CHAPTER 1

Introduction

James L. Chamberlain
Tamara Ticktin
Marla R. Emery
Toral Patel-Weynand

The plants and fungi that are harvested from forests for purposes other than timber are not fully incorporated into management, policies, or resource valuation. These nontimber forest products (NTFPs) have important social, economic, and ecological values and they are integral to the culture of the people of the United States. The plants and fungi are fundamental to the functioning of healthy forests and are essential for the resilience of these ecosystems.

NTFPs are used for myriad purposes, providing cultural, social, and economic functions. People harvest and use these products for food, medicine, arts and crafts, and religious and cultural rituals. They also harvest, trade, and sell NTFPs in local to global markets. Harvesters represent a wide swath of the population, across generations, cultural groups, and sectors of society. This national NTFPs assessment provides the state of knowledge regarding the plants and fungi that comprise NTFPs and the people and markets that rely on them. The assessment also identifies challenges that climate variability and change may pose to these resources and to the services they provide.

In chapter 2, the assessment provides an overview of the diversity of products harvested in the United States as well as their means of production. Most NTFPs are harvested from natural populations across a mix of land ownerships. An estimated 20 to 25 percent of the United States population harvest NTFPs for personal use, and collection occurs on close to a quarter of family forest lands (Butler 2008, Butler et al. 2016, Cordell and Tarrant 2002). The industry can be divided into five broad market segments: culinary products, medicinal and dietary supplemtents, decorative products, nursery stock and landscaping, and fine arts and crafts. American ginseng (*Panax quinquefolius* L.; figure 1.1) is the iconic medicinal forest product; more is known about this forest herb than any other medicinal plant because of its long standing and widespread commercial harvest and its listing in appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (Chamberlain et al. 2013b). Common beargrass (*Xerophyllum tenax* (Pursh) Nutt.), a nontimber product from Pacific Northwest forests, is a prime example of a decorative product. Research on this species has demonstrated the importance of integrating traditional ecological knowledge and scientific knowledge into NTFP management (Hummel and Lake 2015, Hummel et al. 2012). Bareroot stock of Fraser fir (*Abies fraseri* (Pursh) Poir.), endemic to northwest North Carolina, is an example of the nursery stock and landscaping segment of the industry. Baskets of white birch bark are emblematic of NTFPs used for fine

Figure 1.1—American ginseng (*Panax quinquefolius* L.) is the iconic medicinal nontimber forest product. More is known about this forest herb than any other medicinal plant because of its long-standing and widespread commercial harvest and its listing in Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora. (Photo credit: Gary Kauffman, U.S. Department of Agriculture, Forest Service.)

arts and crafts (Emery et. al. 2014). Each geographic region in the United States also has its own culinary icon—maple syrup in the Northeast; fiddleheads (ostrich fern; *Matteuccia struthiopteris* (L.) Todaro) in Maine; pine nuts in the Southwest; mushrooms in the Northwest; ramps (*Allium tricoccum* Ait.) in the Southern Appalachia; and tropical fruits throughout Hawai'i, the Caribbean, and other island areas.

Standard silvicultural practices can be used to improve production of NTFPs, although there is little science-based management of the resources for these products. Forest farming, an agroforestry practice, can provide additional revenue for landowners who grow NTFPs under forest canopies. For most NTFP species, the science of forest farming is not well-developed, but there are many practical guidelines to lead implementation (Chamberlain et al. 2009, Mudge and Gabriel 2014). Forest farming of a few species, such as American ginseng and goldenseal (*Hydrastis canadensis* L.), has been occurring for over 100 years and is well-developed and understood. These model species provide valuable insights for other nontimber forest species.

Most NTFP species are harvested from natural populations, and the potential ecological impacts of harvesting, the possibilities for sustainable harvest, and some of the challenges that may impact NTFPs from climatic variability are discussed in chapter 3. The harvest of the plants and fungi can have impacts at multiple ecological scales—individuals, populations, communities, ecosystems, and landscapes (Ticktin 2004, 2015). The resilience or vulnerability of NTFP populations to harvest depends on the ecological, management, and social context of harvest.

The type of organ (e.g., roots and leaves) harvested and the plant's life history are two important factors that influence a species' potential resilience or vulnerability. The extraction of flowers, fruit, and seeds of long-lived perennials like trees has very high potential for sustainable harvest. Conversely, long-lived perennials tend to be highly sensitive to practices that impact adult survival (Franco and Silvertown 2004); therefore the harvest of bark, roots, rhizome, and bulbs, which leads to mortality of adult individuals, may have large negative impacts on population persistence (Chamberlain et al. 2013a, Schmidt et al. 2011). Almost all medicinal NTFPs that are commercially harvested are valued for their underground organs or for the whole plant (Alexander et al. 2011), and evidence indicates that these species can sustain only very low levels of harvest.

Harvest timing and management methods are important in determining the potential for sustainable harvest. Weed control, overstory manipulation, and replanting germplasm can increase growth, survival, and/or regeneration of natural populations. The seasonal timing of harvest; timing of harvest in the plant life cycle; and the frequency, intensity, and methods and size of harvest (e.g., Albrecht and McCarthy 2006, Sanders and McGraw 2005, Van der Voort and McGraw 2006) have ecological implications on natural populations. These practices are often part of traditional or local ecological knowledge and practice systems and can improve management efforts (Anderson 2005, Turner et al. 2000).

Sustainability of NTFP harvests requires understanding individual species and populations, as well as maintaining interspecific interactions, resistance to herbivore pressure, resilience to natural and anthropogenic disturbances, appropriate landscape management, and competing land uses or management objectives.

Climatic variability may present significant threats to forest-based plants and fungi species that are harvested for their nontimber products (figure 1.2). Predicted shifts in species distributions and phenology as a result of climatic variability may affect their production and ecology. Many NTFPs have wide distributions, although they may be adapted to local conditions, which may narrow their thermal niche, thus increasing vulnerability (Atkins and Travis 2010). Species composed of many locally adapted populations may be less likely to follow conditions of those natural sites as climate changes (Davis et al. 2005). Many species have limited seed dispersal distances, which increases the likelihood of local adaptation (Bennington and McGraw 1995, McGraw 1985), and increases their vulnerability to climatic variability (Davis et al. 2005, Etterson 2004).

NTFPs that are characterized by slow growth, long regeneration times, and low rates of reproduction will be slower to adapt to climatic variability than species that disperse seeds over long distances (Souther and McGraw 2014). Adaptation potential may be further reduced when harvest has decreased genetic variation, as this variation is a requisite for evolution to occur. Nontimber forest species are potential candidates for *ex situ* conservation programs, such as managed

Figure 1.2—Morel mushrooms (*Morchella* sp.). Mushrooms may be particularly susceptible to climatic variability and changes in disturbance regimes. (Photo credit: Michelle J. Baumflek, U.S. Department of Agriculture, Forest Service.)

relocation, but the relative benefits and risks of this conservation strategy need to be fully examined.

In addition to ecological considerations, NTFPs provide provisioning and cultural ecosystem services through contributions to food and health security, livelihood strategies, and spiritual and ceremonial observances, which may be affected by climatic variability (see chapter 4). The centrality of NTFPs for indigenous cultures is illustrated by a 1905 U.S. Supreme Court decision, which described access to such resources as "not much less necessary to the existence of the Indians as the air they breathe" (U.S. vs. Winans 1905). NTFP uses by other U.S. cultural groups include traditional knowledge systems and practices adapted from their place of origin, as well as knowledge learned from indigenous peoples (Turner and von Aderkas 2012), which together may help sustain the cultural identity and resilience of these communities, whether they have been in the country for generations or a few years. Loss of access to NTFPs as a result of climatic variability may present significant risk to cultural survival and material well-being of both individuals and groups (Emery et al. 2014, Garibaldi and Turner 2004).

Changes in spatial and temporal distributions of plants and fungi as a result of climatic variability may have some of the most immediate consequences. Changes in suitable habitat may mean that culturally important species are no longer available within the treaty territory of a tribe or become effectively inaccessible (Ginger et al. 2011). Observances central to cultural identity and the transmission of cultural knowledge may be compromised by shortages in species whose life cycles are dependent on particular climatic conditions. Altered seasonal variations in temperature and precipitation may result in phenological asynchronies that reduce the effectiveness of traditional ecological knowledge or result in a decline in the availability of species at key moments in culturally-defined livelihood cycles. The physical properties of NTFPs also may be altered by changes in hydrology and temperature or by pests and diseases. Increased climate variability also may affect the social structures and values of NTFPs through processes such as increased demand for species as a result of disruptions in food and medicine supplies or displacement and migration of peoples.

A full understanding of the role of NTFPs requires examination of additional social dimensions (chapter 5), including harvester demographics, knowledge, and stewardship practices. NTFP harvesters often possess extensive local and traditional knowledge and including them in planning for climatic variability offers an opportunity to improve management and governance outcomes. Many harvesting communities may be marginalized due to socioeconomic class, language challenges, or cultural barriers (Emery and Barron 2010,

Watson 2010), however, and particular effort will be necessary to assure their participation in such planning.

NTFPs contribute to the economy of this country (chapter 6). They provide part-time and full-time income and employment and can provide viable returns on investment. The products' market values can mitigate economic risks of low-income households, while their nonmarket values provide for subsistence, as well as cultural and recreational benefits. Changes in climate and related stressors may have significant impacts on these and other economic factors.

Some NTFPs have formal markets, while others are traded through informal markets. Harvest volumes of American ginseng are reported and tracked because it is regulated by an international convention. Other highly valued NTFP commodities (e.g., maple syrup, blueberries, moss, and lichens) are tracked by the U.S. Department of Commerce or the National Agricultural Statistics Service. However, the harvest of most NTFPs is neither tracked, monitored, nor recorded, making estimates of volumes and value of trade next to impossible.

Estimating a comprehensive value of NTFPs to the economy is challenging, as many products are traded in informal markets and collected for personal use (McLain et al. 2008). Products traded in the formal economy are easier to value, but still challenging. Using harvest permit data from Forest Service and U.S. Department of the Interior, Bureau of Land Management, Chamberlain et al. (2018) used methods developed by Alexander et al. (2011) to estimate the total wholesale value of NTFPs, which averaged approximately $253 million for the ten years (2004-2013) analysed.

NTFPs can play an important role as a revenue stream for forest landowners and landless households. Input costs for people who harvest from natural populations involve labor, transportation, equipment, and possibly permit fees to access the resource. Forest farming may involve higher input costs and the opportunity cost of the land needed for production. The opportunity cost of labor makes forest farming of some NTFPs not particularly profitable. Forest farming high-valued NTFPs, however, may be viable and coproduction of timber and nontimber products can improve profitability of forest operations, as well.

NTFPs also contribute monetary, and nonmonetary benefits to households. People derive value from harvesting for recreational or cultural purposes. Households may turn to NTFPs in times of economic crisis, such as when coal mines temporarily close (Bailey 1999) or when economic shocks affect individual households. The products also are used to build and maintain social capital, indirectly contributing to another household strategy for dealing with risk. Gift-giving and fundraising can strengthen local social capital (Baumflek et al. 2010, Emery et al. 2006). NTFPs contribute to household well-being by improving nutritional status, food and healthcare sovereignty, inputs to household maintenance, and the quality of recreational and cultural life.

There is much uncertainty in terms of the true economic impact of climatic variability on NTFPs. Extreme weather events may cause acute (short-term but strong magnitude) impacts. During more frequent crises, communities may rely more heavily on NTFPs, or they may lose access to NTFP resources due to declines in populations or changes in their natural habitats. Thus, there is a risk of an added economic impact that may adversely affect those communities in crises.

Finally, the regulatory landscape for managing NTFPs is as complex as the broad spectrum of harvesters, users, species, and products. Regulations and policies that address access to, management, extraction, trade, or conservation of NTFPs exist at multiple governmental levels (chapter 7). Many national legal and administrative frameworks that impact NTFPs pertain to controlling their harvest based on protected status, commodity type, or the purpose of the extraction. Early approaches resulted in regulations to restrict access, prevent spread of plant disease or invasive species, or assess taxes for commerce. Reserved federally recognized rights of American Indians and Alaska Natives, and state-level subsistence regulations increase the complexity for balancing the rights to harvest with the need to conserve the resources.

The major principles shaping national regulations and policies stem from the shift to ecosystem-based management in the 1990s to recent efforts to be more inclusive in conservation of the resources. Several national

laws relevant to NTFPs apply across all agencies, and the major land management agencies are governed by specific regulations and have operating policies that shape their behavior with respect to NTFPs. Different international and Federal policies are applicable to indigenous and tribal peoples to access, use, and conserve NTFPs. The variety of agencies and expertise involved in the regulation of the products and the policies generated from them are variable and distinct to each State, and may range from no specific regulations to a complex regulatory environment incorporating NTFPs within natural resource management regulations. County and municipal-level regulations are expected to comply with overarching Federal, tribal, and state-level regulations and may be based on laws that delineate conversion of land uses that affect forest cover.

NTFP policies and regulations exist within complex and dynamic socioecological governance systems. Development of policies for the sustainable use and access of NTFPs are complicated by lack of species-specific biological information on how much harvest pressure species can withstand while remaining viable elements of forest ecosystems. Natural resource policy recognizes the merits of community-based conservation and the reliance of communities on natural resources for health, subsistence, and economic needs. Participation in international dialogues regarding NTFPs provides opportunities for a broader understanding of the conservation and management of these resources.

The forest plants and fungi that provide nontimber products are rarely considered in national climate change research and discussions and are underrepresented in related policies. Potential impacts must often be inferred from forest-level studies that focus on predominant tree species. Few policies and assessments address the dependence of forest-based communities on NTFPs and the vulnerability of associated social, cultural, and economic systems to climatic variability. This report takes an important first step, by providing a comprehensive assessment of the multiple dimensions NTFPs, the ecosystem goods and services they provide, and the threats that climate variability and change may pose to their long-term availability.

1.1 Literature Cited

Albrecht, M.A.; McCarthy, B.C. 2006. Comparative analysis of goldenseal (*Hydrastis canadensis* L.) population re-growth following human harvest: implications for conservation. The American Midland Naturalist. 156(2): 229–236.

Alexander, S.J.; Oswalt, S.N.; Emery, M.R. 2011. Nontimber forest products in the United States: Montreal Process indicators as measures of current conditions and sustainability. Gen. Tech. Rep. PNW-GTR-851. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 36 p.

Anderson, K. 2005. Tending the wild: Native American knowledge and the management of California's natural resources. Berkeley: University of California Press. 558 p.

Atkins, K.E.; Travis, J.M.J. 2010. Local adaptation and the evolution of species' ranges under climate change. Journal of Theoretical Biology. 266: 449–457.

Bailey, B. 1999. Social and economic impacts of wild harvested products. Morgantown: West Virginia University. Ph.D. dissertation. 103 p.

Baumflek, M.J.; Emery, M.R.; Ginger, C. 2010. Culturally and economically important nontimber forest products of Northern Maine. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 74 p.

Bennington, C.; McGraw, J. 1995. Natural selection and ecotypic differentiation in Impatiens pallida. Ecological Monographs. 65(3): 303–323.

Butler, B.J. 2008. Family forest owners of the United States, 2006. Gen. Tech. Rep. NRS-27. Newton Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 72 p.

Butler, B.J.; Hewes, J.H.; Dickinson, B.J. [and others]. 2016. USDA Forest Service National Woodland Owner Survey: national, regional, and state statistics for family forest and woodland ownerships with 10+ acres, 2011–2013. Res. Bull. NRS-99. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 39 p.

Chamberlain, J.L.; Mitchell, D.; Brigham, T. [and others]. 2009. Forest farming practices. In: Garret, H.E. North American agroforesty: an integrated science and practice. 2nd ed. Madison, WI: America Society of Agronomy: 219–255.

Chamberlain, J.L.; Ness, G.; Small, C.J. [and others]. 2013a. Modeling below-ground biomass to improve sustainable management of *Actaea racemosa*, a globally important medicinal forest product. Forest Ecology and Management. 293: 1–8.

Chamberlain, J.L.; Prisley, S.; McGuffin, M. 2013b. Understanding the relationship between American ginseng harvest and hardwood forests inventory and timber harvest to improve co-management of the forests of Eastern United States. Journal of Sustainable Forestry. 32(6): 605–624.

Chamberlain, J.L.; Teets, A.; Kruger, S. 2018. Nontimber forest products in the United States: an analysis for the 2015 National Sustainable Forest Report. e-Gen. Tech. Rep. SRS-229. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 42 p.

Cordell, H.K.; Tarrant, M.A. 2002. Forest-based outdoor recreation. In: Wear, D.N.; Greis, J.G., eds. Southern Forest resource assessment. Gen Tech. Rep. SRS-53. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station: 269–282.

Davis, M.; Shaw, R.; Etterson, J. 2005. Evolutionary responses to changing climate. Ecology. 86: 1704–1714.

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: Center for Integrated Natural Resources and Agricultural Management (CINRAM), University of Minnesota: 25–32.

Emery, M.R.; Barron, E.S. 2010. Using local ecological knowledge to assess morel decline in the U.S. mid-Atlantic region. Economic Botany. 64: 205–216.

Emery, M.R.; Martin, S.; Dyke, A. 2006. Wild harvests from Scottish woodlands: social, cultural and economic values of contemporary nontimber forest products. Edinburgh, Scotland: Forestry Commission. 40 p.

Emery, M.R.; Wrobel, A.; Hansen, M.H. [and others]. 2014. Using traditional ecological knowledge as a basis for targeted forest inventories: paper birch (*Betula papyrifera*) in the US Great Lakes region. Journal of Forestry. 112(2): 207–214.

Etterson, J. 2004. Evolutionary potential of *Chamaecrista fasciculata* in relation to climate change. I. Clinal patterns of selection along an environmental gradient in the Great Plains. Evolution. 58(7): 1446–1456.

Franco, M.; Silvertown, J. 2004. A comparative demography of plants based on elasticities of vital rates. Ecology. 85: 532–538.

Garibaldi, A.; Turner, N.J. 2004. Cultural keystone species: implications for ecological conservation and restoration. Ecology and Society. 9(3): art 1.

Ginger, C.; Emery, M.R.; Baumflek, M.J.; Putnam, D.E. 2011. Access to natural resources on private property: factors beyond right of entry. Society & Natural Resources. 25: 700–715.

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.

Hummel, S.; Foltz-Jordan, S.; Polasky, S. 2012. Natural and cultural history of beargrass (*Xerophyllum tenax*). Gen. Tech. Rep. PNW-GTR-864. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 80 p.

McLain, R.J.; Alexander, S.J.; Jones, E.T. 2008. Incorporating understanding of informal economic activity in natural resource and economic development policy. Gen. Tech. Rep. PNW-GTR-755. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 53 p.

McGraw, J. 1985. Experimental ecology of *Dryas octopetala* ecotypes. III. Environmental factors and plant growth. Arctic and Alpine Research. 17: 229–239.

Mudge, K.; Gabriel, S. 2014. Farming the woods. White River Junction, VT: Chelsea Green Publishers. 359 p.

Sanders, S.; McGraw, J.B. 2005. Harvest recovery of goldenseal, *Hydrastis canadensis* L. The American Midland Naturalist. 153: 87–94.

Schmidt, I.; Mandle, L.; Ticktin, T.; Gaoue, O. 2011. What do matrix population models reveal about sustainability of harvesting nontimber forest products (NTFP)? Journal of Applied Ecology. 48(4): 815–826.

Souther, S.; McGraw, J.B. 2014. Synergistic effects of climate change and harvest on extinction risk of American ginseng. Ecological Applications. 24(6): 1463–1477.

Ticktin, T. 2004. The ecological consequences of harvesting nontimber forest products. Journal of Applied Ecology. 41: 11–21.

Ticktin, T. 2015. The ecological sustainability of harvesting nontimber forest product harvest: principles and methods. In: Shackleton, C.; Pandey A.; Ticktin, T., eds. Ecological sustainability of nontimber forest products: case studies of harvesting. London: Earthscan: 31–52.

Turner, N.J.; Ignace, B.; Ignace, R. 2000. Traditional ecological knowledge and wisdom of aboriginal people in British Columbia. Ecological Applications. 10: 1275–1287.

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 States v. Winans, 198 U.S. 371, 381 (1905).

Van der Voort, M.E.; McGraw, J.B. 2006. Effects of harvester behavior on population growth rate affects sustainability of ginseng trade. Biological Conservation. 130: 505–516.

Watson, K. 2010. Tupelo forests and honey production along the Apalachicola River of Northwest Florida: livelihood preservation and forest conservation in a changing rural landscape. Tallahassee: Florida State University. Ph.D. dissertation. 165 p.