



CHAPTER 4

Cultural Dimensions of Nontimber Forest Products

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4.1 Nontimber Forest Products and Culture

NONTIMBER FOREST PRODUCTS (NTFPs) provide cultural ecosystem services for peoples throughout the United States and its affiliated territories. Cultural ecosystem services of NTFPs are those tangible and intangible functions that contribute to the traditions, livelihoods, and well-being of social groups including, but not limited to, indigenous and minority communities (Daniel et al. 2012, Hernandez-Morcillo et al. 2013). The Millennium Ecosystem Assessment (2005) recognized six services of ecosystems necessary to support cultural landscapes and traditions: heritage values, cultural identity, spiritual functions, inspiration, aesthetic appreciation, and recreational tourism (Tengberg et al. 2012). Some NTFP species are so fundamental to the cultural identity of a people because of their diverse roles in diet, materials, medicine, and spiritual practices that they may be thought of as cultural keystone species, with loss of access presenting a risk to cultural survival (Emery et al. 2014, Garibaldi and Turner 2004).

For purposes of this chapter, we define culture as learned customs and traditions of thought and behavior expressed as everyday life practices, especially as these maintain social cohesion and help groups live in their biophysical environment (American Anthropological Association 2014, Barnard and Spencer 2002). Culture includes ways of thinking and acting, as well as material objects that shape and reinforce a people's shared way of life and identity. Preservation of culture and cultural identity is positively associated with human well-being (Dockery 2010) and may be particularly important in times of change and insecurity (Kassam et al. 2010, National Scientific Council on the Developing Child 2015) such as rapidly changing climatic conditions.

Cultural ecosystem services of NTFPs derive from landscapes, plant materials and mushrooms, *and* the social and economic practices that surround their use (Burger et al. 2008, de Groot et al. 2002, Fisher et al. 2008). Contributions of NTFPs and associated practices to culture and human well-being include, but are not limited to:

- Support for food, health and economic security.
- Inputs for culturally appropriate livelihood strategies.

- Materials for spiritual and ceremonial observances.
- Occasions for sharing cultural stories and teachings.
- Conservation of traditional ecological knowledge and connections to nature.
- Distribution traditions that create social cohesion and provide security for vulnerable community members.

Like all aspects of culture, NTFP practices and habitats are dynamic even as they maintain aspects of cultural continuity. Cultures may adopt the use of new species as humans and plant materials move (Emery 2002a). The technologies used in the harvest and processing of NTFPs also may change over time. For example, equipment used historically for collecting maple sap has evolved from folded and sewn birch bark vessels, to wooden and then metal buckets, to vacuum tubing. However, such developments are not unidirectional or universal, such that multiple technologies may be in use simultaneously without fundamentally altering the cultural functions of a NTFP. The choice to adapt or modify traditional methods or adopt new practices and methods to contemporary circumstances and conditions can empower NTFP harvesters (Turner 2001). Nevertheless, while the adaptive capacity of cultures are considerable, it is not limitless. The speed and intensity with which changes occur, their cumulative effects, and the resources available to communities will affect the resilience of cultural ecosystem services from NTFPs and the cultures that rely on them (Bennett et al. 2014, Berkes et al. 2000, Daniel 2012, Tengberg et al. 2012).

This chapter uses a cultural ecosystem services framework (Daniel et al. 2012, Hernández-Morcillo et al. 2013) to synthesize the literature on cultural uses of NTFPs by diverse United States communities, with reference to the implications of a changing climate. Section 4.2 provides a brief introduction to the cultural values and functions of NTFPs. Section 4.3 examines how biophysical and social factors that affect the condition and availability of NTFPs and their physical properties combine with NTFP-based practices to support cultural ecosystem services. Section 4.4 discusses potential impacts of increasing climatic variability on cultural ecosystem services provided by NTFPs. Finally, sections 4.5 and 4.6 identify gaps in knowledge about the cultural ecosystem services provided by NTFPs and potential strategies to fill these gaps. The chapter draws primarily upon research conducted in the United States and its territories,

but incorporates international literature where this provides insights relevant to the United States context.

4.2 Cultural Values and Functions of Nontimber Forest Products

Cultures that rely on NTFPs for ecosystem services make use of dozens to hundreds of species of plants and mushrooms from diverse habitats, across landscapes of many ecosystems (see appendix 1—Regional Summaries for more detailed descriptions of NTFP species, their uses, and cultural values). The material (i.e., tangible) functions of these plants and mushrooms include food, medicine, ceremonial, and utilitarian purposes. There are countless nonmaterial (i.e. intangible) services or functions NTFPs provides as well (Satterfield et al. 2013, Tengberg et al. 2012). Their cultural values are derived from social practices that surround the harvest and use of plant materials and mushrooms, including traditional teachings, ceremony, preparation, and distribution, as well as harvest. Further, their values extend beyond harvesters, as family and community members generally take part in and benefit from NTFP management and harvesting practices. NTFPs have particular salience and legal standing for many indigenous cultures. However, settler and immigrant cultures also make use of plant materials and mushrooms that grow wild, are semicultivated, or are developed and produced in agroforestry systems (e.g., cultural landscapes) of varying degrees of management intensity (Satterfield et al. 2013, Tengberg et al. 2012).

4.2.1 Indigenous Cultures and Nontimber Forest Products

There are hundreds of indigenous cultures in the United States and its affiliated islands. As of publication date there are over 560 federally recognized American Indian and Alaska Native tribes. There are many state-recognized and federally unacknowledged tribes and indigenous communities with the United States and its affiliated territories. Outside the continental United States, the Native Hawaiian Health Care Act of 1988 codified the fact that “Native Hawaiians comprise a distinct and unique indigenous people...determined to preserve...their cultural identity in accordance with their own spiritual and traditional beliefs, customs, practices, languages, and social institutions.” In addition

to federally recognized tribes, more than 300 groups have sought or are seeking Federal recognition as a tribe of the United States and affiliated territories.

The centrality of access to NTFPs for the cultural survival of indigenous peoples is illustrated by a decision of the U.S. Supreme Court, which described access to such resources as “not much less necessary to the existence of the Indians as the air they breathe” (U.S. v. Winans 1905). Access to land and the plant materials and mushrooms on them plays a central role in the capacity of any people to maintain their NTFP-based cultural practices and identity. Tribally controlled land bases, such as Alaskan Native Corporation managed land, reservations, rancherias, and allotments, range in size from several million acres to scarcely more than 1 acre. In some cases, indigenous peoples in the United States have legally retained rights to hunt, fish, and gather in their ancestral territory, although these rights may not always be fully realized. However, not all indigenous communities have land or legally specified retained rights. Further, in the 2000 Census, 64 percent of people identifying as American Indian and Alaska Native lived off Indian lands and 45 percent were urban residents (National Urban Indian Family Coalition 2008). Harvesting and using NTFPs provide powerful ways for these individuals to reconnect with or maintain their indigenous heritage, lands, and resources (Turner 2001). Despite these reserved tribal rights another barrier for tribal access to and the utilization of NTFPs can occur from competition with nontribal communities, commercial interests, and other nontraditional uses.

4.2.2 Settler and Immigrant Cultural Uses of Nontimber Forest Products

NTFPs also play cultural roles in some communities of long-settled (referred to here as settlers) and recent immigrants to the United States and territories, including those who arrived voluntarily and those who were forcibly relocated (figure 4.1). Their NTFP uses include practices adapted from their ancestral place of origin (e.g., Voeks and Rashford 2013), as well as those learned from indigenous peoples (Still 1998, Turner and von Aderkas 2012). In either case, harvesting and use of NTFPs may sustain cultural identity and capacity to live in place for nonindigenous communities throughout the Nation, whether they have been settled inside the current boundaries of the United States for many



Figure 4.1—Harvest and use of nontimber forest products sustain cultural identities for diverse peoples. For example, making baskets from bulrush needles (*Juncus roemerianus* Scheele), strips of palmetto leaves (*Sabal palmetto* (Walt.) Lodd.), longleaf pine needles (*Pinus palustris* Mill.), and blades of sweetgrass (*Muhlenbergia filipes* M.A. Curtis) is important to the culture and economy of contemporary Gullah/Geechee artisans in South Carolina (top and bottom left). Lupines (*Lupinus* spp.) and other plant material harvested by the Swedish colony of northern Maine are used in its Midsommar Fest (top and bottom right). (Photo credits: Brian Grabbatin (left), Michelle J. Baumflek (right), U.S. Department of Agriculture, Forest Service.)

generations or a few years. Some examples of cultural uses of NTFPs by nonindigenous peoples include Gullah/Geechee basketmaking traditions (Hurley et al. 2008), lupines (*Lupinus* spp.) and other plant materials harvested by the Swedish colony of northern Maine for its annual Midsommar Fest (Baumflek et al. 2010), the iconic status of ramps (*Allium tricoccum* Aiton) as a regional food in the Appalachian Mountains (Hufford 2000, Shortridge 2005), and the values of harvesting and eating brackenfern fiddleheads (*Pteridium* spp.) for Japanese and Korean immigrants to southern California (Anderson et al. 2000).

4.3 Nontimber Forest Product Social-Ecological Systems and Ecosystem Services

The cultural ecosystem services that flow from NTFPs are produced through social-ecological systems with spatial, temporal, and social dimensions that operate at scales from the individual plant or person to entire landscapes and cultural groups (de Groot et al. 2002, Fisher et al. 2008, Satterfield et al. 2013, Tengberg et al. 2012). Biophysical availability of plant materials and mushrooms is essential. However,

cultural potency arises from their use by human beings and the social structures and processes in which these are embedded (Cocks and Wiersum 2014).

Figure 4.2 offers a visualization of NTFP social-ecological systems and cultural ecosystem services. As a necessarily simplified representation of rich processes and meanings, figure 4.2 and the ensuing discussion inevitably omit much important detail. In particular, five aspects of NTFP cultural ecosystem services, as cultural values, are discussed (Burger et al. 2008). However, in actual cultural life these are often interdependent and mutually reinforcing; the distinctions between them presented here may be regarded as largely artificial and assumed for explanatory purposes only. The authors mean no disrespect in taking this approach, which is necessary to accurately assess cultural implications of NTFP use from a systems perspective that is national in scope.

4.3.1 Management and Nontimber Forest Product Availability

Land management has direct bearing on the presence and density of NTFPs in a location and also may affect their material properties (Hummel and Lake 2015). Ethnobotanical research in diverse ecosystems documents how local and indigenous management historically and presently works at scales from the landscape to individual plants to enrich populations of desired species (Cocks and Wiersum 2014, Peacock and Turner 2000) and reduce

populations of competing species such as invasives (Pfeiffer and Voeks 2008, Ticktin et al. 2006). Some of this work also has recorded traditional ecological knowledge (TEK) regarding changes in NTFP populations in response to settlement, other land management priorities (e.g., timber and fire suppression), and prohibition of traditional practices (Voggeser et al. 2013). In urban to ex-urban environments, development and land use conversion can eliminate or severely reduce populations of NTFP species (Hurley et al. 2008). However, NTFPs also may be present in residential and novel landscapes and habitats, such as greenways or parking lots (Head and Muir 2006, Hurley et al. 2008, Rocheleau et al. 1996), although their material properties may be altered and harvesters may be required to negotiate equally novel terms for access or consider health and safety for consumption or medicinal uses from contaminants.

The response of NTFP species to land management practices remains an area for research on cultural ecosystem services in temperate and boreal regions (Anderson 2005, Daniel et al. 2012). Noteworthy examples of research to date include work conducted in Finland on the response of production levels of berries to differing silviculture practices (Miina et al. 2010) and the United States Pacific Northwest on the response of mushrooms (Pilz et al. 1999, 2004; Wurtz et al. 2005) and huckleberries (Kerns et al. 2004, Minore et al. 1979) to fire and silvicultural techniques.

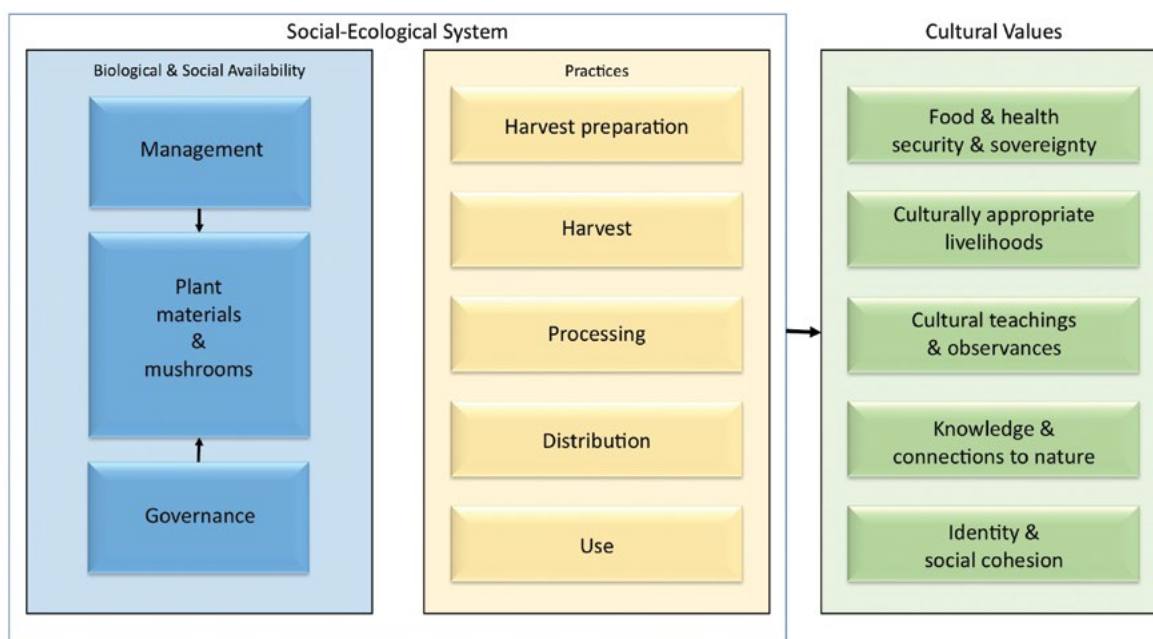


Figure 4.2—Nontimber forest product social-ecological systems and cultural ecosystem services. (Source: M.R. Emery, U.S. Department of Agriculture, Forest Service.)

4.3.2 Governance and Access to Nontimber Forest Products

While land management practices can affect the presence of NTFPs in a landscape, governance and legal standing influence whether people make use of them without fear of sanctions (Laird et al. 2010). In addition to formal legal governance (see chapter 7 for detailed discussion of the laws and regulations that apply to NTFPs), access to NTFPs also is governed by informal governance structures, including traditional community-based norms. Examples include customs regarding the timing and allocation of berry harvests in the Pacific Northwest (Peacock and Turner 2000) and the traditional Hawaiian system, which designates to a community or kinship group responsibility for management and right of access to resources throughout a watershed (*ahupua'a*), from the mountains (*mauka*) to the ocean (*makai*; Minerbi 1999).

Effects of governance on indigenous peoples have particular importance in a discussion of NTFP cultural ecosystem services (de Groot et al. 2002, Fisher et al. 2008, Hernández-Morcillo et al. 2013, Satterfield et al. 2013). Here, again, formal and informal structures condition access to NTFPs for cultural uses. Informal structures can be both enduring and particularly vulnerable to disruption. For example, in northern Maine, changes in agricultural technology and land ownership severed relationships between Maliseet and Mi'kmaq basketmakers and farmers, which had been the basis for ready access to black ash (*Fraxinus nigra* Marshall) on the latter's land (Ginger et al. 2012). In contrast, indigenous peoples are still the majority or plurality of the population on most U.S.-affiliated Pacific islands and retain largely indigenous patterns of land tenure and rights to resource management and use.

Formal governance structures must navigate complex land ownership and jurisdictional boundaries. In the Upper Midwest, harvest of NTFPs by American Indians takes place in a mix of legal and political jurisdictions. On reservations, harvests are under the control of the tribal governments. Few, if any, tribes in the region use harvest regulations such as seasonal restrictions or harvest limits in the management of NTFPs. Harvesting off reservation by tribal members presents a more complex picture. Following key court decisions (Lac Courte Oreilles Band of Lake Superior Chippewa v. Wisconsin, 700 F.2d 341 (7th Cir. 1983); Minnesota v. Mille Lacs Band, 199 S. Ct. 1187 1999), treaty-

reserved gathering rights have been restored on most public lands, including national forests managed by the Forest Service. Some tribes have negotiated harvesting regulations with the Forest Service and have documented those agreements in Memoranda of Understanding or similar agreements at a government-to-government basis. In some instances, permits are required for tribal gathering on public lands and monitoring techniques are employed to document harvests. In California, the 2006 Indian Free Use Policy reaffirms tribal members' access to manage and harvest NTFPs for traditional and cultural purposes without permits or fees on lands managed by the Bureau of Land Management and Forest Service. Similar policy is now nationally available for federally recognized tribes to harvest forest products for traditional and cultural [noncommercial] purposes "free of charge" on Forest Service-administered lands (Cultural and Heritage Cooperation Authority of 2008).

4.3.3 Nontimber Forest Product Practices

Biophysical and social availability are necessary but not sufficient to produce NTFP cultural ecosystem services. Brief descriptions of the practices essential to these values follow.

Harvest preparation: Short-term preparations may include visiting potential harvest locations and assembling and checking any tools or other implements needed for harvesting. Long-term preparations include acquiring the knowledge needed for successful harvesting. In some cases, preparations may include managing plants, populations, or landscapes to ensure the presence of a desired NTFP on a seasonal or ceremonial need basis.

Harvest: In addition to locating desired NTFP species, harvest involves decisions about which plant materials and/or mushrooms to take and which to leave. Harvest also may be used as a form of opportunity for management to promote future harvests.

Processing: Most NTFPs require some form of processing before they can be used. Processing varies with plant material or mushroom and intended use. Examples include cooking or preserving foods and weaving one or more NTFP species into baskets.

Distribution: NTFPs used for their cultural values commonly are distributed beyond harvester households to social networks composed of friends, family, and others. Distribution takes diverse forms including gifts and trade.

Use: Among their cultural functions, NTFPs are consumed or used as food, medicine, aesthetic and utilitarian objects, and ritual and ceremonial resources.

4.3.4 Nontimber Forest Product Cultural Ecosystem Services

Food sovereignty and health security—NTFPs play central roles in the food security and sovereignty of indigenous and other peoples throughout the United States and its affiliated islands (Emery and Pierce 2005, Kuhnlein et al. 2009, Lynn et al. 2013). The 1996 World Food Summit defined food security as “access to sufficient, safe, nutritious food to maintain a healthy and active life” (World Food Summit 1996). Food sovereignty refers to the ability of an individual or group to produce and/or obtain the foods of their choice, especially as these are defined by sociocultural traditions (Kassam 2010). The related concepts of health security and sovereignty are referenced in Article 24, Section 1 of the United Nations Declaration on the Rights of Indigenous Peoples, to which the United States is a signatory. The Declaration states that, in addition to the right of access without discrimination to all other health and social services, indigenous peoples have “the right to their traditional medicines and to maintain their health practices, including the conservation of their vital *medicinal plants*, animals, and minerals” (United Nations 2008; emphasis added).

The actual and potential contributions of NTFPs to health and nutrition are considerable (see also section 6.5 in this report). Tribal health professionals have noticed that as traditional food consumption has declined, rates of nutritionally related diseases such as diabetes and heart disease have increased (Lynn et al. 2013, Phillips et al. 2014). This trend in tribal community health and well-being is expected to be compounded by the impacts of increasing climatic variability (Ford 2012). Research on the nutritional content of NTFP food species is limited but growing (Kuhnlein 1986, Phillips et al. 2014). As of 2014, the USDA Agricultural Research Service’s National Nutrient Database includes a dataset of the nutritional content of 165 American Indian or Alaska Native foods, including over 40 single or combination NTFP foods (USDA ARS 2014). Analyses of traditionally foraged plant foods harvested on American Indian reservations in North Dakota found high nutritional values (see also section 6.5 in this report). Recommendations based

on these results support reintroducing or increasing consumption of edible NTFPs for their nutritional and cultural values (Phillips et al. 2014). Such efforts are under way in tribal communities regarding efforts within USDA school lunch and farm-to-school programs.

Access to and uses of NTFP foods are central to the cultural survival of peoples, as well as their material survival (figure 4.3). Food is a key ingredient in bringing families and larger social groups together to celebrate, define, and maintain their identity (Reddy 2015). An indication of the importance of edible NTFPs to identity is their role in foundational cultural teachings. For example, the Mohawk creation story, *Tsi Kiontonhwentsison*, describes how strawberry seeds (*Fragaria* spp.) were carried to this world from the Sky World. Today, strawberry drinks continue to be served during ceremonies and other community events (Hoover 2010). Anishinaabe (also known as Ojibwe or Chippewa) teachings relate how, expelled from their territory in the East, the Anishinaabe were instructed to travel west until they found “the place where food grows



Figure 4.3—Nontimber forest product foods are central to the material and cultural survival of indigenous peoples. Lion’s mane mushroom (*Hericium erinaceus* (Bull.) Persoon), tanoak acorns (*Notholithocarpus densiflorus* (Hook. & Arn.) Manos, Cannon, & S.H. Oh), and evergreen huckleberries (*Vaccinium ovatum* Pursh) are foods important to the Karuk and other tribes of northern California. (Photo credit: Frank K. Lake, U.S. Department of Agriculture, Forest Service.)

on water” (Janowiak et al. 2014). This is a reference to the aquatic grain, wildrice or *manoomin* (*Zizania palustris* L.), a traditional staple in the Ojibwe diet.

Contemporary practices using NTFPs for medicinal purposes remain important to diverse communities (e.g., Garibaldi 1999). Ethnobotanical studies of indigenous peoples published in the 19th and 20th centuries list hundreds of plant species used for medicinal purposes in simple and compound formulations (e.g., Smith 1923 and Moerman 1998 for North America). Today, NTFPs continue to be used to treat illness and support physical and psycho-social health. It is common for families to have their own NTFP-based traditional medicinal practices. Many communities also have traditionally trained healers, who harvest and administer NTFPs. Medicinal and spiritual practices using NTFPs are among the most culturally sensitive (Geniusz 2009), and detailed information about these uses is generally avoided in this report, including the regional summaries, except where information is broadly known and published.

The line between food and medicine frequently is indistinct, a widely observed phenomenon encapsulated in the quotation attributed to Hippocrates (460–370 B.C.E.), “Let medicine be thy food and let food be thy medicine.” Berries offer one example of the importance of NTFP foods for the physical and social health of many communities. These small fruits are traditional foods throughout most of the continental United States. Recent research has documented the value of phytochemicals present in many berries for regulation of a variety of metabolic conditions (Basu et al. 2010, as cited in Lynn et al. 2013). In Wabanaki culture (the Maliseet, Mi’kmaq, Passamaquoddy, and Penobscot tribes of Maine), berries are used extensively for women’s health, and in coming-of-age ceremonies (Lynn et al. 2013).

A similarly blurred line exists between the medicinal and spiritual functions of many NTFPs used throughout the United States and its affiliated islands. Examples from two regions illustrate. Devil’s club (*Oplopanax horridus* (Sm.) Miq.) is the most common and widely used medicinal plant of coastal Alaska Natives (Garibaldi 1999). It is also considered to have spiritual properties (Moerman 1998). In Pacific island cultures with rich ethnobotanical traditions, *Piper methysticum* ((G.) Forst.), known as *kava* in Polynesia and *sakau* in Pohnpei, is commonly used for ceremonial, medicinal, and recreational purposes.

Culturally appropriate livelihoods—The U.N. Declaration on the Rights of Indigenous Peoples recognizes economic practices as having cultural bases fundamental to the survival of peoples (United Nations 2008). The ways households and communities meet their needs for material survival can be grounded in and have profound implications for cultural practices. Many indigenous peoples struggle to maintain livelihoods that support material well-being while honoring cultural teachings about right relationships among human beings and between humans and the nonhuman world. NTFPs play important roles in such efforts through their use as subsistence goods, in traditional trade and barter, and trade in formal and informal economies (Emery 1998, 2001; Emery and Pierce 2005).

Basketry traditions offer a case in point. A wide variety of wild plant materials are used in the making of baskets by peoples from Maine and New York (Benedict and Frellich 2008) to California, Oregon, and Washington (Hummel and Lake 2015). Basketry traditions have endured ecological and political transitions (Hill 1997) and are central to indigenous cultural revitalization efforts taking place throughout the country (figure 4.4). Baskets in many sizes and shapes are used for utilitarian purposes including food storage and cargo. They also are works of art that rely on and give physical form to traditional ecological knowledge (TEK) and culture (Anderson 2005). The sale of baskets made from NTFPs allows individuals and families to derive some or all of their needs for cash income through traditional cultural practices. For example, in the Pacific islands, over one hundred cultivars of *Pandanus* spp. (common names include pandan and screw palm) provide fruit and palm-like leaves that are processed and woven into mats, traditional clothing, and baskets. Some of these items have profound cultural significance, such as fine mats offered as gifts in ceremonies of marriage or meetings of leadership. Others, including baskets, have been adapted to modern markets and are major sources of income for indigenous women, especially in the Marshall Islands and other atolls.

Subsistence practices are central to many cultures, particularly indigenous peoples. Hunting, fishing, trapping, and gathering NTFPs are regarded as forms of acquiring wealth. Loss of capacity to engage in subsistence practices is a form of impoverishment and represents a fundamental threat to material, cultural, and economic survival (Emery and Pierce 2005, Hunn



Figure 4.4—Nontimber forest products are foundations for culturally appropriate livelihoods. Sale of baskets using traditional techniques and contemporary artistry is an important source of income for many Native artisans. Left: Gabriel Frey (Passamaquoddy Tribe) pounding a black ash log (*Fraxinus nigra* Marshall) to delaminate annual growth rings for basket making. Right: Black ash purse with a leather lining, created by Gabriel Frey. (Photo credits: Suzanne Greenlaw.)

1999, Schroeder 2002). The subsistence practices of some peoples in the United States enjoy legal status (see chapter 7), although the actual terms under which these are exercised are frequently contested.

Alaska has 229 federally recognized tribal governments that represent indigenous peoples of that state. Alaska Native groups maintain strong physical and cultural ties to traditional areas used for subsistence harvests of fish, wildlife, plants, and mushrooms. For Alaska Natives, subsistence is a cultural marker and a way of maintaining what it means to be a native. NTFP harvesting, including the gathering of traditional foods, provides connection to place, belief, and heritage that are essential to expressing and maintaining native culture and indigenous identity (Schroeder 2002). The Alaska State Department of Fish and Game maintains data on subsistence practices in the United States. While these records have focused on fish and game, NTFPs such as berries and wild greens also are widely used for subsistence purposes (Norris 2002).

Cultural teachings and observances—Each step in the suite of NTFP practices, from preparation for harvest to final use of a plant material or mushroom, offers an occasion

for cultural teaching (figure 4.5) and NTFPs are essential to many cultural observances. The description of cultural teachings and observances, like other information presented here, is not intended to romanticize or universalize what actually happens on the ground. In any community, there are individuals who follow or adhere to social guidelines about correct behavior and those who do not. This is no less true where NTFPs are concerned than it is in any other arena. Likewise, there are variations in customs between and within cultures. Nevertheless, the following describes common teachings across cultures about how to do things “in a good way,” which dedicated cultural practitioners teach, observe personally, and hold as the measure of best practices and personal integrity (as stewardship obligations and respectful use of NTFPs). Taken as a whole, it demonstrates the importance of NTFPs to the survival and maintenance of culture.

Often, NTFP practices are social occasions, in which people of different ages and levels of ability take part. Each activity is an opportunity to teach interrelated material and spiritual and cultural values to youth and others (Ruelle and Kassam 2013).



Figure 4.5—Nontimber forest product practices offer an occasion for cultural teaching. Elders of the Karuk Tribe, Lillian Rentz (upper left) and LaVerne Glaze (lower right), harvest edible corms (*Brodiaea coronaria* (Salisb.) Jeps.). (Photo credit: Frank K. Lake, U.S. Department of Agriculture, Forest Service.)

Preparations for harvest may include instruction in making tools or containers from other NTFPs. Understanding phenological characteristics, i.e., the relationship between observable phenomena in the landscape such as weather or events in the lifestage of a species with appropriate timing for the harvest of a plant material or mushroom, can be especially important to success [see chapter 2] (Armatas et al. 2016, Lantz and Turner 2003). Instruction about these relationships occurs in practice on the ground, but also may be embedded in cultural teachings that have ensured the survival of people through extended periods of time.

Teachings that accompany harvest include information about how to find a NTFP and choose materials with the desired properties. They also may involve orientation to and reinforcement of larger world views, including human beings' roles, relationships, and responsibilities to the natural world (Emery et al. 2014). Often, instruction in best practices includes prayers and other forms of respect and reciprocity (Reo and Whyte 2012, Turner 2001)

Processing NTFPs can provide occasions for diverse members of a community to come together, including

those who are unable to participate in harvesting. When the plant material or mushrooms are intended for sacred use, rituals may be an essential part of their preparation. Practices surrounding *imu*, or underground ovens, exemplify cultural values embedded in preparations that involve NTFPs. *Imu* is a traditional food preparation that has been used across Oceania for over 4,000 years to cook taro (*Colocasia esculenta* (L.) Schott), breadfruit (*Artocarpus altifolius* (Parkinson) Fosberg), and other staples for nutritional and ceremonial purposes. Events surrounding *imu* bring people together to gather resources, prepare the *imu*, enjoy food, clean up, and distribute leftover food. It also brings people together metaphorically, through sharing culturally meaningful experiences and maintaining social relationships (Kamelamela 2012).

In addition to cultural teachings and practices that emphasize relationships between human beings and the natural world, NTFPs are integral to customs that reinforce cultural norms about right relationships among people. Harvesting, processing, distributing, selling, and using NTFPs for cultural and social activities allow different individuals in a family, tribe, community, or business to serve roles that strengthen sociocultural cohesion. This is particularly evident in the distribution and use of NTFPs. Redistribution or sharing of NTFPs serves as a form of social capital and an expression of respect, as when younger individuals make “payment” with NTFPs to elders or mentors who instructed them. Frequently, plant materials and mushrooms are distributed so that their benefits extend beyond harvesters and their households. Sharing NTFPs may be as formalized and ceremonial as the potlatches of Pacific Northwestern tribes (Turner et al. 2008) or as commonplace as taking a slice of wild berry pie to a neighbor. In either case, such forms of distribution reinforce relationships between people and reflect cultural teachings about respect and reciprocity. Day-to-day use of an object made from an NTFP can create continuous, living connections between a person and the environment from which it came (Deur and Turner 2005), but also between the user and the people who harvested, prepared, and distributed that item.

NTFPs also are essential materials in special cultural observances. With their role in observances of major life passages such as marriages and coming of age ceremonies, cultural uses of NTFPs are part of supporting individuals and weaving together communities. As the focal point

of seasonal celebrations, they help to orient people in time and reinforce resource-based livelihood strategies.

Knowledge and connections to nature—Local and traditional ecological knowledge are essential to the exercise of NTFP cultural values. As described earlier in this chapter, knowledge developed through stewardship, gathering, and using NTFPs is comprehensive (Turner 2001). It includes, among other things, information about factors needed to access, harvest, process, and use plant materials and mushrooms. Local and traditional ecological knowledge employed to access and use NTFPs includes species identification, phenological relationships, microsite and landscape characteristics, stewardship strategies, and processing to unlock nutritional and medicinal values and produce items such as baskets.

NTFP knowledge and practices are not homogenous within individual tribes and communities. Rather, gathering and use of NTFPs varies across and within them. As some practices are widespread (e.g., berry picking), specialization of knowledge and practices for particular NTFPs also is common (Emery 1998). Individual families may focus on a particular species or suite of species and it may be inappropriate to share some or all of this knowledge. Further, like other forms of TEK (Reo and Whyte 2012), NTFP knowledge is dispersed. No individual or family possesses the full body of a tribe or community's collective knowledge about the plants and mushrooms in their environment.

In addition to its value for cultural maintenance, such knowledge and the practices associated with it create connections to nature with demonstrated benefits to physical and psycho-social well-being of individual community members (Tenberg et al. 2012). Research demonstrates that time spent in natural environments reduces cortisol levels and other physiological measures associated with stress-related diseases (Park et al. 2011), and some research indicates a reduction in behaviors associated with attention deficit/hyperactivity disorder (Kuo and Taylor 2004).

Erosion of such knowledge poses corresponding risks to cultural survival and individual well-being. In addition to traditional methods of passing information within families, many communities have institutions and programs designed to teach youth about their cultures, including NTFP use and TEK of species, habitat requirements, environmental processes, and

disturbance or management effects, all associated with sustainability of the resources (Turner 2001).

Such detailed ecological knowledge has clear value for understanding effects of climatic variability at local and regional scales. Much effort has been dedicated to understanding TEK (Berkes 2012, Parrotta and Trospen 2012) and establishing ethical protocols for respecting indigenous knowledge and culture (Geniusz 2009, Smith 1999). Key principles include recognizing the rights of communities, especially indigenous communities, to choose what information is and is not shared and how it is used (Williams and Hardison 2013) (box 4.1). Applying these principles to work on cultural values of NTFPs in an era of changing climate will provide a foundation for respectful, productive collaboration between harvesters, their communities, scientists, and policymakers.

Identity and social cohesion—NTFPs are part of cultural expression and identities of indigenous peoples and contribute to social cohesion of individuals and communities, whether residing in ancestral homelands, cities, or distant locations. The role of NTFPs in identity formulation is especially evident in indigenous origin stories. In addition to examples provided earlier in this chapter, traditional accounts state that Native Hawaiians are descendants of Sky Father (*Wākea*), Earth Mother (*Papa*), the Progenitor of the stars (*Ho'ohōkūkalani*), and the taro plant (*Colocasia esculenta* (L.) Schott). Wabanaki teachings say that the peoples of present day Maine sprang from black ash (*Fraxinus nigra* Marshall).

Material practices using NTFPs also are potent markers of identity. As noted earlier in this chapter, subsistence practices, including uses of NTFPs, are regarded as an important part of what it means to be an Alaska Native. Arts and crafts produced from forest plants are integral to culture and are vehicles for expressing identity. For example, California and Pacific Northwest basketmakers traditionally have used combinations of materials, techniques, designs, and patterns distinctive to their tribe (Hummel and Lake 2015).

NTFPs also play a role in, among other elements, a sense of belonging and responsibility to a larger group and forms of social assistance for individuals understood to be vulnerable or in need (Norton and Haan 2013). NTFP practices and celebrations that use foraged plant materials and mushrooms are occasions for extended families and broader social networks to come together around a sense of community. Norms surrounding the distribution

BOX 4.1 ETHICS AND NONTIMBER FOREST PRODUCT KNOWLEDGE

Often people ask, “How do American Indians use this plant?” It is a simple enough question and the questioner usually expects a commensurately simple response. To answer this question in a culturally appropriate manner, however, takes time, depth of understanding, respect, and trust not obtained quickly. As knowledge holders, culture keepers may be charged with maintaining a body of knowledge with proscriptions such as what information can be shared, with whom, at what time of year, and under what circumstances. The responsibility of those entrusted with the traditional knowledge of how the plant is used extends to rules about how that knowledge may be shared, if at all. It may be that specialized or sacred information can be shared only with the individual or family who will become the next steward(s) of that knowledge. Others may be deemed not culturally qualified or unable to honor the responsibility to safeguard that knowledge in culturally appropriate context.

In her book, “Our Knowledge is Not Primitive: Decolonizing Anishinaabe Botanical Knowledge”, Wendy Makoons Geniusz discusses the history of ethnobotanical work with tribes in the U.S. Upper Midwest:

Researchers have recorded a fair amount of information about how the *Anishinaabeg* work with plants and trees; however, much of this information has been colonized. To use this knowledge for cultural revitalization, it must be reworked and reinterpreted into a format that is appropriate and usable to contemporary *Anishinaabe-izhitwaawin* (Anishinaabe culture). (2009: 4)

Thus, to answer the simple question posed in this box in a respectful manner, any response must be complete

including who provided the information, the community they are from, and when it was provided. The information should include how and when the plants or mushrooms are collected, how they are prepared, and instructions for their use. It is only through this complete set of information, including any traditional teachings, special instructions for use, prayers, or songs that may go with the plant or mushroom that a culturally appropriate portrayal can be presented. Given the critical nature of NTFPs to the cultural survival of indigenous communities, it becomes equally critical to ensure that their traditional knowledge be protected against misappropriation and maintained in the most culturally relevant and useful forms possible.

In this chapter, which documents uses of NTFPs by indigenous peoples, some specific uses of forest products are presented. Out of respect, the authors have avoided mention of plant uses involving medicinal, ceremonial, or spiritual purposes that are not widely known. We have attempted to limit our description of NTFPs to those which are more public and utilitarian in nature. For example, noting that maple sap is collected for the purpose of making maple syrup does not disclose a use for a plant not already widely known.

While recognizing the cultural intricacies of sharing traditional knowledge, it is hoped that knowledge exchange between Western scholars and traditional practitioners will help to ensure the continued viability of culturally important NTFPs in the face of increasing climatic variability and the associated disruptions to knowledge systems and traditional practices. The authors thought it important, however, to offer this perspective so the indigenous people who read this chapter will know we tried to offer this knowledge in a respectful and inclusive manner.

of NTFPs can provide for the most vulnerable in a community, particularly elders. The role of NTFPs in social cohesion is evident in many cultures and economies, where harvesting and using plant materials and mushrooms are integral to celebrations, healing, and redistribution of food and adornment resources.

4.4 Impacts of Climatic Variability on Cultural Uses of Nontimber Forest Products

Direct and indirect effects of increasing climatic variability on NTFPs may result in significant disruptions to culture and its contributions to human well-being (Chief et al. 2014, Parrota and Agnoletti 2012). Altered

spatial and temporal distributions of NTFP may have some of the most immediate consequences. Changes in location of suitable habitat may mean that a culturally important species is no longer available within the treaty territory or trust lands of a tribe or becomes effectively inaccessible because of long travel distances (Ginger et al. 2012). Observances central to cultural identity and the transmission of knowledge may be compromised by episodic or chronic shortages in volumes of cultural keystone species whose life cycles are dependent on particular climatic conditions. Likewise, altered timing of seasonal variation in temperatures and precipitation may result in phenological asynchronies (decoupling of events that previously occurred simultaneously or in predictable sequence), which reduce the effectiveness of TEK or result in lack of availability of species at key times in culturally defined livelihood cycles (Armatas et al.

2015, Lantz and Turner 2003, Turner and Clifton 2009). Where species continue to be available in place and time, the physical properties needed for spiritual, religious, utilitarian and craft materials may be altered directly by factors such as changes in hydrology and temperature, or indirectly by the emergence of insects and diseases.

Many sacred sites are considered as such, because of the high significance of spiritually or religiously important NTFPs found and utilized in those localities. Climate-related disturbances and mechanisms that result in changes of species at sacred sites, could have a profound impact on the continuance of cultural practices that require the locality and the NTFP resource both be present.

The effects of climatic variability on social structures and processes also will have ripple effects for culturally important NTFPs. For example, rising sea levels may result in greater pressure on upland NTFP resources as land bases are reduced in island and coastal environments. With sea level rise, coastal and island communities face physical displacement, domestic freshwater source contamination, and impairment to habitats that sustain them culturally (Feary et al. 2012, FSM 2010, Maldonado et al. 2013, Parrotta and Agnoletti 2012). Where these displaced community members move into areas with existing cultural uses of NTFPs (and there are few places where this will not be the case), there is potential for conflict due to competing demands for resources. In the case of displaced peoples for whom NTFPs have cultural keystone values, movement into areas where these species are unavailable by virtue of bio-physical absence or social barriers to obtain them could represent a threat to material and cultural survival. At the same time, it should be noted that on some Pacific islands, traditions of accommodating kin displaced by drought or storm are being adapted today as governments with higher elevation lands proactively provide land for displaced atoll dwellers (FSM 2010, Parrotta and Agnoletti 2012).

Within these general parameters, specific effects of climatic variability on NTFP cultural functions will vary by region and cultural group. Each cultural group is vulnerable to effects depending on their geographic location, the cultural values of the species, and interacting stressors at multiple scales (Bennett et al. 2014, Burger et al. 2008). Some examples of impacts that may be anticipated in particular regions are provided in the regional appendixes.

4.5 Key Findings

- NTFPs are important to the cultures of diverse peoples in the United States.
- Direct and indirect effects of increasing climatic variability on NTFPs may result in significant disruptions to culture and its contributions to human well-being.
- The resilience of cultures and their NTFP-based practices may be a function of the intensity, speed, and duration of events that pose ecological and/or social challenges to them.

4.6 Key Information Needs

- Many culturally important overstory species and their likely responses to increasing climatic variability have not been modeled and understory species largely are absent from such analyses.
- Research on the cultural functions of NTFPs is lacking for many peoples and parts of the Nation.
- Analyses are needed to understand the interactions of increasing climatic variability impacts, management, governance, and cultural uses of NTFPs.

4.7 Conclusions

NTFP cultural values derive from practices of harvest, processing, distribution, and use, as well as plant materials and mushrooms themselves. As changes associated with altered climate affect landscapes and social systems in which cultural uses of NTFPs occur, they will affect and possibly threaten cultures throughout the United States and its affiliated islands. Among the contributions to human well-being at risk are the roles of NTFP knowledge-practice-belief systems (Berkes 2012) in food sovereignty and health security (Kassam et al. 2010, Lynn et al. 2013), identity formation, social cohesion, and livelihoods (Cocks and Wiersum 2014, Emery 2002b, Lynn et al. 2013, Voggesser et al. 2013). Such alterations could have adverse consequences for indigenous, settler, and immigrant populations across rural to urban environments. Particular attention may

be required to fulfill the treaty and reserved rights and comply with laws relevant to cultural values of NTFPs to American Indians, Native Hawaiians, Alaska Natives, and other rural residents of a state.

At the same time, culture is dynamic and there are opportunities to mitigate and adapt to climatic variability effects on NTFP cultural values. Indeed, NTFPs frequently provide essential survival resources in times of disruption when and where commercially products are limited or not available (e.g., Redzic 2010) and may do so during climate-related disturbances. The resilience of cultures and their NTFP-based practices may be a function of the intensity, speed, and duration of events that pose ecological and/or social challenges to them. Indigenous peoples have noted that their cultures are the product of millennia of adaptation to social and ecological change. As a consequence, indigenous peoples have knowledge systems and wisdom to offer as all of humanity seeks to adapt to changing climate (Vogesser et al. 2013).

4.8 Literature Cited

- American Anthropological Association. 2015. Defining culture. www.aaanet.org/committees/commissions/aec/resources.htm#Definitions. [Date accessed: January 18, 2015].
- Anderson, J.A.; Blahna, D.J.; Chavez, D.J. 2000. Fern gathering on the San Bernardino National Forest: cultural versus commercial values among Korean and Japanese participants. *Society and Natural Resources*. 13(8): 747–762.
- Anderson, M.K. 2005. *Tending the wild: Native American knowledge and the management of California's natural resources*. Berkeley, CA: University of California Press. 558 p.
- Armatas, C.A.; Venn, T.J.; McBride, B.B. [and others]. 2016. Opportunities to utilize traditional phenological knowledge to support adaptive management of social-ecological systems vulnerable to changes in climate and fire regimes. *Ecology and Society*. 21(1): 16.
- Barnard, A.; Spencer, J. 2002. Culture. In: Barnard, A.; Spencer, J., eds. *Encyclopedia of social and cultural anthropology*. London: Routledge: 206–216.
- Basu, A.; Du, M.; Leyva, M.J. [and others]. 2010. Blueberries decrease cardiovascular risk factors in obese men and women with metabolic syndrome. *Journal of Nutrition*. 140: 1582–1587.
- Baumflek, M.J.; Emery, M.R.; Ginger, C. 2010. Culturally and economically important nontimber forest products of northern Maine. Gen. Tech. Rep. NRS-68. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 74 p.
- Benedict, M.A.; Frelich, L.E. 2008. Site factors affecting black ash ring growth in northern Minnesota. *Forest Ecology and Management*. 255: 3489–3493.
- Bennett, T.M.B.; Maynard, N.G.; Cochran, P. [and others]. 2014. Indigenous peoples, lands, and resources. In: Melillo, J.M.; Richmond, T.T.C.; Yohe, G.W., eds. *Climate change impacts in the United States: the third national climate assessment*. Washington, DC: U.S. Global Change Research Program: 297–317.
- Berkes, F. 2012. *Sacred ecology: traditional ecological knowledge and resource management*. Philadelphia: Taylor & Francis.
- Berkes, F.; Colding, J.; Folke, C. 2000. Rediscovery of traditional ecological knowledge as adaptive management. *Ecological Applications*. 10(5): 1251–1262.
- Burger, J.; Goachfeld, M.; Pletnikoff, K. [and others]. 2008. Ecocultural attributes: evaluating ecological degradation in terms of ecological goods and services versus subsistence and tribal values. *Risk Analysis*. 28(5): 1261–1271.
- Chief, K.; Daigle, J.J.; Lynn, K.; Whyte, K. 2014. Indigenous experiences in the U.S. with climate change and environmental stewardship in the Anthropocene. In: Sample, V.A.; Bixler, R.P., eds. *Forest conservation and management in the Anthropocene: Conference proceedings*. RMRS-P-71. Ft. Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station: 161–176.
- Cocks, M.L.; Wiersum, F. 2014. Reappraising the concept of biocultural diversity: a perspective from South Africa. *Human Ecology*. 42(5): 727–737.
- Cultural and Heritage Cooperation Authority of 2008; 25 U.S.C. 32A § 3055.
- Daniel, T.C.; Muhar, A.; Arnberger, A. [and others]. 2012. Contributions of cultural services to the ecosystem service agenda. *PNAS*. 109(23): 8812–8819.
- de Groot, R.; Wilson, M.A.; Boumans, R.M.J. 2002. A typology for the classification, description and valuation of ecosystem functions, goods, and services. *Ecological Economics*. 41: 393–408.
- Deur, D.; Turner, N.J. 2005. *Keeping it living: traditions of plant use and cultivation on the northwest coast of North America*. Seattle: University of Washington Press. 404 p.
- Dockery, A.M. 2010. *Culture and wellbeing: the case of indigenous Australians*. *Social Indicators Research*. 99(2): 315–332.
- Emery, M.R. 1998. *Invisible livelihoods: nontimber forest products in Michigan's Upper Peninsula*. Ann Arbor, MI: University of Michigan. Ph.D. dissertation.
- Emery, M.R. 2001. Social values of specialty forest products to rural communities. In: Josiah, S.J., ed. *Proceedings of the North American conference on enterprise development through agroforestry: farming the forest for specialty products*. Minneapolis, MN: University of Minnesota, Center for Integrated Natural Resources and Agricultural Management (CINRAM): 25–32.
- Emery, M.R. 2002a. Historical overview of nontimber forest product uses in the Northeastern United States. In: Jones, E.T.; McLain, R.J.; Weigand, J., eds. *Nontimber forest products in the United States*. Lawrence, KS: University Press of Kansas: 3–25.
- Emery, M.R. 2002b. Space outside the market: implications of NTFP certification for subsistence use. In: Shanley, P.; Pierce, A.; Laird, S.; Guillen, A., eds. *Tapping the green market: management and certification of NTFPs*. London: Earthscan: 302–312.
- Emery, M.R.; Pierce, A.R. 2005. Interrupting the telos: locating subsistence in contemporary U.S. forests. *Environment and Planning A*. 37(6): 981–993.
- Emery, M.R.; Wrobel, A.; Hansen, H. [and others]. 2014. Using traditional ecological knowledge as a basis for targeted forest inventories: paper birch (*Betula papyrifera*) in the U.S. Great Lakes Region. *Journal of Forestry*. 112(2): 207–214.

- Feary, S.A.; Eastburn, D.; Sam, N.; Kennedy, J. 2012. Western Pacific. In: Parrotta, J.A.; Trosper, R.L., eds. *Traditional forest-related knowledge: sustaining communities, ecosystems and biocultural diversity*. Dordrecht, the Netherlands: Springer: 395–447.
- Federated States of Micronesia (FSM). 2010. *Federated States of Micronesia state-wide assessment and resource strategy 2010–2015+*. Palikir, Pohnpei, FSM: Department of Resources and Development. 215 p. <http://www.forestationplans.org/states/federated-states-of-micronesia>. [Date accessed: January 30, 2015].
- Fisher, B.; Turner, K.; Zylstra, M. [and others]. 2008. *Ecosystems services and economic theory: integration for policy-relevant research*. *Ecological Applications*. 18(8): 2050–2067.
- Ford, J.D. 2012. Indigenous health and climate change. *American Journal of Public Health*. 102 (7): 1260–1266.
- Garibaldi, A. 1999. *Medicinal flora of the Alaska natives*. Anchorage: University of Alaska, Alaska Natural Heritage Program. 209 p.
- Garibaldi, A.; Turner, N.J. 2004. Cultural keystone species: implications for ecological conservation and restoration. *Ecology and Society*. 9(3): 1.
- Geniusz, W.D. 2009. *Our knowledge is not primitive: decolonizing botanical Anishinaabe teachings*. Syracuse, NY: Syracuse University Press. 223 p.
- Ginger, C.; Emery, M.R.; Baumflek, M.J.; D. E. Putnam. 2012. Access to natural resources on private property: factors beyond right of entry. *Society & Natural Resources*. 25(7): 700–715.
- Head, L.; Muir, P. 2006. Suburban life and the boundaries of nature: resilience and rupture in Australian backyard gardens. *Transactions of the Institute of British Geographers*. 31(4): 505–524.
- Hernández-Morcillo, M.; Pliening, T.; Bieling, C. 2013. An empirical review of cultural ecosystem service indicators. *Ecological Indicators*. 29: 434–444.
- Hill, S.H. 1997. *Weaving new worlds: southeastern Cherokee women and their basketry*. Chapel Hill: University of North Carolina Press. 414 p.
- Hoover, E. 2010. *Local food production and community illness narratives: responses to environmental contamination in the Mohawk community of Akwesasne*. Providence, RI: Brown University. Ph.D. dissertation.
- Hufford, M. 2000. *Tending the commons: folklife and landscape in Southern West Virginia*. Washington, DC: American Folklife Center, Library of Congress. As cited in Emery and Pierce 2005. <http://memory.loc.gov/ammem/cmnshtml/cmnshtml.html>. [Date accessed: August 16, 2017].
- Hummel, S.; Lake, F.K. 2015. Forest site classification for cultural plant harvest by tribal weavers can inform management. *Journal of Forestry*. 113(1): 30–39.
- Hunn, E.S. 1999. The value of subsistence for the future of the world. In: Nazarea, V.D., ed. *Ethnoecology: situated knowledge/located lives*. Tucson: The University of Arizona Press: 23–36.
- Hurley, P.T.; Halfacre, A.C.; Levine, N.S.; Burke, M.K. 2008. Finding a “disappearing” nontimber forest resource: using grounded visualization to explore urbanization impacts on sweetgrass basketmaking in greater Mt. Pleasant, South Carolina. *Professional Geographer*. 60(4): 1–23.
- Indian Free Use Policy. 2006. *Traditional gathering policy for lands in California managed by the U.S. Forest Service and Bureau of Land Management*, per Forest Service Manual Supplement #1560, Region 5, approved July 25, 2007 and Bureau of Land Management Instruction Memo No. CA-2007-017, April 10.
- Janowiak, M.K.; Iverson, L.R.; Mladenoff, D.J. [and others]. 2014. *Forest ecosystem vulnerability assessment and synthesis for northern Wisconsin and western Upper Michigan: a report from the Northwoods Climate Change Response Framework project*. Gen. Tech. Rep. NRS-136. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 247 p.
- Kamelamela, K. 2012. *Imu o nui mai mauka i kai-contemporary Native Hawaiian gathering practices*. Honolulu: Hawai'i Conservation Alliance, 20th Hawai'i Conservation Conference <https://vimeo.com/51649631>. [video presentation]. [Date accessed: August 16, 2017].
- Kassam, K.A.; Karamkhudoeva, M.R.; Baumflek, M. 2010. Medicinal plant use and health sovereignty: findings from the Tajik and Afghan Pamirs. *Human Ecology*. 38(6): 817–829.
- Kassam, K.A.S. 2010. Pluralism, resilience, and the ecology of survival: case studies from the Pamir Mountains of Afghanistan. *Ecology and Society*. 15(2): 8.
- Kerns, B.K.; Alexander, S.J.; Bailey, J.D. 2004. Huckleberry abundance, stand conditions, and use in Western Oregon: evaluating the role of forest management. *Economic Botany*. 58(4): 668–678.
- Kuhnlein, H.V.; 1986. Food sample collection for nutrient analyses in ethnobiological studies. *Journal of Ethnobiology*. 6(1): 19–25.
- Kuhnlein, H.V.; Erasmus, B.; Spigeliski, D. 2009. *Indigenous peoples' food systems*. Rome: Food and Agriculture Organization of the United Nations.
- Kuo, F.E.; Taylor, A.F. 2004. A potential natural treatment for attention-deficit/hyperactivity disorder: Evidence from a national study. *American Journal of Public Health*. 94(9): 1580–1586.
- Laird, S.A.; McLain, R.J.; Wynberg, R.P. 2010. *Wild product governance: finding policies that work for nontimber forest products*. Washington, DC: Earthscan. 394 p.
- Lantz, T.C.; Turner, N.J. 2003. Traditional phenological knowledge of Aboriginal peoples in British Columbia. *Journal of Ethnobiology*. 23(2): 263–286.
- Lynn, K.; Daigle, J.; Hoffman, J. 2013. The impacts of climate change on tribal traditional foods. *Climatic Change*. 120(3): 545–556.
- Maldonado, J.K.; Shearer, C.; Bronen, R. [and others]. 2013. The impact of climate change on tribal communities in the US: displacement, relocation, and human rights. *Climatic Change*. 120(3): 601–614.
- Miina, J.; Pukkala, T.; Hotanen, J.P.; Sale, K. 2010. Optimizing the joint production of timber and bilberries. *Forest Ecology and Management*. 259(10): 2065–2071.
- Millennium Ecosystem Assessment. 2005. *Ecosystems and human well-being: synthesis*. Washington DC: Island Press. 39 p.
- Minerbi, L. 1999. Indigenous management models and protection of the ahupua'a. In: Aoudé, I.G.; Kelly, M., eds. *The ethnic studies story: politics and social movements in Hawai'i*. Honolulu: University of Hawai'i Press: 208–225.
- Minore, D.; Smart, A.W.; Dubrasich, M.E. 1979. *Huckleberry ecology and management research in the Pacific Northwest*. Gen Tech. Rep. PNW-093, Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 60 p.
- Moerman, D.E. 1998. *Native American ethnobotany*. Portland, OR: Timber Press. 927 p.
- National Scientific Council on the Developing Child. 2015. *Supportive relationships and active skill-building strengthen the foundations of resilience: working paper 13*. Cambridge, MA: Harvard University. 16 p.
- National Urban Indian Family Coalition. 2008. *Urban Indian America: the status of American Indian & Alaska Native children & families today*. Seattle, WA: National Urban Indian Family Coalition. 23 p.
- Native Hawaiian Health Care Act of 1988; U.S.C. 42 Chap. 122 Sec. 11701.
- Norris, F. 2002. *Alaska subsistence: a National Park Service management history*. Anchorage, AK: U.S. Department of the Interior, National Park Service, Alaska Support Office.

- Norton, A.; Haan, A.D. 2013. Social cohesion: theoretical debates and practical applications with respect to jobs. Background paper for the World Development Report 2013. Washington, DC: World Bank. 23 p. [es/8258024-1320950747192/8260293-1320956712276/8261091-1348683883703/WDR2013_bp_Social_Cohesion_Norton.pdf](https://doi.org/10.1093/wdr/2013.1348683883703/WDR2013_bp_Social_Cohesion_Norton.pdf). [Date accessed: August 15, 2017].
- Park, B. J.; Furuya, K.; Kasetani, T. [and others]. 2011. Relationship between psychological responses and physical environments in forest settings. *Landscape and Urban Planning*. 102(1): 24–32.
- Parrotta, J.A.; Agnoletti, M. 2012. Traditional forest-related knowledge and climate change. In: Parrotta, J.A.; Trosper, R.L., eds. *Traditional forest-related knowledge: sustaining communities, ecosystems and biocultural diversity*. World Forest Series 12. Dordrecht: Springer: 491–533. Chapter 13.
- Parrotta, J.A.; Trosper, R.L., eds. 2012. *Traditional forest-related knowledge: sustaining communities, ecosystems and biocultural diversity*. World Forest Series 12. Dordrecht: Springer. 620 p.
- Peacock, S.L.; Turner, N.J. 2000. Just like a garden: traditional resource management and biodiversity conservation on the interior plateau of British Columbia. In: Minnis, P.E.; Elisens, W.J., eds. *Biodiversity and Native America*. Norman, OK: University of Oklahoma Press: 133–179.
- Pfeiffer, J.M.; Voeks, R.A. 2008. Biological invasions and biocultural diversity: linking ecological and cultural systems. *Environmental Conservation*. 35(4): 281–293.
- Phillips, K.M.; Pehrsson, P.R.; Agnew, W.W. [and others]. 2014. Nutrient composition of selected traditional United States Northern Plains Native American plant foods. *Journal of Food Composition and Analysis*. 34(2): 136–152.
- Pilz, D.; Smith, J.; Amanranthus, M.P. [and others]. 1999. Mushrooms and timber: managing commercial harvesting in the Oregon Cascades. *Journal of Forestry*. 97(3): 4–11.
- Pilz, D.; Weber, N.S.; Carter, M.C. [and others]. 2004. Productivity and diversity of morel mushrooms in healthy, burned, and insect-damaged forests of northeastern Oregon. *Forest Ecology and Management*. 198(1–3): 367–386.
- Reddy, S.N. 2015. Feeding family and ancestors: Persistence of traditional Native American lifeways during the Mission Period in coastal Southern California. *Journal of Anthropological Archaeology*. 37: 48–66.
- Redzic, S. 2010. Use of wild and semi-wild edible plants in nutrition and survival of people in 1430 days of siege of Sarajevo during the war in Bosnia and Herzegovina (1992–1995). *Collegium Antropologicum*. 34(2): 551–570.
- Reo, N.J.; Whyte, K.P. 2012. Hunting and morality as elements of traditional ecological knowledge. *Human Ecology*. 40: 15–27.
- Rocheleau, D.; Ross, L.; Morrobel, J.; Hernandez, R. 1996. *Forests, gardens and tree farms: gender, class and community at work in the landscapes of Zambrana-Chacuey, Dominican Republic*. Worcester, MA: Clark University.
- Ruelle, M.L.; Kassam, K.A.S. 2013. Foodways transmission in the Standing Rock Nation. *Food and Foodways*. 21(4): 315–339.
- Satterfield, T.; Gregory, R.; Klain, S. [and others]. 2013. Culture, intangibles, and metrics in environmental management. *Journal of Environmental Management*. 117: 103–114.
- Schroeder, R. 2002. Contemporary subsistence use of nontimber forest products in Alaska. In: Jones, E.T.; McLain, R.J.; Weigand, J., eds. *Nontimber forest products in the United States*. Lawrence, KS: University Press of Kansas: 300–326.
- Shorridge, B.G. 2005. Apple stack cake for dessert: Appalachian regional foods. *Journal of Geography*. 104(2): 65–73.
- Smith, H.H. 1923. Ethnobotany of the Menomini Indians. *Bulletin of the Public Museum of the City of Milwaukee*. 4(1): 8–175.
- Smith, L.T. 1999. *Decolonizing methodologies: research and indigenous peoples*. London: Zed Books Ltd. 215 p.
- Still, C.C. 1998. *Botany and healing: medicinal plants of New Jersey and the region*. New Brunswick, NJ: Rutgers University Press. 261 p.
- Tengberg, A.; Fredholm, S.; Eliasson, I. [and others]. 2012. Cultural ecosystem services provided by landscapes: Assessment of heritage values and identity. *Ecosystem Services*. 2: 14–26.
- Ticktin, T.; Whitehead, A.N.; Fraiola, H. 2006. Traditional gathering of native hula plants in alien-invaded Hawaiian forests: adaptive practices, impacts on alien invasive species and conservation implications. *Environmental Conservation*. 33(3): 185–194.
- Turner, N.J. 2001. “Doing it right”: issues and practices of sustainable harvesting of nontimber forest products relating to First Peoples in British Columbia. *Journal of Ecosystems and Management*. 1(1): art. 6.
- Turner, N.J.; Ari, Y.; Berkes, F. [and others]. 2009. Cultural management of living trees: an international perspective. *Journal of Ethnobiology*. 29(2): 237–270.
- Turner, N.J.; Clifton, H. 2009. It’s so different today: climate change and indigenous lifeways in British Columbia, Canada. *Global Environmental Change*. 19(2): 180–190.
- Turner, N.J.; Gregory, R.; Brooks, C. [and others]. 2008. From invisibility to transparency: identifying the implications. *Ecology and Society*. 13(2): 7.
- Turner, N.J.; von Aderkas, P. 2012. Sustained by First Nations: European newcomer’s use of indigenous plant foods in temperate North America. *Acta Societatis Botanicorum Poloniae*. 81(4): 295–315.
- United Nations. 2008. *United Nations Declaration on the Rights of Indigenous Peoples*, ed. General Assembly, 18. New York: United Nations.
- USDA Agricultural Research Service (USDA ARS). 2014. *National nutrient database for standard reference*, release 27, ed. N. D. Laboratory. Beltsville, MD.
- United States v. Winans, 198 U.S. 371, 381 (1905).
- Voeks, R.; Rashford, J. 2013. *African American ethnobotany in the Americas*. New York: Springer.
- Voggegger, G.; Lynn, K.; Daigle, J. [and others]. 2013. Cultural impacts to tribes from climate change influences on forests. *Climatic Change*. 120(3): 615–626.
- Williams, T.; Hardison, P. 2013. Culture, law, risk and governance: contexts of traditional knowledge in climate change adaptation. *Climatic Change*. 120(3): 531–544. doi:10.1007/s10584-013-0850-0.
- World Food Summit. 1996. *Rome declaration on world food security and world food summit plan of action*. Paper read at World Food Summit 1996, November 13–17. <http://www.fao.org/docrep/003/w3613e/w3613e00.htm>. [Date accessed: June 29, 2017].
- Wurtz, T.L.; Wiita, A.L.; Weber, N.S.; Pilz, D. 2005. Harvesting morels after wildfire in Alaska. Res. Note PNW-RN-546. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 31 p.