and with specific oral transmission that has allowed the handing down of this knowledge.

Nevertheless, in interviewing people who are still used to collecting wild edible plants, as well as through field surveys conducted by ethnobotanists, a fairly complete list of the species forming the ***prebuggiun*** herb collection can be compiled. It consists of a total of 38 plants, belonging to 15 families, but half of which are from Asteraceae (see Table 3). These species share similar morphological, ecological and physiological features; they are annual, biennial or rarely perennial herbaceous plants. Most are hemicryptophytes, with a basal leaf rosette, and range very widely in size, depending on their places of origin and substrate conditions (Bisio and Minuto, 1997).

Research studies have investigated the antioxidant properties of a dozen of wild herbs used to make *prebuggiun*. Among

TABLE 2
Edible plants included in the "pistic" blend.

	Edible parts	
Plant species	Boiled	Raw
Aposeris foetida (L.) Less	Lf	Bl
Aristolochia pallida Wild	Lf	
Aruncus dioicus (Walter) Fernald	Spr	
Bellis perennis L.	Lf	
Campanula trachelion L.	Lf	
Capsella bursa-pastoris (L.) Medicus L.	Lf	
Cardamine flexuosa With.	Lf	
Cardaminopsis halleri (L.)	Lf	
Carum carvi L.	Lf	Se
Centaurea nigrescens Willd	Lf	
Chenopodium album L.	Lf	
Chenopodium bonus-henricus L.	Lf	
Chenopodium polyspermum L.	Lf	
Cirsium oleraceum (L.) Scop.	Lf	
Clematis vitalba L.	Spr	
Crepis capillaris (L.) Wallr	Lf	Lf
Crepis setosa Hall.	Lf	
Erigeron annuus (L.) Pers	Lf	
Fagus sylvatica L.	Lf	
Filipendula vulgaris Moench	Lf	
Fragaria vesca L.	Lf	Fr
Galium aristatum L.	Lf	
Galium mollugo L.	Lf	
Hypochaeris maculata L.	Lf	
Hypochaeris radicata L.	Lf	Lf
Lamium purpureum L.	Lf	
Leontodon hispidus L.	Lf	
Leucanthemum vulgare Lam.	Lf	
Myosotis arvensis (L.) Hill	Lf	
Ornthogalum pyrenaicum L.	Lf, Bl	
Oxalis acetosella L.	Lf	Lf
Papaver somniferum L.	Lf	
Phyteuma spicatum L.	Lf, Bl	
Plantago lanceolata L.	Lf	
Plantago major L.	Lf	
Plantago media L.	Lf	
Polygonum persicaria L.	Lf	
Primula acaulis (L.) Hill	Lf	
Ranunculus ficaria L.	Lf	Lf
Ranunculus repens L.	Lf	
Rubus ulmifolius Schott	Spr	Fr
Rumex acetosa L.	Lf	Lf
Rumex obtusifolius L.	Lf	
Ruscus aculeatus L.	Lf	
Salvia pratensis L.	Lf	
Silene alba (Miller) Krause	Lf	
Silene dioica (L.) Clairv	Lf	
Silene vulgaris (Moench) Gorcke	Lf	

TABLE 2
Edible plants included in the "pistic" blend. *(Continued)*

Plant species	Edible parts	
	Boiled	Raw
Sonchus asper (L.) Hill	Lf	
Sonchus oleraceus L.	Lf	
Stellaria media (L.) Vill	Lf	
Tamus communis L.	Spr	
Taraxacum officinale Weber	Lf	Lf
Tragopogon pratensis L.	Lf	
Urtica dioica L.	Lf	
Veronica beccabunga L.		Lf

Note: Fl = Flowers, Lf = Leaves, Spr = Sprouts, Se = Seeds, Fr = Fruits, Bl = Blossoms.

them at least six are characterized by radical scavenging activity, similar or better than those of some foods that are well known for their antioxidant properties such as blueberry (*Vaccinium myrtillus* L.) and Verona red chicory [*Cichorium intybus* L. var. *foliosum* (Hegi) Bishoff] (Sacchetti *et al*., 2009; Vanzani *et al.*, 2011).

TABLE 3
Edible plants included in the "prebuggiun" blend.

Plant species	Edible parts	
	Boiled	Raw
Arctium lappa L.	Lf	
Capsella bursa-pastoris (L.) Medicus	Lf	
Beta vulgaris L.	Lf	Lf
Borago officinalis L.	Lf, Fl	Lf, Fl
Brassica oleracea L. *convar. capitata*	Lf	Lf
Campanula rapunculus L.	Lf, Rt	Lf, Rt
Centranthus ruber L.	Lf	Lf
Chenopodium album L.	Lf	Lf
Cichorium indivia L.	Lf	Lf
Cichorium intybus L.	Lf	Lf
Cirsium vulgare (Savi) Ten.	Lf	
Crepis foetida L.	Lf	
Crepis vesicaria L.	Lf	
Diplotaxis muralis (L.) DC.	Lf	Lf
Foeniculum vulgare Miller	Lf	Lf
Hyoseris radiata L.	Lf	Lf
Hypochaeris radicata L.	Lf	
Inula conyza DC.	Lf	
Leontodon hispidus L.	Lf	Lf
Leontodon leysseri (Wallr)	Lf	Lf
Leontodon tuberosus L.	Lf	Lf
Papaver rhoeas L.	Lf	

TABLE 3
Edible plants included in the "prebuggiun" blend. *(Continued)*

Plant species	Edible parts	
	Boiled	Raw
Picris echioides L.	Lf	
Galium aristatum L.	Lf	
Pimpinella major L.	Lf	Lf
Plantago major L.	Lf	
Plantago lanceolata L.	Lf	
Ranunculus ficaria L.	Lf, Fl	Lf, Fl
Reichardia picroides L.	Lf	
Raphanus rhaphanistrum Strobl	Lf	
Rumex crispus L.	Lf	
Sanguisorba minor L.	Lf	Lf
Silene alba (Miller) Krause	Lf	
Silene vulgaris (Moench) Gorcke	Lf	
Sonchus oleraceus L.	Lf	
Taraxacum officinale Weber	Lf	Lf
Urospermum dalechampii L.	Lf	
Urtica dioica L.	Lf	

Note: Fl = flowers, Lf = leaves, Rt = roots

D. "Minestrella" of Gallicano

The gathering of weedy greens for the ***minestrella*** is still a ritual for many women of the village of Gallicano in the Garfagnana (upper Serchio valley) in Northwest Tuscany (Pieroni, 1999). The area of distribution of the ***minestrella*** is restricted to the territory extending from Gallicano east to the Apuan crest and the association of several boiled spontaneous vegetables is common also in the cooking traditions of other areas on the other side of the Apuan Alps (in the Versilia region) and Liguria (the northeastern region bordering Tuscany). In all these territories the domination of the Ligurian-Apuans (2nd to 3rd Centuries BC) was remarkable and we could hypothesize that the specific history of this area may have played a role in developing these culinary customs.

Weeds, whose young aerial parts are gathered during the spring in the territory of Gallicano for preparing the local vegetal soup (Minestrella) Pieroni (1999).

TABLE 4
Wild edible plants included in "Minestrella".

Allium ampeloprasum L., *A. schoenoprasum*, and *A. vineale* L.
Apium nodiflorum L.
Bellis perennis L.
Beta vulgaris L. ssp. *maritima* (L.) Thell.
Borago officinalis L.
Bunias erucago L.
Campanula rapunculus L. and *C. trachelium* L.

TABLE 4
Wild edible plants included in "Minestrella". *(Continued)*

Cichorium intybus L.
Cirsium arvense (L.) Scop.
Crepis leontodontoides All., *C. sancta* (L.) Babcock, and *C. vesicaria* L.
Daucus carota L.
Foeniculum vulgare Miller
Geranium molle L.
Hypochaeris radicata L.
Lapsana communis L.
Leontodon hispidus L.
Lychnis flos-cuculi L.
Malva sylvestris L.
Papaver rhoeas L.
Picris echioides L. and *P. hieracioides* L.
Plantago lanceolata L. and *P. major* L.
Primula vulgaris Hudson
Raphanus raphanistrum L.
Ranunculus ficaria L.
Reichardia picroides (L.) Roth
Rumex crispus L. and *R. obtusifolium* L.
Salvia pratensis L. and *S. verbenaca* L.
Sanguisorba minor Scop.
Silene alba (Miller) Krause and *S. vulgaris* (Moench) Garcke
Sisymbrium officinale (L.) Scop.
Sonchus asper L. and *S. oleraceus* L.
Symphytum tuberosum L.
Taraxacum officinale Web.
Urtica dioica L.
Urtica urens L.
Viola odorata L.

VII. "LEAVES" IN THE MEDITERRANEAN CUISINE—A CASE STUDY IN INLAND SOUTHERN ITALY

A. Ethnotaxonomy of Food Weeds

Pieroni *et al*. (2005) studied how local women in an inland Southern Italian village, Castelmezzano, classify non-cultivated botanicals (excluding fruits). The "concept" of non-cultivated plants is not clearly expressed linguistically by local women. Most of the classification elements have the lynchpin in being or being part of the midlevel or intermediate (Berlin, 1992) category, "*fogliē*" (literally "leaves"), corresponding roughly to the concept of "edible leafy vegetables." Moreover, even the distinction between cultivated and non-cultivated species is quite vague and fluctuant. So, for example, if the term "*fogliē*" indicates generally non-cultivated leafy vegetables, there are also a few semi-cultivated plants that would be referred to this group, as is the case with rocket (*Eruca sativa*), spinach beet (*Beta vulgaris*), and broccoli raab tops (*Brassica rapa* ssp. *rapa* Group Ruvo Baley). One of the reasons could be that cultivated species are growing in the same ecological zone, whereas *fogliē* are generally gathered, for example around home gardens in the vineyards.

On the other pole, people in the same area perceive as prototypical for non-cultivated (wild) species, mushrooms (*fungi*), and to a less extent, the young non-cultivated shoots (as like those of wild asparagus (*Asparagus acutifolius*), butcher's broom (*Ruscus aculeatus*) and traveller's joy [*Clematis vitalba*]), and the flower receptacles of wild artichoke (*Cynara cardunculus* ssp. *cardunculus)* and carlines (*Carlina acaulis*), which are not at all considered kind of *fogliē*.

It is interesting to underline that mushrooms and shoots are generally gathered in the secondary forests or in the hedgerows bordering the durum wheat fields, which represent the ecological zones located quite far from the village centers. *Fogliē* are instead mainly collected by women near the inhabited centre, along countryside pathways, in the vineyards or near the wheat fields. Only a few plants are gathered in the marshes. Men are the main collector of mushrooms.

Perception of "wilderness" as cultural construct seems than in the study area to be related to the distance from the inhabited village and especially to the degree of human disturbing (agricultural/pastoral) activities: what is gathered in the forest (mushrooms, wild asparagus, butcher's brooms shoots, wild artichoke and carline) is considered "more wild" of what growing spontaneously and gathered around vineyards (*fogliē*).

These examples demonstrate how the collection of non cultivated plants is inextricably embedded with cultural concepts describing the traditional management of natural resources and the spatial organization of the natural/cultural landscape.

B. Wild Food Plants, Generational and Gender Relations, and Cultural Identity

Elderly people in Southern Italy agreed in referring us that non-cultivated vegetables are consumed nowadays to much less extent than decades ago. The reason of this shift, which has been observed in other areas in the Mediterranean as well, could be found in the changed socio-economic context: the younger generation have nearly lost the competence (Traditional Knowledge, TK) necessary to identify, gather and process in the kitchen these species, while for many informants of the middle generations consuming non cultivated vegetables is now perceived in a negative way, oft enas a symbol of a poor past.

Moreover, nowadays young women in inland Southern Italy often join the workforce through factory labor and as clericals, and rely on older women in their family (mothers, aunts, grandmothers) to care for their children while they are at work. These women have little time to carry on the traditional ways of preparing food and also to gather vegetables; they instead buy nearly all foodstuffs for the family in supermarkets and local open-air markets. For both genders of the younger and middle generation, trends towards leaving the traditional ways of living behind in the search for other living styles (reliant on pre-made meals) have played a detrimental role in the transmission and perpetuation of TK on non-cultivated vegetables and

subsequently in maintaining these local products in the daily diet.

The authority of these elderly women was strong in the villages of Southern Italy while. From the authority of elderly women a long series of particular annexes are derived: managing gathering activities, organizing home gardening, and co-operating with men in the decisions concerning agriculture (which, however, was still the final prerogative of the men in the community). As the persons who had nearly total responsibility for the domestic domain, and in particular for the kitchen, elderly women were accustomed to directing everyday life in the house.

Today, of all these sources of authority, nothing remains in the hands of younger generations of women. All decisions concerning work in the fields are made by their male partners, and their role at home is weaker than before. They generally do not manage home gardens (keeping only a few flowers in the balcony); they are still the 'queens' of the kitchen, but the majority of have lost the knowledge associated with traditional cuisine. In some ways, they no longer have the same authority as their mothers or grandmother: this is perhaps the price that they have had to pay to become economically independent. If this new situation is partially accepted by their male partners, it is generally rejected by the oldest generations (both male and female), which at times produces deep conflicts inside families between generations (Pieroni, 2003).

On the other hand, the majority of the young women have attended school. It seems then that their mothers' and grandmothers' TEK has been substituted by formal education, without the latter having the same social implications as the former. At present, young women in the study area are very conscious about their muted role in the family and their broader independence (both economic and psychological) that they have finally attained. In the many open discussions that were held with young women in the Vulture area, the majority tended to automatically reject an exclusive role in domestic affairs, which was 'functional' in a society conjugated in the masculine form where men dominated a lot of important decision-making processes as well as all matters related to the administration of cash income.

VIII. FUTURE OF TK RELATED TO WEEDY FOOD PLANTS

Re-instilling lost TK will require time and will be heavily dependent upon the positive acceptance by the younger generations of the knowledge connected with the elderly female cosmos. Acculturation processes that take place in schools and universities could facilitate insights and ideas for the formation of new activities, which could start from the reevaluation of TK related to the world of their older relatives, which is now quickly vanishing. Revalorization of women's domestic knowledge has to take into account the emancipatory challenges that young women have begun to pose to the community especially because of their roles in economically sustaining the family.

New visions of the relations between people and nature in the studied area will depend on whether the latter will become a significant political and cultural force. Regional agricultural and rural development policies could support the creation of innovative for-profit activities, such as the controlled gathering of weedy herbs, the re-introduction of old and archaic crops and handicrafts, the development of agro- and eco-tourism, farmers' markets, the management of natural and cultural pathways, and ethno-culinary events promoting regional and specialty food niches (e.g., Slow Food circuits).

Local women's co-peratives or enterprises comprised of women belonging to different generations could become the protagonist of the implementation of the heritage related to wild food plants in eco-sustainable interdisciplinary projects, as a few examples of small female-run enterprises in other regions in the Mediterranean show.

They could develop strategies to enhance TEK transmission between elderly women and the new generations within local schools, sustaining the gathering of wild plants and maybe decreasing the gap between generations. Moreover, they could incorporate conservation of both natural and cultural/linguistic resources with economically profitable small-scale production of food plant derivatives and local typical food products, managed by women.

Traditional consumption of food weeds is than strongly embedded with unique cultural aspects relating local people and their management of the natural environment. Revalorization of this TK will have necessarily to pass also through its sustain via a more acute education frameworks in the schools/universities, but also maybe through substantial changes in the agenda of many national food and local policy-makers and cultural stakeholders in the Mediterranean: sustaining food agro-biodiversity could only have a sense if the efforts will take in account the inextricably connected cultural heritage, what we nowadays call "bio-cultural diversity."

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