Medicinal Plants at Risk

Nature's Pharmacy, Our Treasure Chest: Why We Must Conserve Our Natural Heritage

A Native Plant Conservation Campaign Report

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Black cohosh in flower and ginseng berries photos by
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The Native Plant Conservation Campaign is a project of the Center for Biological Diversity. The Center works through science, law, and creative media to secure a future for all species, great or small, hovering on the brink of extinction.

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Goldenseal

Photo courtesy Kathryn A. Lynch and Eric T. Jones

Executive Summary

"The land abounds in these natural remedies and to classify the plants, give their names and describe their properties, the presence of a botanist would be required. It is certain that many illnesses are cured by people and they have their remedies for everything, many quite effective. For this reason not a few prefer their herbs and roots to our unguents and salves."

— Reply by a missionary at Mission San Antonio as to what knowledge the natives had of medicines (Geiger and Meighan, 1976)

Medicinal plants grow naturally around us. Over centuries, cultures around the world have learned how to use plants to fight illness and maintain health. These readily available and culturally important traditional medicines form the basis of an accessible and affordable health-care regime and are an important source of livelihood for indigenous and rural populations.

Increasingly, medicinal species that reside in natural areas have received scientific and commercial attention. In the United States, of the top 150 prescription drugs, at least 118 are based on natural sources. A child suffering from leukemia in 1960 faced a 10 percent chance of remission; by 1997, the likelihood of remission had been increased to 95 percent thanks to two drugs derived from a wild plant native to Madagascar.

But we still know little about the treasure trove inhabiting our wild places. As of 1995, less than 1 percent of all tropical plant species had been screened for potential pharmaceutical applications.

As medicinal plants receive increased scientific and commercial attention, there is increasing pressure on the wild plant populations from which most medicinal plants are harvested. Overharvesting has placed many medicinal species at risk of extinction. Commercial exploitation has also sometimes led to traditional medicines becoming unavailable to the indigenous peoples that have relied on them for centuries or millennia.

For all of these reasons, the study and conservation of medicinal plant (and animal) species has become increasingly urgent. The accelerating loss of species and habitat worldwide adds to this urgency. Already, about 15,000 medicinal plant species may be threatened with extinction worldwide. Experts estimate that the Earth is losing at least one potential major drug every two years.

Organizations and governments throughout the world are rising to meet this challenge. Through the Global Convention on Biological Diversity, the Convention on International Trade in Endangered Species, and non-governmental organizations such as those working to develop an International Standard for Sustainable Wild Collection of Medicinal and Aromatic Plants (ISSC-MAP), scientists and policymakers are proposing new procedures and policies to safeguard our remaining medicinal treasures in the wild so that they can protect this and future generations.

Goldenseal in flower
Photo by Jeff McCormack/gardenmedicinals.com

Introduction

This planet's spectacular web of life supplies countless gifts to humanity. Healthy wild ecosystems clean the water we drink and produce the air we breathe, the foods we eat, the medicines that cure and protect us, and the materials that form our shelter and clothing. Wild ecosystems moderate our climate and mitigate natural hazards such as hurricanes, floods, and landslides. They even protect us from pests and diseases — for example, species such as spiders literally filter insects from the air, just as plant roots filter disease organisms and pollutants from streams and other water sources. Individuals, communities, and economies depend on intact diverse native wildlands for all of these irreplaceable services.

The medicinal species that reside in natural areas have received increasing scientific and commercial attention in recent years. Worldwide, between 50,000 and 80,000 flowering plants are used medicinally (IUCN Species Survival Commission, 2007; Marinelli, 2005). In the United States, of the top 150 prescription drugs, at least 118 are based on natural sources: 74 percent come from plants, 18 percent from fungi, 5 percent from bacteria, and 3 percent from vertebrate species such as snakes or frogs (Ecology Society of America, 1997).

Black cohosh
Photo courtesy horizonherbs.com

The life-saving benefits of this treasure trove are enormous:

• According to the National Cancer Institute, at least 70 percent of new drugs introduced in the United States in the last 25 years are derived from natural sources (Steenhuysen, 2007).

• Plant-derived anti-cancer drugs such as taxol, first isolated from the Pacific yew, save at least 30,000 lives per year in the United States (Daily, 1997).

• Thanks to two drugs derived from alkaloids of Madagascar's rosy periwinkle, the likelihood of remission for a child suffering from leukemia increased by 85 percent between 1960 and 1997 (Daily, 1997; Botanic Gardens Conservation International, 1996).

• New compounds, such as one recently discovered in a plant in Madagascar, are likely to provide novel antibiotics and help curb the epidemic of antibiotic-resistant diseases (Wang et al., 2006).

• New classes of anti-viral drugs derived from plants such as star anise provide unprecedented hope for combating potential epidemic viral diseases such as flu (Laurance, 2005).

• Drugs to fight life-threatening diseases such as diabetes, HIV, and diarrhea — and even substances to protect crops from slugs — are being developed from plants, microorganisms, amoebae, and other species from African countries such as Egypt, Somalia, Libya, and Gambia (Barnett, 2006).

Of course, the use of wild species to cure and resist disease is nothing new. In China, medicinal plant use goes back at least 4,000 years, and healers have used more than 5,000 plant species (Tuxhill, 1999). More than 80 percent of South Asia's 1.4 billion people have no access to modern health care; they rely instead on traditional medicine using native species. In fact, many indigenous and local communities are immense reservoirs of traditional knowledge that can benefit biotechnology, agriculture, pharmaceutical development, and health care.

Our ability to use wild resources to prevent disease and improve health is not dependent on humans alone. The stability of our supplies of food, fiber, and other crops is threatened by pests, diseases, climate change, and other ever-changing stresses. According to the Ecology Society of America (1997), society's ability to maintain crop production depends on compounds and genes derived from wild relatives of animal and plant crop species. The extraction of genetic resources from the world's so-called "library in the wild" has recently accounted for annual increases of at least 1 percent in agricultural productivity, equivalent to about $1 billion in revenues (Ecology Society of America, 1997.

Plant-derived anti-cancer drugs save at least 30,000 lives per year in the United States alone.

Bloodroot flowering near Ithaca, New York

Photo courtesy Kathryn A. Lynch and Eric T. Jones

Although this report focuses on medicinal plant species, it is worth noting that the above-referenced estimate is confined to medicines and so excludes losses of new foods, fibers, and other potential tools that may fight famine, create housing, or generate other benefits to local communities, societies, and economies. Our ignorance becomes increasingly dangerous as the rates of loss of plants, fish, wildlife, and habitat accelerate (Marinelli, 2005). Each species lost to extinction represents not only the potential loss of life-saving cures for diseases such as cancer or AIDS, but also the loss of possible protein- or vitamin-rich foods or more productive and stable crops.

Threats: Habitat Destruction, Bioprospecting, and Overharvesting

Medicinal plants are at increasing risk from destruction of their habitats, bioprospecting for new sources, and overharvesting of known medicinal species. Currently, the conservation group United Plant Savers lists 19 North American medicinal native plants as "at risk." An additional 22 plant species are identified on the group's "to watch" list (www.unitedplantsavers.org/UpS_At_Risk_List.html). The Global Convention on Biological Diversity, the Convention on International Trade in Endangered Species (CITES), the Forest Service, the National Center for the Preservation of Medicinal Herbs (NCPMH), other herb societies, and scientists also track, maintain lists of, and work to conserve imperiled medicinal species worldwide.

Foxglove flowers
Photo courtesy horizonherbs.com

Habitat Destruction

As of 1995, less than 1 percent of all tropical plant species had been screened for potential pharmaceutical applications (World Atlas of Biodiversity, 1995). Habitats are being destroyed more quickly than scientists can investigate them. At current extinction rates, experts estimate that the Earth is losing at least one potential major drug every two years (World Atlas of Biodiversity, 1995).

Bioprospecting and "Biopiracy"

Medicinal species are very profitable. A 1995 analysis estimated that each new plant-derived drug is worth an average of $94 million to drug companies and $449 million to society (Mendelsohn and Bialick, 1995 cited in Daily, 1997). Other estimates have reported sales ranging from $1.5 to $5.7 billion annually for non-prescription medicinal plants in the United States, and $24.4 billion in sales worldwide. The reported market value of prescription and over-the-counter plant-based drugs in 1985 was $19.8 billion in the United States, and $84.3 billion worldwide (Pearce and Moran, 1994; Tuxhill, 1999).

This profitability can make traditionally used, accessible, and affordable medicinal plant resources less available to populations that have relied on them for centuries. The term "biopiracy" has been coined to describe the practice of private companies patenting traditional remedies from the wild and selling them at a vast profit, often allowing little or none of that profit to go back to the country or indigenous and local communities of origin (Barnett, 2006). Sometimes indigenous and local communities who have used a remedy for centuries may be prevented from using

or benefiting from it after patenting. For example, the neem tree, a South Asian relative of mahogany, has yielded extremely effective and profitable germicides, fungicides, and other compounds. By 1995, at least 50 patents had been granted to U.S. and international corporations for products extracted from this species. These patents have been contested by environmentalists and international aid groups (Torrance, 2000).

In 2001, following an Indian proposal in response to the patents of traditional products such as neem and tumeric (used for wound healing), the World Intellectual Property Organization (WIPO) established a Traditional Knowledge Task Force consisting of representatives from the United States, Japan, the European Union, China, and India. The Task Force carried out an extensive search on international patent databases and found more than 5,000 patent references on 90 medicinal plants in U.S. Patent and Trademark Office databases alone. Out of these 90 medicinal plants, 80 percent of patents were generated for seven plants of Indian origin. An extensive examination of 762 patents granted on medicinal plants by the Patent and Trademark Office revealed that more than 45 percent of patents could be categorized as belonging to traditional knowledge systems (CSIR News, 2001).

Worldwide, between 50,000 and 80,000 flowering plants are used medicinally. Of these, at least 15,000 may face extinction due to overharvesting and habitat loss.

Because of the controversy surrounding the rights of nations and indigenous communities to traditional medicines and local native species and products, the Global Convention on Biological Diversity specifically recognizes the property rights of indigenous and local communities over commercial exploitation of traditional remedies and other native species (Barnett, 2006; see also Convention text: www.biodiv.org/programmes/socio-eco/traditional/default.shtml).

Overharvesting

In addition to the loss of access to traditional remedies by indigenous peoples, overcollection of species poses a significant threat to some commercially valuable wild species and to their habitats as well. This threat has been known for decades. According to the World Conservation Union (IUCN), about 15,000 medicinal plant species may be threatened with extinction worldwide from overharvesting (see ISSC-MAP, 2007; IUCN Species Survival Commission, 2007). More than 30 years ago, the World Wildlife Fund and the IUCN formed The Wildlife Trade Monitoring Network (TRAFFIC) to monitor and control global trade in wild species, including those used for medicinal purposes. TRAFFIC and the U.S. National Park Service have published several reports documenting overcollection threats to wild species on U.S. public lands (Robbins, 1999).

Examples of Species at Risk

Examples of species that have been identified as imperiled in the wild include:

• Slippery elm (*Ulmus rubra*): The gummy lining of the bark of the slippery elm has long been used in North America, especially Appalachia, as a soothing agent for coughs, gastrointestinal ailments, and skin irritations. But now, slippery elm and other herbal products that were once used seasonally by locals are in demand by millions. Slippery elm wood has no commercial value, so trees are stripped of bark and then left to die. Approximately 12 trees are sacrificed for each 50 pounds of dried bark. Fifty-pound bags of bark can command as much as $150. This species has been identified at "at risk" by the U.S. Forest Service, the U.S. Park Service, and the National Center for the Preservation of Medicinal Herbs (NCPMH) (Associated Press, 2006).

Who knows, or can say, what potential cures for cancer or other scourges, present or future, may lie locked up in the structures of plants which may yet be undiscovered, much less analyzed?… Sheer self-interest impels us to be cautious.

— From U.S. Congressional deliberations on the bill introducing the Endangered Species Act, 1973

Ginseng roots

Photo courtesy Kathryn A. Lynch and Eric T. Jones

• American ginseng (*Panax quinquefolius*): Sales of wild and cultivated ginseng exceed $25 million each year in North America, with wild ginseng seen as the more desirable type. Wild ginseng is so much more profitable than cultivated ginseng that there is great concern about the decline and imperilment of the species in the wild (U.S. Forest Service, 2001). This species is regulated under CITES.

• Yew (*Taxus* species): Yew trees, including the Pacific yew (*Taxus brevifolia*) and Chinese yew (*Taxus chinensis*), are used to produce the popular, profitable, and effective cancer drug taxol. CITES has identified several yew species as in need of protection from overharvesting for international trade.

Black cohosh in flower
Photo by Jeff McCormack/gardenmedicinals.com

At current extinction rates, experts estimate that the Earth is losing at least one potential major drug every two years.

• Black cohosh (*Cimicifuga racemosa*): This member of the buttercup family has traditionally been used to treat a variety of conditions including colds, pain, rheumatism, and menopause. Nearly 100 percent of black-cohosh supply comes from wild harvesting. The species has been identified by the U.S. Forest Service and other institutions as at risk from overharvesting and habitat degradation (U.S. Forest Service, 2001).

• Goldenseal (*Hydrastis canadensis*): This buttercup-family member has numerous traditional uses as a tonic and to treat ailments such as hemorrhoids. According to the NCPMH, more than 60 million goldenseal plants are being harvested annually without being replaced, and goldenseal is already considered rare, threatened, or endangered in many states and by CITES (see NCPMH Web site; U.S. Forest Service, 2001). International trade in this and many other species is regulated under CITES to prevent overharvesting from the wild (see www.cites.org).

Examples of Naturally Derived Medicines

The following tables show a small portion of the species used to make popular — and profitable — naturally derived medicines. Some examples of non-plant medicinal species are included.

Plant-derived Medicines

DRUG	MEDICINAL USE*	SOURCE **	PLACE OF ORIGIN
Aloe	Treatment of burns and wounds	*Aloe* species (Marinelli, 2005)	South Africa, Arabian Peninsula
Aspirin	Pain relief, promotion of heart- health, blood thinning	Willow (*Salix* species) (Tuxhill, 1999)	Europe
Black cohosh	Treatment of hormonal disorders, rheumatism	Black cohosh (*Cimicifuga racemosa*) (Marinelli, 2005)	Eastern United States and Canada
Bloodroot	Treatment of skin disorders and cancer	Bloodroot (*Sanguinaria Canadensis*) (Robbins, 1999)	Southeastern United States
Camphor	Rheumatic pain relief	Camphor tree (*Cinnamomum camphora*) (Tuxhill, 1999)	Asia
Codeine	Pain relief, cough suppression	Opium poppy (*Papaver somniferum*) (Online Medical Dictionary, 2007)	Southeastern Europe, western Asia
Colchicine	Cancer and gout treatment	Autumn crocus (*Colchicum autumnale*) (Tuxhill, 1999)	Eurasia
Devil's club shrub	Infection cure, diabetes and tuberculosis treatment	*Oplopanax* species (Marinelli, 2005; MPWG, 2007)	Western North America
Digitalis	Heart failure treatment	European foxglove (*Digitalis purpurea*) (Tuxhill, 1999)	Europe

DRUG	MEDICINAL USE*	SOURCE PLANT**	PLACE OF ORIGIN
Gamma-linolenic acid	Eczema, cancer, and nerve-damage treatment	Evening primrose (*Oenothera biennis*) (Online Medical Dictionary, 2007)	North America
Hoodia	Weight loss	Hoodia plant (*Hoodia gordonii)* (Online Medical Dictionary, 2007)	South Africa
Irinotecan	Colon cancer treatment	Xi shu tree (*Camptotheca acuminata*) (Online Medical Dictionary, 2007)	China
Madagascar periwinkle	Treatment of leukemia, Hodgkin's disease, and other cancers	Madagascar periwinkle (*Catharanthus roseus*) (Daily, 1997)	Madagascar
Pseudoephedrine (Pseudophed)	Bronchodilation, nasal decongestion, allergies	Ma huang shrub (*Ephedra sinica*) and other plants and fungi; (Tuxhill, 1999)	China
Pilocarpine	Glaucoma treatment	Jaborandi plant (*Pilocarpus* species) (Online Medical Dictionary, 2007)	Amazon Basin
Quinine, quinidine	Malaria and heart-disease treatment	*Cinchona* species (Tuxhill, 1999) (Online Medical Dictionary, 2007)	South America
Scopolamine	Sedation, motion-sickness reduction	*Datura* and *Solananceae* species	Americas
Shikimic acid (e.g., Tamiflu)	Cure of viral diseases (influenza)	Star anise (*Illicium verum*) (Laurance, 2005)	Asia

* Neither the Native Plant Conservation Campaign nor the Center for Biological Diversity has verified the effectiveness of these products.

** Forms of some substances derived from these species are also poisonous.

Plant-derived Medicines, Continued

DRUG	MEDICINAL USE*	SOURCE PLANT**	PLACE OF ORIGIN
Slippery elm bark lining	Relief of coughs, gastrointestinal ailments, skin irritations	Slippery elm (*Ulmus rubra*) (Associated Press, 8/9/06)	Southeastern United States
Taxol	Treatment of breast and other cancers	*Taxus* species (Medicinal Plant Working Group, 2007)	North America, Asia
Tazopsine	Malaria treatment (in development)	*Strychnopsis thouarsii* bark (Carraz et al., 2006)	Madagascar
Topotecan	Ovarian and lung cancer treatment	Xi shu tree (*Camptotheca acuminata*) (Steenhuysen, 2007)	China
Tubocuranine	Surgical muscle relaxation	Curare vine (*Chondrodendron tomentosum*) (Online Medical Dictionary, 2007)	South America

Bloodroot flower

Medicines Derived From Other Species

DRUG	MEDICINAL USE*	SOURCE **	PLACE OF ORIGIN
Byetta	Diabetes treatment	Gila monster (*Heloderma suspectum*) saliva (McClain, 2005)	Southwestern United States
Penicillin	Bacterial infection cure	*Penicillium* fungus species(Abramovitz, 1997)	Widespread

Aloe vera
Photo by Anna Mirocha

* Neither the Native Plant Conservation Campaign nor the Center for Biological Diversity has verified the effectiveness of these products.

** Forms of some substances derived from these species are also poisonous.

Conclusion and Recommendations

Habitat loss and unchecked commercialization of wild medicinal plants is threatening the future of vital resources, as well as the beauty, diversity, and natural heritage of our planet. As wildlands are destroyed or degraded, we lose unique and precious species, from flowers to frogs to butterflies, and with them potential resources to combat hunger, poverty, natural disasters, and social and economic insecurity. This loss of diversity may also take with it important cures for diseases — both those we face now and those that may emerge in the future. Unchecked commercialization may render important traditionally used medicinal plant resources inaccessible and unaffordable to populations that have relied on them for centuries — as well as to the rest of the world.

When President Nixon and Congress enacted the Endangered Species Act in 1973, they recognized that species conservation and human survival go hand in hand. Congress' deliberations leading up to the passage of the law emphasized this point. The House Committee on Merchant Marine and Fisheries, in explaining the need for H.R. 37 — a bill that contained the essential features of the subsequently enacted Endangered Species Act — stated:

> *As we homogenize the habitats in which these plants and animals evolved, and as we increase the pressure for products that they are in a position to supply (usually unwillingly), we threaten their — and our own — genetic heritage. The value of this genetic heritage is, quite literally, incalculable....*
>
> *From the most narrow possible point of view, it is in the best interests of mankind to minimize the losses of genetic variations. The reason is simple: they are potential resources. They are keys to puzzles which we cannot solve, and may provide answers to questions which we have not yet learned to ask.*
>
> *To take a homely, but apt, example: one of the critical chemicals in the regulation of ovulations in humans was found in a common plant. Once discovered, and analyzed, humans could duplicate it synthetically, but had it never existed — or had it been driven out of existence before we knew its potentialities — we would never have tried to synthesize it in the first place.*
>
> *Who knows, or can say, what potential cures for cancer or other scourges, present or future, may lie locked up in the structures of plants which may yet be undiscovered, much less analyzed? … Sheer self-interest impels us to be cautious.*
>
> — Report of the House Committee on Merchant Marine Fisheries, July 27, 1973

Our responsibilities are clear:

We must re-commit ourselves to conservation of our remaining wild species and wild places so that the loss of these resources is minimized.

For those species that are in commercial use, we must adopt and implement sustainable-use and cultivation measures. Such methods are already being developed through the Convention on Biological Diversity, CITES, the National Center for the Preservation of Medicinal Herbs, ISSC-MAP, the Medicinal Plant Working Group, and other initiatives and organizations (see "Web Sites").

The ISSC-MAP, for example, proposes a series of actions including:

• the mapping of wild populations of commercial species;

• the conservation and restoration of their habitat;

• compliance with all applicable laws and regulations such as state and federal Endangered Species Acts, public land use policies, harvesting prohibitions, permitting requirements, and quantity limitations;

• working with local and indigenous communities to learn and respect their rights, traditions, and practices;

• the development and implementation of responsible and sustainable management practices; and

• the development and implementation of responsible business practices.

The Global Convention on Biological Diversity Article 8 (j) on Traditional Knowledge, Innovations and Practices proposes curbing overexploitation and destructive bioprospecting by developing procedures:

• to ensure that indigenous and local communities obtain a fair and equitable share of the benefits arising from the use and application of their traditional knowledge;

• to ensure that private and public institutions interested in using such knowledge obtain the prior informed approval of indigenous and local communities;

• to regulate how impact assessments are carried out regarding any proposed development on sacred sites or on land and waters occupied or used by indigenous and local communities; and

• to assist governments in the development of legislation or other mechanisms to ensure that traditional knowledge and its wider applications are respected, preserved, and maintained.

The recognition of the value of medicinal species and of our remaining biological diversity in general must be incorporated into our laws, as well as our land and resource management methods, through adoption of these types of priorities, management practices, and philosophical frameworks. Unless we act now, we are doomed to lose countless life-saving treasures, often without even knowing of their existence. No intelligent species should needlessly risk its future through thoughtlessness and waste.

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Plant Conservation Alliance Medicinal Plant Working Group (MPWG): www.nps.gov/plants/medicinal/plants.htm.

National Center for the Preservation of Medicinal Herbs (NCPMH): home.frognet.net/~rural8/frames2.html.

International Standard for Sustainable Wild Collection of Medicinal and Aromatic Plants (ISSC-MAP): www.forum-essenzia.org/PDFs/ISSC-MAP.pdf

Herb Society of America: www.herbsociety.org.

United Plant Savers: unitedplantsavers.org.

Ohlone Medicine (Cabrillo College, CA): www.cabrillo.edu/~crsmith/OhloneMed.html#anchor5.