Chapter 9

Ethnobotany: The Study of People–Plant Relationships

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INTRODUCTION

Ethnobotany's development has challenged the prevailing trend in academic studies of the twentieth century of disciplinary specialization. It reflects congruence with our human efforts to understand our place in the world. It parallels other interdisciplinary fields: environmental history, political ecology, cultural ecology, environmental ethics, ecological economics, and ecological restoration.

Linked to ethnobotany are taxonomy, nutrition, pharmacognosy, phytochemistry, palynology, ecology, and conservation biology. Ethnobotany has also been constructed to include studies of those life forms traditionally, but no longer, considered as plants: algae,

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lichens, and fungi. On the social sciences and humanities side are anthropology, political science, geography, environmental studies, economics, psychology, linguistics, and philosophy, among others.

Ethnobotany can lead to a fascinating and fulfilling career, whether in a university, a community, government, international agencies, or non-government organizations. There is room for people who enjoy analytical and statistical methods, for those who prefer qualitative methods, and for those who like to use multiple-method approaches. Although some ethnobotanical studies can be conducted in a botanical, archaeological, linguistics or computer laboratory or in a herbarium (where plant specimens are identified and stored as records), most ethnobotanists find that working collaboratively with other people at a personal and community level is a major and essential part of research in ethnobotany. Most ethnobotanical research requires fieldwork in the outdoors for at least part of any project. Participatory research is common.

Methods that ethnobotanists employ include: note taking, photography, tape and video recording, statistics, collecting and preparing plant specimens, microscope work, analysis of nutrients and plant chemicals, genetic studies, and ecological survey work. Presentation of results is by writing for publication, giving public presentations, conducting workshops, teaching, and outreach. Collaborative work between academic ethnobotanists and Indigenous or other local plant and cultural specialists can benefit both communities and researchers. Ethnobotanical studies need not be confined to far-away places or different cultures; people everywhere have knowledge of plants.

Ethnobotany has achieved a relatively high profile in recent years. A quick web check of "ethnobotany" in October 2008 revealed that there were 669,000 Google hits for this term, 33,000 more than in a similar search in March 2005. The exotic nature of some ethnobotanical studies, notably the work of ethnobotanists such as Richard Evans Schultes (Schultes and Hofmann 1987) and his students such as Wade Davis (1997) and Mark Plotkin (1993) with remote peoples and plants of the South American Amazon, has captured the imagination of many, and has even resulted in Hollywood images of ethnobotanists in romanticized situations, interacting with new tribal peoples in far-away jungles and "discovering" new medicines for treating cancer or other difficult diseases. While there is an undeniable lure of adventure in ethnobotanical research, it is the recognition of the critical importance of the diversity of environments and human knowledge systems based on them that drives these and other ethnobotanists in their work. Most ethnobotanists love plants and diverse ecosystems, and have a deep interest in human adaptations and innovations, which allow some people to live in places where many others would not be able to survive. Most ethnobotanists believe that the collective environmental knowledge of humanity is essential in efforts to conserve the earth's biodiversity. Certainly, one of the striking correlations that Wade Davis (2001) and other ethnobotanists have helped to identify is the close correspondence between the earth's biological diversity and its cultural diversity (Carlson and Maffi 2004). Regions of high biological diversity in the world correlate strongly with the regions of highest linguistic and cultural diversity (Stepp et al. 2005).

THE DEVELOPMENT OF ETHNOBOTANY

In 1893, a unique collection of botanical objects exhibited at the Chicago World's Fair caught the attention and imagination of John W. Harshberger, an archaeologist with a keen interest in plants. This collection inspired Harshberger to propose a new field of study, written up in the *Botanical Gazette* in an article entitled "The purposes of

ethno-botany" (1896). He emphasized the significance of the World's Fair collection: "Never before in the history of American archaeology had such a completed series been brought together for study and comparison . . . plant products in the form of food, dress, and household utensils being very largely represented. . . ." He suggested that the topic it represented should become a designated area of study, "ethno-botany," which would aid in ". . . elucidating the cultural position of the tribes who used the plants for food, shelter or clothing." As a male academic of the late nineteenth century, his writings and ideas represented the state of society and anthropological thought of his day. In discussing how comparisons could be made in plant use across human cultures, he submitted, "The well-known classification of men into savage, pastoral, agricultural and civilized will roughly serve our purpose. . . ." He described the Indigenous peoples of the southwestern United States simplistically as follows: ". . . a roving people, traveling from place to place in search of game and settling only long enough to plant a little corn, beans and pumpkins to break the monotony of a too strict animal diet. Where they did not pursue agriculture, they subsisted on the seeds of wild grasses and herbs. The cliff dwelling peoples, probably driven to the mountain fastnesses, had practically left the hunter stage and had begun to enter the agricultural stage" (Harshberger 1896: 146).

Harshberger's conception of ethnobotany—recording the uses of plants by "primitive" peoples—was undeniably limited in scope, but it was a beginning. Some of his suggestions, such as creating ethnobotanical gardens that would feature culturally important plants, stimulating interest in their names and applications by various peoples, and providing specimens and opportunities for scientific study, are as relevant today as they were over a century ago. Others became captivated, and many researchers began documenting ethnobotanical knowledge of the peoples and languages they were studying.

Meanwhile, anthropology as a field was maturing and, with it, ethnobotany was also expanding its horizons. In 1994, Richard Ford published an elegant "tree-ring" schematic to represent the evolution of ethnobotany as a discipline since its inception (Ford 1994).

Harshberger's cultural evolution assumptions are no longer accepted. The shift in underlying premises has led to a more inclusive, effective, and realistic approach in ethnobotany. The beginnings of this respectful relationship are seen in the work of Richard Evans Schultes (1915–2001), whose compelling photographs and participatory research with Amazonian healers inspired a whole generation of ethnobotanists, and raised the profile, status, and legitimacy of traditional healers and other specialists both within their communities and beyond (Anderson 2001).

Ties with cognitive anthropology opened the field of ethnobotanical and ethnobiological classification, pioneered by Harold Conklin with his doctoral dissertation, *The Relation of Hanunóo Culture to the Plant World* (1954), which reflected meticulous research and observations of one agricultural group in the Philippines. Conklin discovered a surprisingly extensive lexicon of plants, consisting of over 1800 terms, categorized by an elegant, hierarchical principle of organization. Brent Berlin and his colleagues (Berlin 1972, 1992; Berlin et al. 1966) followed with numerous proposals of universal principles of classification and nomenclature applicable across human languages. During the 1970s and 1980s, researchers constructed and contested theories of human cognition *vis-à-vis* ethnological evaluations of culturally salient plants and their corresponding names and uses (Brown 1984; Dougherty 1978; Hunn and Brown, 2011). The cognitive dimension of ethnobotany is relevant to understanding interrelations between language, thought, and memory in human societies (Nolan 2002, 2007; Shipman and Boster 2008).

Studies of the role of plants in folklore, narrative, ceremony and worldview have emerged within ethnobotany, and the variation in knowledge and perspectives of plants

across societal subgroups based on age, gender, social status, and specialization has also gained interest (Table 9.1). As the environmental movement became prominent in the late 1960s and early 1970s, ethnobotanists examined the role of a people's knowledge of plants and environments in the areas of conservation, and how a culture's underlying philosophy and worldview can influence its collective behavior towards other species and the environment in general. This area of focus was certainly strengthened by the publication of the Brundtland Commission report, *Our Common Future* (United Nations Commission on Environment and Development 1987), which emphasized the need to recognize Indigenous and local peoples' knowledge systems in our global search for sustainability and biodiversity conservation. Since this time, Traditional Ecological Knowledge (TEK), including diverse traditional land and resource management methods, has been a prominent and important aspect of ethnobotanical studies (Anderson 2005b; Deur and Turner 2005; Minnis and Elisens 2000; Nazarea 1999). Ethnobotany has become more and more international in its development. Ethnobotanical researchers are prominent in many countries of the world, especially in India, where there are said to be more ethnobotanists *per capita* than in any other country (see Jain 2002).

The international status of ethnobotany in the twenty-first century was prominently reflected in August 2005 at the Fourth International Congress of Ethnobotany, held in Istanbul, Turkey. Hosted by Yeditepe University, with ethnobotanist Z. Füsun Ertug as Congress Secretary, the Congress theme, "Ethnobotany: At the Junction of the Continents and the Disciplines," highlighted the strategic location of ethnobotany at the intersections of disciplines, knowledge systems, cultures, and regions. Ethnobotanists attended this congress from dozens of different countries, from Nepal to Argentina, from Mexico to Iran (Ertug 2006).

Table 9.1 Examples of Some Contemporary Ethnobotanical Research

Topic within ethnobotany	Notes on topic	Some example references
Paleoethnobotany	Ethnobotany of past cultures, including traditional management systems for plant resources	Ford 1978, 1985; Fritz 2005; Lepofsky et al. 2003; Minnis 1991; Minnis and Elisens 2000; Peacock 1998; Pearsall 2001
Historical ecology	Understanding people–plant relationships through time and space	Balée 1998; Ellen 2006; Minnis and Elisens 2000
Nutritional ethnobotany and foodways	Identification and description of nutritional components of native plants in human diet and medicine	Anderson 2005a; Etkin 2006; Johns 1996; Pieroni and Price 2006
Medical ethnobotany	Assessing bioactivity of medicinal plant compounds; designating the cross-cultural applications and significance of botanical families	Etkin 1990; Moerman 1991, 1996; Quinlan 2004; Quinlan et al. 2002; Stepp 2004
Ethnobotanical classification systems	Discovering universal systems of naming and categorizing living things; calibrating folk and scientific thought	Berlin 1992; Brown 1984; Hunn 1982, 1990

(*Continued*)

Table 9.1 (*Continued*)

Topic within ethnobotany	Notes on topic	Some example references
Cognitive ethnobotany	Studying distribution and forms of plant knowledge, learning styles, knowledge transmission	Ingold 2004; Nolan 2002, 2007; Sanga and Ortalli 2004; Zarger and Stepp 2004
Symbolic ethnobotany	Examines plants through ritual in folkloristics and ceremonial healing	Quave and Pieroni 2007; Vildarich 2007
Sensory and perceptual ecology	Focuses on human sensory recognition of plants and perceptual distinctiveness	Alcorn 1994, 1995; Boster 1985; Casagrande 2004; Jernigan 2006
Quantitative and experimental ethnobotany	Measuring biodiversity within geographic regions, applying multivariate statistics to assess the use potential of botanical families, genera, and species	Anderson 1993a,b; Martin 1995; Prance et al. 1987; Stepp et al. 2005; Ticktin et al. 2002
Intellectual property rights	Negotiation of legal rights pertaining to Indigenous botanical wisdom, building equitable partnerships	Brush 1996; Moran et al. 2001
Evolutionary ecology	Demonstrates how ethnobotanical knowledge relates to human cognitive development, adaptation, and survival through time and space	Atran et al. 2004; Ellen 2006; Mithen 2006
Interpretive ethnobotany and traditional ecological knowledge	Emphasizes traditional wisdom and philosophies, highlights Indigenous teachings and narratives regarding native plant sustainability	Turner 2006, 2008
Ethnobotany and agrodiversity	Investigating germplasm conservation; implementing "seed banking" of local cultivars to propagate variation and choice in regional cultures	Balick 1996; Brush 2004; Campbell 2005; Nazarea 1999; Veteto and Skarbø 2009
Traditional agricultural systems	Interprets traditional cultivation strategies for selected cultivars, shifting subsistence practices, adaptations to seasonal stress	Estabrook 1998; Nabhan 1989
Ethnobotany and conservation	Identifying and safeguarding biota in accordance with Indigenous priorities	Cunningham 2001; Minnis 2000; Rea 1997
Political ecology	Examines local access to plant resources, institutional policies, dimensions of management and control, grassroots activism	Anderson 2000; Nabhan 2002
Historic migrations and ethnobotany	Analyzes how human movements relate to ethnobotanical cultural memory of economic botany	Pieroni and Vanderbroek 2007; Ramirez-Sosa 2009

Note: The references are examples only; most of these areas are represented by dozens of associated research projects and publications, many of them published in the *Journal of Ethnobiology*.

One of the most important current tasks is the development of ethical protocols for the study of traditional ecological knowledge, or TEK (see Bannister and Hardison, 2011; Gilmore and Eshbaugh, 2011). Traditional ecological knowledge is associated, among other things, with biodiversity research, "bioprospecting," and cultural conservation (Alexiades and Laird 2002; Maffi 2005; Nolan and Robbins 1999; Zent 1999). Since 1990, globalization and commercialization have dramatically changed the legal environment for ethnobotanical research. No longer associated with mere list making, ethnobotanists are strategically positioned to integrate the priorities of community members with ecological conservation initiatives (Carlson and Maffi 2004). Ethnobotanists who work on the ground, alongside Indigenous people, are keen to recognize the value of local knowledge in addition to their social, ecologic, and economic priorities (Maffi 2005). Many ethnobotanists have begun to design partnerships to ensure that benefits will be shared in ways that are equitable and responsible (Alexiades and Laird 2002; Tobin 2002).

Ethnobotany is closely linked to ethnoecology (see Davidson and Johnson, 2011). Ethnoecology entails interpreting complex resource management strategies. The intrinsic value of diverse ways of knowing, and perpetuating local knowledge, are foci of ethnoecology. This field also emphasizes how and why human feelings, attitudes, values, memories, and emotions become associated culturally with plant-based foods, medicines, and other natural resources (Anderson 1996; Davidson and Johnson, 2011). Knowledge of regional ecosystems, when examined through expressive traditions and customs of use, can revivify resource philosophies and practices (Anderson 2005b; Salmón 2000; Timbrook 2007). Safeguarding biodiversity is a fundamental goal in ethnoecological studies, through "memory banking," which Nazarea describes as "the parallel collection and documentation of Indigenous knowledge and technologies, including uses, preferences, and evaluation criteria associated with traditional varieties of crops" (Nazarea 1998: 5). Memory banking, when pursued alongside the collection of a germplasm of staple food crops, helps ensure agronomic integrity and the genetic diversity needed to sustain human populations. To offset the impact of agricultural commercialization, ethnoecology seeks to identify and conserve local "heirloom" varieties of subsistence crops, such as the "five finger" sweet potato in the Philippines or the "moon and stars" watermelon in rural Missouri. Local cultivars are themselves representative of cultural diversity the world over (Campbell 2005; Nabhan 1989, 2002).

Another contemporary trend in ethnobotany involves the dynamics between human populations and plant foods and medicines that have historic significance in maintaining human nutrition and health. A growing compendium of edible medicines is being discovered and catalogued by ethnobotanists: chili peppers, seaweed, blackberries, and mushrooms, for example, are valued not only for their role in maintaining cultural identity as edible foods, but also for their powerful healing virtues as flavorful medicines (Etkin et al. 2011; Johns 1996; Pieroni and Price 2006). Recent discoveries of edible medicines, sometimes called nutraceuticals, and the health implications of traditional foodways serve to illustrate the breadth of ethnobotany in a world comprised of increasingly transnational communities (Etkin 2006; Pieroni and Vandebroek 2007). Work in environmental anthropology and ethnopharmacology is presently informed by the fluidity of human movement through time and space. Displaced populations are known to develop social networks to aid in the procurement of plant materials needed to retain traditional medical praxis (Volpato et al. 2007). Ethnoecologists also consider traditional plant foods and medicines in their efforts to interpret health belief systems (Quave and Pieroni 2007). Ethnoecological studies also highlight the forces that continuously shape how information is transferred from one generation to the next (Nolan 1998; Zarger and Stepp 2004; Zent 1999).

Over the past decade, ethnobotanists have focused attention toward the survival of plant-based knowledge at its source—in local communities where it is rendered especially meaningful (Thompson 2004; Turner et al. 2008). Encouraging headway can also be seen through grassroots organizations such as CIBA (California Indian Basketweavers' Association), the Northwest Native American Basketweavers Association, and the Cherokee Native Plants and Arts Society in Oklahoma. These examples of contemporary ethnobotany in practice share a holistic and multidisciplinary approach that is increasingly necessary for the advancement of human wellbeing on multiple levels—physical, spiritual, nutritional, and emotional.

METHODS IN ETHNOBOTANY

Over the past 40 years, the scope of methods in ethnobotany used to assess relationships between people and plants has broadened significantly. The first task for many ethnobotanists is to develop a research question that can be investigated during a feasible period of time. Questions might be general, such as, "Which wild plant foods are consumed most frequently among the North Carolina Lumbee Indians?" Or they might be more specific, such as, "Why is river cane (*Arundinaria gigantea*) a culturally important plant species, threatened in the Cherokee Nation of Oklahoma?" Other questions extend or advance prior discoveries, for example: "What can Native or Indigenous communities do to protect culturally significant species from overexploitation in the Pacific Northwest?" Researchers often base their work on hypotheses, which can be tested by using one or more lines of evidence and methods.

Choosing a research site goes with the selection of questions the ethnobotanist seeks to answer. Students who are new to the field may begin their inquiry on a local level, which ensures affordable access to research settings, such as Native American communities in Canada, the United States, or Latin America, or traditional communities wherever the student may happen to live. Conducting fieldwork "locally" is valuable on two levels. First, it inspires appreciation for cultures and ecosystem conservation in the researcher's own homeland. Second, it provides ample opportunity for researchers to familiarize themselves with the toolkit of techniques they will use in future studies. Emerging ethnobotanists may develop interest in and commitment to other peoples and places through university seminars, field schools, and local cultural events that expose them to very different cultural and geographic settings.

Many ethnobotanical studies proceed through a technique known formally as participant observation, an approach commonly used among ethnographers who work with Indigenous peoples. This is a methodology in which ethnobotanists adopt the lives and daily routines of the people they wish to learn about. It entails participating in day-to-day activities, such as household chores, collecting water and fuel, helping out in the garden, or going fishing, hunting, or gathering and preparing food with community members. While offering a chance to develop rapport, friendship, and goodwill with others, participant observation yields obvious insights for ethnobotanists who seek to understand the meaning of plants in everyday life. Valuable personal experiences with people and plants can be documented, recorded, or videotaped (only with permission, of course) as they occur in context. Subtleties of people–plant interactions, when observed and examined in this manner, can lead to larger discoveries about local systems of plant cultivation, harvesting, fertilization, utilization, and management (cf. Turner et al. 2000; Deur and Turner 2005). By actually doing what local people do, the researcher learns much that is so "obvious" that local people would never think to mention it in interviews!

As a general rule, most community members, including children, know something valuable about ambient flora, whether wild, cultivated, or semi-cultivated (Zarger 2002). Therefore it is advisable to undertake an assessment of the full range of botanical knowledge existing within a population. One technique for identifying "experts" is to collect enough data to develop a consensus of intracultural agreement regarding the names of plants used frequently among members of a cultural group. These individuals, known as key respondents, represent the culmination of generations of expertise in their home communities. Of course it is important to remember that some individuals may have expertise in one area of ethnobotanical knowledge, and some in another. Men and women, for example, usually hold differing knowledge and experience in relation to ethnobotany (cf. Howard 2003). Consulting with key respondents, formally or informally, generates insights about the total constellation of plants known among a social group. They may convey messages about threatened species, once abundant but suddenly scarce, or the social forces deemed responsible for changes observed in species diversity and distribution. Important local priorities about natural resource conservation often emerge through repeated conversations with expert respondents. Other concerns regarding intellectual property rights may also become apparent through the course of rapport building (e.g., Bannister and Hardison, 2011; Brush 1996; Gilmore and Eshbaugh, 2011).

Community elders are frequently the bearers of the largest amounts of native plant knowledge. Other personal demographic factors are considered when respondents are sought out for consultation. Resident healers, for instance, are sometimes available and willing to share their wisdom. In instances when the healer provides the names and applications of therapeutic species, the ethnobotanist inquires about the respondent's wishes regarding the dissemination of this valuable information. Ethnobotanists are responsible for the ethical management of all information entrusted to them. Cultural knowledge of plants is at once a personal and collective construction of knowledge, composed of peoples' experience with plants and of the broader social understanding of what plants "mean" to those who use them in any society. Modernization can lead to erosion of knowledge among members of industrial societies and remote ethnic groups alike. New techniques for assessing ethnobotanical knowledge change have recently been identified (e.g., Zent and López-Zent 2004). Ethnobotany is thus capable of generating historical and ecological texts of people–plant interactions.

Ethnobotanists should, whenever possible, and with the permission of the community, collect "voucher specimens" of the plants they document through the interview process. For actual botanical identification and research, vouchers are *necessary.* Generally, collection is conducted under the supervision of expert respondents and, if required, with the collaboration of a translator. Voucher specimens aid the researcher in the scientific identification needed to confirm the alignment of folk names with scientific species of culturally significant taxa in a region. Most voucher specimens are recorded and catalogued for future reference, then dried, preserved, and deposited in a herbarium (see Martin 1995). It is often desirable to make duplicate collections, so that one set can remain in the community where the plants originated. Photographs are also helpful in this regard. *Since special permits are generally required when specimens cross national borders, ethnobotanists must consult with customs officials accordingly before they proceed.* Researchers can examine collections using novel microscopic, chemical, or genetic techniques. Thus, as new knowledge becomes available, the collections—together with the information recorded with them—become even more valuable as concrete representations in ethnobotanical knowledge systems.

Photographs of local flora can be useful reference tools for determining the distribution of plant knowledge among a community (Thomas et al. 2007). Ethnobotanists have

also employed model building in their collective studies of human–plant interactions. Reenactments and replicas of subsistence and food processing and other activities in archaeobotany have been fruitfully employed (Martin 1995), alongside multi-scale mapping, assessing disturbance regimes, controlled burns, and soil development as they relate to the agricultural sciences. Ethnobotanists borrow sophisticated tools of inquiry from quantitative biology, for example, in assessing the economic value of plant resources harvested in various sectors of Africa (Cunningham 2001). This entails the analysis of botanical commodities in the broader exchange market, and their relationships to social networks to determine how goods and benefits are distributed among community members. Such efforts become increasingly generative and collaborative, and thus call for multidisciplinary efforts from ecologists, conservation biologists, linguists, cartographers, statisticians, and economists, alongside local communities.

CLASSIC CASE STUDIES AND THEIR CONTRIBUTIONS TO ETHNOBOTANICAL PRAXIS

Intergenerational Research in Medical Ethnobotany

In 1979, ethnobotanist Daniel Moerman set out to examine the bioactivity of Native North American plant medicines as recorded by generations of ethnographers and ethnologists. Moerman's quest to demystify Native medicine would become a seminal work in medical anthropology (Moerman 1979). Moerman applied a simple regression analysis to determine whether Native American plant medicines are distributed randomly, as the "placebo effect" might suggest, or if they occur in potentially meaningful, statistically relevant patterns throughout the plant world. Moerman's effort pulled together many decades of folk pharmacology to reveal medical applications that transcend social, ethnic, and linguistic boundaries of Native North America. His subsequent publications advanced and confirmed these findings by identifying evolutionary properties that explain why families of medicinal plants, such as the rose (Rosaceae), bean (Fabaceae), and mint (Lamiaceae) families are prominent. These families produce alkaloids and other compounds with bioactive properties that serve as chemical defenses against insect predation. When prepared and administered to the patient in accordance with culturally prescribed traditions, certain species within these families are now known to render efficacious physiologic effects which, as Etkin (1993) asserts, are experienced by individuals in ways that are culturally constructed. More recently, ethnobotanist John Richard Stepp joined forces with Moerman to extend earlier findings regarding the distribution of medicinal species, many of which occur as weeds in disturbed forest regions (Stepp and Moerman 2001). Stepp (2004) also discovered that the weeds found within disturbed regions of ecosystems yield a higher proportion of pharmacologically active compounds than would be expected by chance. Stepp continues to generate innovative discoveries in medical ethnobotany through the application of Geographic Information Systems (GIS) technology to reveal regions of the world where cultural, linguistic, and ecological diversity correlate and overlap.

Using Paleoethnobotany to Understand the Past: Ötzi and Kwäday dän Ts'inchí

In paleoethnobotany—the ethnobotany of past human societies—chance discoveries often lead to amazing insights about how our ancestors lived. In 1991, a fully intact human

body was discovered melting from a glacier in the Tyrolean Alps, at the border of Italy and Austria, over 3200 m elevation. Named *Ötzi* after the Ötztal Alps where he was found, he died at around the age of 46 about 5200 years ago: the earliest intact human body known to date. Some time after he was found, an arrowhead embedded in his back under the left shoulder was detected, which had probably caused his death.

Then, in 1999, the body of a young man, probably in his late teens when he died, was discovered by hunters at the foot of a glacier in far northwestern British Columbia, in the upper Alsek River watershed in the Tatshenshini-Alsek Park, about 85 km from the seacoast just inland from Yakutat, Alaska. Named *Kwäday dän Ts'inchí* (Long Ago Person Found) in the language of the Southern Tutchone, he had died approximately 550 years ago, from unknown causes (Beatty et al. 2000).

Who were these ancient mountain travelers? What were they doing when they died? How far, and from where, had they traveled? These key questions, and paleoethnobotany have played an important role in answering them, particularly through the work of James Dickson and his colleagues (Dickson et al. 2003, 2004). Studies of artifacts and visible plant, animal, and fungal remains, and microscopic examinations of pollen, moss fragments, silt and minerals, and other materials within their digestive tracts and in association with the bodies of these men have revealed important evidence, including of what they had eaten in the hours before their deaths, and where they had probably lived their lives.

Ötzi was found to have eaten the meat of ibex and red deer, cereal, and other plant food prior to his death. A whole array of belongings was found with him, including a number of artifacts of different woods: an axe with a yew wood haft and copper blade; an unfinished bow of yew wood (*Taxus baccata*), over 1.8 m long; arrows with shafts of the wayfaring tree (*Viburnum latana*), mostly unfinished; a dagger with an ash wood (*Fraxinus excelsior*) handle; and a pack frame of bent hazel wood (*Corylus avellana*). He was carrying sloe plums (*Prunus spinosa*) and two birch-bark vessels, one to carry embers. He had wrapped pieces of charcoal in fresh maple leaves (*Acer* sp.). He was carrying two kinds of fungus, *Fomes fomentariaus* and *Piptoporus betulinus*, possibly for tinder or medicine. His clothing was carefully fitted and stitched and included a cape with a grass weft and a warp of the bast fibers of lime, or basswood (*Tilia* sp.), and goatskin shoes with bearskin soles lined with grass. Over 80 species of bryophytes in Ötzi's digestive tract and surroundings were identified by Dickson, and two of them, *Neckera complanata* and *N. crispa*, helped (along with the style of axe and his flints), to pinpoint his origin from South Tyrol, rather than from Austria. The pollen of hop-hornbeam (*Ostrya carpinifolia*) and hazel in his gut and other evidence indicated that he had died in early summer (Dickson et al. 2003).

The story of *Kwädāy dän Ts'ìnchí* is equally compelling. His belongings were of both coastal and interior origins: a sewn cape of interior style made from skins of Arctic ground squirrel (*Spermophilus parryi*), a species common only in the interior; and a twined spruce root hat (probably *Picea sitchensis*) of Tlingit style. A high proportion of the pollen in his stomach and intestine was of Chenopodiaceae, concluded to be that of glasswort, *Salicornia depressa*, a coastal marsh species whose pollen was also present on his ground squirrel cape. Cultural associations with this species were determined through ethnobotanical consultations with elders of Champagne-Aishihik, Tagish, Gwitch'in, and Tlingit First Nations (Mudie et al. 2005). This pollen, added to other evidence (i.e., a fruit of mountain sweetcicely *Osmorhiza berteroi*, and a needle of mountain hemlock, *Tsuga mertensiana*, pollen of Sitka spruce, *Picea sitchensis* and western hemlock, *Tsuga heterophylla*, and scales of four-year-old chum salmon, *Oncorhynchus keta*, all coastal species, on his cape; a fragment of *Sphagnum imbricatum*—a coastal bryophyte species, in his gut; and a skeleton fragment of a large crustacean from his stomach), indicate that he had been on the coast recently previous to his travels (Dickson et al. 2004). Bone and hair isotope data indicate

that he had lived on marine food, mainly fish and marine mammals, for most of his life, but had spent time inland for a few months before he died. These are just two of many examples of how ethnobotany contributes to our understandings of past human lifeways.

Solving the Mystery of a Notorious Illness: Ethnobotany and Cycad Toxicity

Sago palm (*Cycas revoluta*) and other cycads (*Cycas* spp.), sometimes called seed ferns, are commonly grown as house and greenhouse ornamentals, as well as outdoors in warmer areas. In some parts of the world—for example, Australia and the South Pacific—humans have used the seeds of cycads as a food source, but only after prolonged processing, since the raw seeds are known to be toxic. Various animals also consume cycad seeds, however. For example, flying foxes, large fruit-eating bats of the genus *Pteropus*, forage on the seeds of a tree cycad, *Cycas micronesica*. Knowing about cycad seeds as fruit bats' food enabled ethnobotanist Paul Alan Cox and his colleagues (Cox et al. 2003) to determine the cause of a deadly affliction of the Chamorro Indigenous People of the Pacific island of Guam.

The Chamorro population has suffered from a disease called ALS-PDC (amyotrophic lateral sclerosis/parkinsonism–dementia complex), which causes deterioration of the muscles and nervous system with effects similar to the well known "Lou Gehrig's Disease," at 50–100 times the average incidence in other populations throughout the world. Cox and his colleagues determined, first of all, that a major source of cycad toxicity originates not in the plants themselves, but in cyanobacteria (formerly known as blue-green algae). These organisms live in a symbiotic relationship in specialized coralloid roots of cycads and produce a non-proteinogenic amino acid called beta-methylamino-L-alanine (BMAA), which is highly toxic and particularly affects the nerves and spinal cord. BMAA is taken up by the host cycad and is concentrated in its seeds, especially in the outermost seed layer. These researchers determined that BMAA is further bioaccumulated when animals eat cycad seeds; flying foxes accumulate BMAA in their flesh at over twice the levels found in the cycad fruits. Finally, the researchers noted, fruit bats have been a prized food item of the Chamorro, who boil them in coconut cream and eat them whole. This practice, then, was identified as the source of the high incidence of neurodegenerative disease for the Chamorro. Cox et al. (2003) note that BMAA has also been found in the brain tissues of Alzheimer's patients from Canada, suggesting alternative pathways for bioaccumulation of this compound in aquatic or terrestrial ecosystems. Nevertheless, one cause of the disease—linking toxins from cyanobacteria to people through cycads and fruit bats—is now determined, and this is a major breakthrough in our understanding of the risks and benefits of human food systems.

CONCLUSION

Ethnobotany started as a rather narrow and limited field of study, comprised initially of inventories of useful plants and their corresponding uses among Native peoples. Yet there is perdurability within people–plant relationships that has captured and maintained the attention of people from all walks of life, from all reaches of the world. Furthermore, what would appear as a simple and straightforward study of human–plant relationships expands to tell the stories of humans' place in the world and their ties to each other. Historically, ethnobotany is a field of study defined by a merging of botany and ethnology. Like its parental disciplines, ethnobotany has evolved significantly since its inception, and is

serving new purposes in the twenty-first century. Environmental degradation and resource mismanagement, accompanied by an even more precipitous erosion of linguistic and cultural diversity, have fueled creative and progressive goals in the minds and hearts of ethnobotanists, whose work typically involves social concerns for sensible, sustainable, mutually compatible strategies to maintain cultural diversity and biodiversity for the benefit of present and future generations. More than ever before, collaboration and partnership are being promoted with Indigenous and local communities, and ethnobotanists have involved themselves in the struggle to preserve the integrity of both cultures and languages and the environments in which they are situated.

This supportive function will undoubtedly continue and strengthen in the coming years, as Indigenous peoples and local communities, governments, educators, non-government organizations (NGOs) and corporations all strive to address impending environmental degradation and cultural loss. It is a trend situated within the context of international imperatives to respect and support the rights and knowledge of Indigenous peoples worldwide. The Convention on Biological Diversity arising from the United Nations Conference on Environment and Development in Brazil (United Nations BDC 1992), and the Declaration on the Rights of Indigenous Peoples, which was adopted by the United Nations General Assembly in September 2007, contain explicit requirements for governments of Member Nations (including Canada and the United States) to respect the rights of Indigenous Peoples, and to consult and collaborate with them meaningfully in all aspects of resource use affecting their lands and territories. The Preamble to the Convention on Biological Diversity, for example, clearly recognizes the close interrelationships between Indigenous Peoples and their lands, and the critical importance of their environmental knowledge. It also recognizes the often overlooked but significant role of women as resource managers and keepers of traditional ecological knowledge.

Ethnobotanists have a major role to play at the community level, where objective approaches are especially valuable in data collection. They can also involve themselves in policy-making and legislation to ensure the recognition and protection of such knowledge. They can serve communities by providing vital information on scientific plant identification and broad-scale ecological knowledge, and by forging creative linkages to other communities with similar needs and goals of preserving and perpetuating cultural knowledge of plants and environments. They can participate in developing school and college curricula, audiovisual productions, science and cultural camp activities, museum exhibits, and locally relevant plant guides (e.g., Thompson 2004), and in establishing ethnobotanical gardens (Turner and Wilson 2006), and eco-cultural centers. They can contribute to local bioeconomic development such as sustainable harvesting of Non-Timber Forest Products (Cunningham 2001) or ecotourism ventures supported by local cultural and ecological knowledge. They can help to connect Indigenous and local communities with ethical partners for researching and marketing local products, and can also facilitate relationship building between local Indigenous peoples and other academics wishing to undertake collaborative research. They can also serve to corroborate, substantiate, and validate Indigenous knowledge in treaty and land rights negotiations (Turner 2004).

Harshberger's original concept of ethnobotany has been transformed many times over the past century, and ethnobotany in the twenty-first century promises to serve humanity well. As long as there is a need for original, careful, systematic, collaborative documentation of peoples' dynamic interactions with the plant world, for bridging social and ecological systems, for maintaining and enhancing biocultural diversity, and for reconnecting health and wellbeing with cultural and environmental integrity, ethnobotany will be a field of relevance and importance in the world.

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