

human dimensions

# Opportunities for Enhancing Nontimber Forest Products Management in the United States

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This article addresses aspects of nontimber forest products (NTFPs) management in the United States. Results from a thematic synthesis of literature germane to harvesters and forest managers indicate that many NTFPs have considerable markets but most are inadequately monitored, economically underregulated, and ecologically poorly understood. The people who harvest wild-grown NTFPs are often referred to as wildcrafters. Literature suggests that wildcrafters have historically been marginalized and are often reticent to share information or to participate in government-led initiatives. Additionally, forest managers and wildcrafters often are unable or unwilling to work together. Social networking has been suggested as a way to improve collaboration between the two stakeholders. Some examples of successful networks exist, but norms and priorities may inhibit greater participation. Asynchronous communication via the Internet and other wireless technology could improve the situation. Developing systematic inventory systems, designing NTFP output reporting protocols, advancing forest farming, and improving access to information on NTFP markets, policies, and practices may also be useful. The need for improvement on all fronts is increasingly relevant because of growing demand for NTFPs.

**Keywords:** forest management, wildcrafting, forest farming, forest inventory, NTFPs

Nontimber forest products (NTFP) include a broad range of edible, medicinal, decorative, and handicraft goods harvested from woodlands (Chamberlain et al. 1998, Morse 2003, Thandani 2001). From mushrooms and plants such as goldenseal to pine straw, grape vines, and cypress knees, NTFPs are a notable part of the US forest economy (Duryea 1988, Dix et al. 1997, Jones and Lynch 2002, Taylor and Foster 2003). The total monetary value of NTFPs is difficult to estimate because of the informal nature of many NTFP markets and lack of compre-

hensive product tracking and inventory (Chamberlain et al. 2009, USDA Forest Service 2011). Nevertheless, numerous species- and regional-specific estimates have been published that establish their importance as a forest product.

In 1989, for instance, the Pacific Northwest floral green industry added nearly \$81 million to the US gross domestic product, used an estimated 10,300 people, and paid almost \$50 million for wild cuttings (Schlosser et al. 1991). The wild mushroom industry in Oregon, Idaho, and Washington used roughly 11,000 individuals in 1993,

and in 1995 maple syrup production in the United States generated revenues totaling \$25 million (Alexander 1999, Lynch 2004). Herbal medicinal sales in the United States in 1997 were estimated to have been between \$1.6 and 2 billion, and annual wild ginseng exports were somewhere between \$29 and 58 million (Chamberlain et al. 2002). Between 1998 and 2003, the average annual harvests of moss from forests in the Pacific Northwest and Appalachia were estimated to be as high as 20.2 thousand air-dried tons (Muir et al. 2006). The aggregate annual value of NTFP harvests in North America likely runs in the tens of billions of dollars (McLain and Jones 2005).

Wildcrafters are the people who harvest wild grown NTFPs, and they are as diverse and widespread as the products they gather. For some, NTFPs are a primary or supplemental source of livelihood, and for others they are a means for recreation. Professional wildcrafters collect and sell NTFPs for profit, and professional harvesting occurs in practically every region of the United States. Recreational wildcrafters, which are the largest and most rapidly growing type, gather edible items to consume or seek materials for crafts that are personally used, given as

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gifts, or donated; they are often more socio-economically stable and politically active than their professional wildcrafting counterparts (Love and Jones 1997, Love et al. 1998, Jahnige 2002, Emery et al. 2006, Robbins et al. 2008). Professional wildcrafters historically have often been marginalized because of norms and industry decentralization, and on the whole they have played a limited role in formal NTFP management (Savage 1995, Antypas et al. 2002, Lynch et al. 2004, Arora 2008).

At the same time, forest managers admit feeling daunted by the prospect of NTFP management (Chamberlain 2002). Much of their apprehension likely stems from the lack of information about sustainable harvesting and the nuances of wildcrafter culture and operations. As a result, comprehensive management procedures are rare, and NTFP harvesting often occurs with little to no oversight because the parameters for sustainability are difficult to define and therefore enforce (see, e.g., Peck and Muir 2007). Nevertheless, some national forests have, e.g., implemented permit programs, designated harvest seasons, and specified gathering areas and volume limits in an attempt to regulate and systematically track the rates of removal (Love et al. 1998, Alexander et al. 2001, Antypas et al. 2002, Jones and Lynch 2002, Lynch and McLain 2003). However, Muir et al. (2006) suggest that these management efforts may be only able to effectively track a small portion of harvested NTFPs.

With this situation in mind, we reviewed literature pertaining to NTFP management in the United States. The project's objectives and methods are described first, followed by a review of key NTFPs, wildcrafting, challenges faced by forest managers, and NTFP markets. We then consider how social networks, forest farming, and a systematic inventory and product output initiative may enhance NTFP management.

## Objectives and Methods

Our goal was to study wildcrafter and forest manager collaboration and NTFP management more generally and to suggest strategies for enhancing both. Objectives of the study were threefold. First, we systematically selected relevant literature. We then reviewed these sources to identify pertinent themes. Finally, we discuss how these themes relate to wildcrafters and forest managers and NTFP management.

Multiple databases (e.g., government,

United Nations, library, and journal) were searched using NTFP management and wildcrafting keywords. Searches were conducted using keywords such as “nontimber forest product,” “NTFP,” “nonwood forest product,” “minor forest product,” “special forest product,” and “forest farming” to identify relevant literature dating back as far as the 1960s. Databases searched include Treesearch, Food and Agriculture Organization Document Repository, scientific journals, web of science, and numerous library collections. Two hundred twenty-one applicable publications were identified, 64 journal articles, 52 conference proceedings, 50 books or book chapters, 50 reports and serials produced by the USDA Forest Service, nongovernmental organizations, and the United Nations, and 5 masters and doctoral theses. The literature were then evaluated for usefulness in this study and grouped according to publication source and research method. Usefulness was determined based on whether the source characterized key NTFPs and their associated markets, covered any aspect related to wildcrafting, discussed forest managers and NTFPs, and/or touched on networking and NTFP management dynamics.

By far the largest volume of literature used in this project was published by the US Forest Service as general technical reports. Because most publications are based on qualitative research and the total volume of peer-reviewed literature is relatively small, a thematic synthesis of these secondary data was used to aggregate and analyze content. Findings are presented accordingly, and specific indicators are offered where appropriate to highlight contextual evidence for the thematic result.

## Nontimber Forest Products

A substantial number of NTFPs are harvested for subsistence and household income from tropical and temperate forests around the world. In Indonesia, e.g., more than 1,200 species of medicinal forest plants are harvested and sold in local and international markets. Ninety-nine percent of the 400–500 species sold for traditional medicine in South Africa are wild harvested, and more than 1,500 temperate forest plant species have medicinal value, most of which are harvested from wild populations (Secretariat of the Convention on Biological Diversity 2001).

A great number of forest plants are harvested for other reasons. Emery (2001) identified 138 NTFPs that are collected for nonmarket reasons by rural households in northern Michigan. More than 50 native plant species are harvested from forests of the United States for floral and greenery markets (Thomas and Schumann 1993). In Appalachia, forests are the source of more than 30 plant species that are harvested for decorative markets (Nelson and Williamson 1970). Many of these are readily recognized and commonly used among US and global consumers.

According to the American Herbal Products Association (2007), the fruit of saw palmetto, collected from forests in Florida and Georgia, was the most abundantly harvested medicinal NTFP in terms of dry weight (USDA Forest Service 2011). Primary medicinal forest product commodities, after saw palmetto are cascara bark (Pacific Northwest), slippery elm bark (eastern Midwest forests), black cohosh (eastern hardwood forests), goldenseal (eastern Midwest forests), and wild yam tubers (eastern and Midwest forests). Each year the harvest

### Management and Policy Implications

Forest managers need to be aware of the prevalence and challenges of NTFPs. In the United States, NTFPs are widely used for subsistence and generate tens of billions of dollars of revenue annually. They are disproportionately important to marginalized groups such as non-English-speaking immigrants and impoverished rural families. Ensuring that harvest volumes and methods are sustainable has become ever more important in the past few decades as harvest pressures have increased. However, development of harvest guidelines has proven challenging because few NTFP inventories exist and most harvesters are secretive about their activities. Electronic tracking and asynchronous harvester manager communication offer opportunities for improved inventory and harvest guideline implementation. Intentional cultivation or forest farming of NTFPs in the forest understory can be a sustainable method to grow and sell NTFPs. If forest managers implement harvesting guidelines and leases, NTFPs may yield a marketable product from nonharvestable stands and serve as an intermediate income stream while timber matures.

of American ginseng from natural forests generates millions of dollars for rural harvesters in 19 states. Twelve of the 22 medicinal forest plant species tracked by the American Herbal Products Association are native to the eastern hardwood forests.

NTFPs also are harvested for sale to floral and decorative industries. Galax leaves, harvested from 9 counties in western North Carolina for an international market, were valued between \$10 million and 18 million in 2003 (Greenfield and Davis 2003). Pine straw, collected from plantations across the southern United States, provides significant income to landowners and challenges to forest managers. In Georgia, e.g., the total estimated farm gate value of pine straw, for 2001 through 2005, was over \$132 million, with an average annual value of \$26.5 million (Harper et al. 2009). In Minnesota and other north central states, harvests of conifer boughs, during a few months each fall, support a multimillion dollar rural-based industry. Likewise, the leaves of salal and beargrass from Pacific Northwest forests provide tens of millions of dollars to the region's economy every year (Chamberlain 2002).

US forests are also an important source of food. More than 1.6 million lb of edible fruits, nuts, berries, and sap were permitted for harvest on public lands in 2007 (USDA Forest Service 2011). Almost 88% of this came from Pacific coast forests. In that same year, more than 7 million taps produced 1.3 million gal of maple syrup. Data on the volume of other edible forest products, such as fiddlehead ferns, mushrooms, and ramps, is generally lacking. Whether edible, floral, medicinal, or craft-based, the magnitude of NTFPs is clear.

## Wildcrafters

Tens of thousands of wildcrafters in the United States harvest NTFPs for full-time, part-time, or supplemental income, and many more gather recreationally (Jones and Lynch 2002). For instance, McLain et al. (2005) estimate that in the Pacific Northwest region alone, somewhere between 3,000 and 4,000 professional and 3,750 recreational wildcrafters annually harvest morel mushrooms. Wildcrafters are a diverse group with varied motivations, including spirituality, culture, science, subsistence, revenue, and leisure (McLain 2008). They have a passion for NTFPs, derive satisfaction from harvesting, and feel connected to forests through the products they sell or use

(Schlosser et al. 1991, Emery et al. 2002, 2006, Jahnige 2002, Wilsey and Nelson 2008).

Professional wildcrafters depend on the harvest, and many follow seasonal and spatial variations in NTFP availability. For example, some pursue mushroom flushes or respond to cyclic availability of floral greens (Lynch and McLain 2003, McLain et al. 2005). Wildcrafters that follow the availability of NTFPs often do so for extended periods of time. Periodic NTFP availability forces many to shadow fruiting phases (McLain et al. 2005). As examples, mushroom pickers pursue harvesting across the West Coast as species and locations of flushing change, and wildcrafters of floral greens often work seasonally to harvest agricultural crops or labor at construction jobs between wildcrafting seasons (McLain and Jones 1997).

On the other hand, some wildcrafters do not travel far from their homes. They may harvest NTFPs on their own property, take weekend gathering trips, or make daily drivable excursions to public forests. Local harvesting in timber-dependent communities also has increased as economies decline (McLain et al. 2005). In other areas, such as Appalachia, seasonal ginseng, ramp, morel, and galax harvesting is a common local enterprise that has been passed down between generations. Meanwhile, an estimated 1.7 million family forest owners have harvested NTFPs on their property (Butler 2008).

In recent years, harvesting for supplemental or full income has increased among minorities and migrant workers (Emery et al. 2002, Arora 2008). In the Pacific Northwest, e.g., McLain et al. (2005) found that Asians predominate among professional morel mushroom harvesters, and Latinos are the floral gathering majority. A sizable number of immigrants, many of whom are not native English speakers, also partake in local wildcrafting (Emery 1998, Emery and O'halek 2001, Emery et al. 2002, Arora 2008).

An increasing number of wildcrafters harvest without sales in mind. These recreationists make up the largest and most rapidly growing group of wildcrafters (Robbins et al. 2008). They may look for edible items to consume or seek materials for crafts that are used personally, given as gifts, or donated (Jahnige 2002, Emery et al. 2006). Unlike most professionals, recreationists often have greater political leverage because of their vis-

ibility, demographics, and success in developing special interest groups such as mycology clubs and environmental groups (Love and Jones 1997, Love et al. 1998).

The literature suggests that concern about NTFP sustainability is increasing among wildcrafters. In western Washington, e.g., apprehension about the long-term viability of NTFPs has increased in response to growing competition for harvesting sites (Love et al. 1998, Lynch and McLain 2003). Many wildcrafters use conservation measures, including replanting seeds, gathering after plants have reproduced, collecting only a portion of the plant population, selecting old or unhealthy plants, removing marketable portions with minimal damage to the residual plant, and rotating harvest locations (Emery 2001, Love and Jones 2001, Emery et al. 2002, Jones and Lynch 2002). Concerns about sustainability have also led to increased interest in forest farming of NTFPs (Chamberlain et al. 2009). Forest farming is an agroforestry practice that intentionally cultivates NTFPs under an existing or emerging forest canopy and is an alternative to wild gathering that could enhance NTFP sustainability (University of Missouri Center for Agroforestry 2012).

## Forest Managers

Forest managers are generally aware that a great number of NTFPs are harvested annually, and many would like to know more about management options and the people that collect, sell, and aggregate them. For one, NTFP populations face harvesting and habitat loss pressure, and because little is known about standing volume and rates of harvest, appropriate management strategies often are unclear (Alexander et al. 2001, Chamberlain et al. 2002, Kerns et al. 2002). NTFPs usually are not monitored or listed in landscape databases and are inventoried on less than 10% of state-owned lands and 40% of national forests (Lynch et al. 2004, McLain and Jones 2005, Jones and Lynch 2002). Chamberlain et al. (2002) found that less than 1% of the text in management plans for eastern US national forests relates to NTFPs, and monitoring is often a low priority because NTFPs are considered by some to be a service rather than a product. Somewhat differently, forest certification systems promote management of NTFPs but usually do not define specific parameters for doing so (Burkhart and Jacobson 2009).

Forest managers that would like to develop NTFP programs or consultancies



often are ill-equipped because they lack time, money, personnel, and/or technical information (Gautam and Watanabe 2002, Lynch et al. 2004). Two public land-management approaches that have been used with some success are harvesting permits and area-restricted harvesting (Savage 1995, Chamberlain et al. 2002, Arora 2008). Established in 2000, The Federal Pilot Program of Charges and Fees for Harvest of Forest Botanical Products sets ground rules for correlating NTFP permit fees with fair market values and estimates of sustainable harvesting (USDA Forest Service 2011). Lynch and McLain (2003) report that some forest managers believe NTFP rules and regulations only minimally affect wildcrafting, but McLain et al. (2008) report that permit programs reduce wildcrafter autonomy and cause many to work for highly capitalized companies that can absorb the fees but pay them little. Muir et al. (2006) show that despite the efforts of some forest managers, large volumes of harvested NTFPs may go unaccounted for. Also, McLain (2000) suggests that the ability of wildcrafters to afford permits to collect from national forests has been overlooked, and Jones and Lynch (2002) suggest that forest management efforts often fall short because wildcrafter needs and norms are not well understood.

Wildcrafter norms often prevent forest managers from learning about their practices, preferences, and needs (Bailey 1999). Recreational wildcrafters may be more engaged, but interaction between wildcrafters and forest managers seems inconsistent at best. Without improvement, forest managers will likely have no choice but to go about “business as usual”; many wildcrafters will remain marginalized and hidden, and large quantities of harvested NTFPs may go unaccounted for. Increasing communication between both could improve the situation while enhancing market flexibility and NTFP sustainability. Volunteer participation in NTFP monitoring has been considered as a way to overcome in-house limitations and increase interaction between wildcrafters and public forest managers (Lynch 2004, Lynch et al. 2004).

Through volunteer monitoring, wildcrafters could share their traditional ecological knowledge with forest managers and labor for mutual benefit. For instance, mushroom pickers in the Pacific Northwest already regularly monitor and sample NTFPs and have developed a store of mycological data. Appalachian “sangers” track

ginseng patches using traditional biological and geophysical signals (Love et al. 1998). Moreover, market monitoring among professional wildcrafters could be very useful for forest managers (Love et al. 1998, Emery and Pierce 2005). A survey of US Forest Service managers by McLain and Jones (2005) found that 58% think wildcrafters could contribute meaningfully to NTFP monitoring and management, but such arrangements need to include targeted incentives and strike a better balance between large-scale commercial and subsistence-focused forest management (Charnley et al. 2007, Rist et al. 2011).

Another important aspect faced by forest managers is the potential for conflict between professional and recreational wildcrafters (Love et al. 1998, McLain 2000). Robbins et al. (2008) found that 88% of wildcrafters in New England harvest for personal, not professional, use. Some of the tension also may be caused by differences in communication with forest managers. Professional wildcrafters often are secretive and marginalized, whereas recreational harvesters are better mobilized and networked. Professional wildcrafters indicate that they have been reluctant to participate in collaborative NTFP management because they distrust recreationists (Lynch et al. 2004). On the other hand, recreational wildcrafters have been known to think of professionals as intent on squeezing as much as possible out of any population (Love et al. 1998). Examples of cooperation between professional and recreational wildcrafters exist, but large-scale efforts to compatibly manage NTFPs could be challenging.

According to Lynch et al. (2004) professional wildcrafters are reluctant to participate in monitoring efforts because they do not want to expose their harvest locations and also distrust forest managers and recreational gatherers. They shy away from group work and regulatory attention and may not have requisite language skills. Meanwhile, many forest managers hesitate to interact with wildcrafters because they perceive the group as a whole to be hidden (Emery 2001, Love and Jones 2001, Emery et al. 2002, Jones and Lynch 2002, Emery and Pierce 2005, Pierce and Emery 2005).

## NTFP Markets

NTFP harvesting can be a temporary way to make ends meet, a way to generate consistent income, or simply a recreational endeavor (Emery et al. 2002, Pierce and

Emery 2005). It is flexible, has low- or no-cost market entry, and generally is possible on public lands (Emery 2002). Nonetheless, wages for professional wildcrafters are often low and value-added activities underpursued (Everett 1996, Emery 2001). In 1998, e.g., commercial mushroom pickers in the Olympic peninsula grossed an average of \$30/day, and most fell into impoverished and lower middle income brackets (Love et al. 1998). Additionally, Everett’s (1996) observations in the Pacific Northwest indicate that adding value to NTFPs is not commonplace. Several studies suggest that the informal and imperfect nature of NTFP markets is to blame (Taylor et al. 1996, Alexander et al. 2001, Emery 2001, Love and Jones 2001, Emery et al. 2002, McLain et al. 2008).

Imperfect markets operate without full knowledge of market conditions, and informal markets have few or no formal regulations to protect or record the goods that are produced, distributed, and consumed (Neumann and Hirsch 2000). According to Teel and Buck (1998), most NTFP transactions are never reported to the government, taxed, or regulated for safety standards or working conditions, although some threatened species are tracked for conservation purposes. Ginseng is one of the few regulated NTFPs, but harvest and export volumes are often contradictory (Robbins 1998).

Evidence from the northeastern and western United States suggests that returns on harvested NTFPs are low because competitive pricing is lacking (Emery 2002, McLain et al. 2005). Examples from the Rio Grande National Forest show that harvesting profits are also vulnerable to changes in transportation costs and volatile labor shifts (Spero and Fleming 2002). As a result, wildcrafting enterprises often remain small to stay flexible and maximize the returns associated with being mostly tax free, regulation free, and low cost (Alexander et al. 2002). However, the tendency to remain small and flexible can complicate management strategies such as permitting programs. For instance, Charnley et al. (2007) suggest that permitting programs on national forests in the West have strained wildcrafter profitability, perhaps forcing many to harvest without a permit.

Lack of market information is a continual source of frustration for wildcrafters and forest managers, and fluctuations in the supply, demand, and price of NTFPs often hamper efforts by both to formally manage

NTFPs (Chamberlain 2002, Vance 2002). The situation is additionally complicated by the often long and difficult trade pathways for NTFPs, which typically are managed by intermediaries. For example, fiddleheads (immature ferns) are first harvested, and then aggregated, and then sold to local processors, and finally shipped to restaurants. Princess pine is gathered and usually sold to a national processor in Wisconsin who then distributes throughout the United States and Mexico to floral suppliers and wild ginseng roots often pass through several intermediaries before export, auction in Hong Kong, and re-export to processors and retail outlets worldwide (Robbins 1998, Spero and Fleming 2002). Pierce (1999) and Burkhart and Jacobson (2009) suggest that increasing the role of forest certification systems in NTFP management may improve market conditions and build opportunities to better monitor standing and harvested volumes. Use of formalized forest farming on private land could also help by improving product consistency and standards.

It is possible that in some situations NTFP intermediaries could be circumvented and end users sold to directly (Letchworth 2001, Neumann and Hirsch 2000). End-user alternatives include selling raw or value-added products into small niche markets or directly to large manufacturers and retailers, a combination of which could reduce risk and introduce greater harvesting consistency (Shackleton et al. 2007). Buyer-seller trust would be important in niche markets, which would require a consistent supply of high-quality NTFPs and a level of authenticity that makes them distinctive, nonreplicable, and resistant to price competition (Gold et al. 2004). Size is one drawback to niche markets, which are typically small and can lead to high volatility and potentially exacerbate uncertainty surrounding harvests. Conversely, lower volatility is possible if selling directly to manufacturers and retailers, but they also typically require more volume than most can harvest (Letchworth 2001).

## Opportunities

Defined as the interlocking of individuals with shared interests to help organize social action (Scott 2000), social networking has been suggested as a way to enhance trust and collaboration between wildcrafters and forest managers and improve NTFP markets and management (e.g., Banana 1996, Touchette 1998, Letchworth 2001,

McLain 2000, Neumann and Hirsch 2000, McLain and Jones 2001, Gold et al. 2004, Nybakk et al. 2009). Social networks centered on NTFP management have had some success (Lynch et al. 2004, Kelly and Bliss 2009, Sirianni 2009). For example, discussions hosted by the Jefferson Center, a non-government organization in Oregon, resulted in a letter to the US Forest Service followed by development of a formal cross-state NTFP association (McLain and Jones 1997). An NTFP partnership developed by the Falls Brook Center, University of New Brunswick, and the Canadian Forest Service to develop yew harvesting guidelines and promote voluntary acceptance in the Pacific Northwest is another example (Smith et al. 2003). In Asia, the Non-Timber Forest Products Exchange Program has worked the past 15 years through its social network to enhance NTFP management, add value to rattan market chains, and organize participatory NTFP monitoring (Non-Timber Forest Products Exchange Programme for South and Southeast Asia 2010).

Social networks also could help refine NTFP research and regulatory direction (Zaheer et al. 1998). Coordinated monitoring via networks may help verify the stability of wild populations and increase interaction between stakeholders (Emery and Pierce 2005). In terms of NTFP markets, social networks could help boost profits, expand niche-market or large-scale distributor access, enforce industry norms, leverage competition, and circulate technical and trade information (Touchette 1998, Neumann and Hirsch 2000, Gold et al. 2004). They also could facilitate information sharing such as names and locations of buyers, quantities and qualities demanded, advertising opportunities, and distribution channels (Banana 1996, Letchworth 2001). In Virginia, e.g., a network of forest farmers recently formed to research the viability of growing native medicinal herbs in the Appalachian forest understory (Vaughan 2011).

Increasing NTFP social networks could pay dividends, but how they are administered is an important consideration. Synchronized, interpersonal networks may not appeal to many wildcrafters. Communication among wildcrafters always has been challenging. Group meetings and advertising through printed media have historically been ineffective, and many wildcrafters avoid group settings (Lynch et al. 2004). For example, researchers have had the most luck interviewing wildcrafters in the woods or at

their camps (Lynch 2004, Lynch et al. 2004). Synchronized networks also could be challenging for forest managers, because most are unlikely to have the time to meet regularly with or lead wildcrafter networks. Many of the 1.7 million forest owners and tens of thousands of recreationists that gather NTFPs may not have time to regularly travel or commit to scheduled meetings. Asynchronous networking is another option. The question is how to balance wildcrafter identity, forest manager efficiency, and convenience and accessibility while maintaining NTFP procedural integrity.

Recent advances in electronic communication may reduce the opportunity costs of NTFP networks by allowing self-selected, asynchronous participation (Finholt et al. 1990, Wittig and Schmitz 1996). Boyd and Ellison (2007) define online social networks as “an online service that is based around the building and reflecting of social relations among individuals with common interests or social ties.” The upshot of an online network could be that wildcrafters and forest managers are connected but not threatened or burdened. Wildcrafters and forest managers could communicate when and where possible. Online translation devices could help overcome language barriers. Access to high-capacity mobile devices is increasing and may be useful for coordinating NTFP monitoring and simultaneously discussing multiple topics and working on various goals. Including as many or as few networked recipients saves time, which would be important for busy forest managers and wildcrafters with multiple jobs. Virtual NTFP networks could address information such as fruiting locations, ecology, permitting tips, forest farming techniques, general concerns, and market suggestions. Wildcrafters, forest managers, or other parties such as researchers and extension agents could initiate listserves, blogs, “Google” Groups, “Twitter,” “Facebook” pages, and similar tools.

Forest farming is another potential opportunity. Recall that it is an agroforestry practice that cultivates NTFPs under an existing or emerging forest canopy and could help improve NTFP management and markets. Although informal forest farming techniques have been used for generations, interest in refining and formalizing them has recently increased, along with efforts to expand farming through production- and market-side development (Chamberlain et

al. 2009). Driving much of this is the fact that a formal system appeals to many forest owners, a sizable amount of who already harvest NTFPs (Butler 2008). For example, over 40% of southeastern US landowners surveyed by Workman et al. (2003) desire more information on forest farming. Kays (2004) reported that over half of the extension agents and almost 30% of foresters in the mid-Atlantic states have been queried by landowners about NTFPs and forest farming. In Pennsylvania, Strong and Jacobson (2006) found that landowners expressed more interest in NTFPs than any other agroforestry product.

Forest farming could benefit wildcrafting enterprise and interest in that it offers opportunities to strengthen NTFP markets and management and sustain wild populations. More specifically, it could assist in wildcrafter efforts to conserve NTFPs (e.g., methods for replanting seeds and considerations for harvesting intensity) and meet private forest owner management objectives. It could also improve options for public and private forest managers interested in NTFPs. With clear procedures in hand, forest managers could work with private forest owners and public harvesters to enhance the management of NTFPs. Although the possibilities are significant, the operational and market dynamics of formal forest farming remain in need of additional study (Chamberlain et al. 2009).

The success of NTFP networks also will depend on useful member services. Unlike timber products, NTFPs are not comprehensively tracked (USDA Forest Service 2011). Inventorying and tracking akin to timber would provide much needed information to NTFP stakeholders and forest managers. The US Forest Service's Forest Inventory Analysis program and its Timber Product Output (TPO) system provide national data for wood products on lands in all ownership types. A comparable system for NTFPs would help forest managers guide priorities and decisions. Permitting and area-restricted harvesting programs for public lands could be refined and other innovative approaches for various ownerships spawned. Combining inventory and tracking data with NTFP networks also could help to tailor gathering or improve NTFP marketing strategies. These data could be efficiently and advantageously accessed through online reporting systems similar to the TPO.

Systematically tracking NTFPs is no small task. It will require flexibility, the use

of primary and secondary data, and mixed-method analysis. Greenfield and Davis (2003) used mixed methods to estimate the production of medicinal NTFPs in western North Carolina, and McLain (2008) did something similar to document agency efforts to track mushrooms in the western United States. Inventory procedures will need to be adjustable. Formal and informal data are likely needed to adequately track NTFP harvesting. Most wildcrafter operations are decentralized, small, and secretive, which makes tracking volumes through harvesting programs difficult. NTFP networks may help, but it is likely that intermediate buyers also need to be a focal point. Finding them and enlisting participation will require careful consideration. Although the inventory and tracking methods will vary, measuring and comparing standardized volumes is the ultimate goal. Although challenging, these data could markedly benefit NTFP stakeholders and publicly demonstrate a commitment to forest sustainability.

## Conclusion

NTFPs are important forest products, and wildcrafters are the people that harvest them. Wildcrafters are often marginalized because of norms and underdeveloped NTFP markets. Some recreational gatherers are organized advocates, but for the most part wildcrafters have not played a role in NTFP management. The divide between wildcrafters and forest managers complicates the issue. Wildcrafters are often secretive about their activities and sometimes stigmatized or overlooked by busy forest managers with limited resources and time. Forest farming is of interest but is currently in need of further scientific study.

Social networks could help bridge the divide by organizing cooperative efforts such as volunteer monitoring or landowner groups. A review of the literature and subsequent discussion suggests that asynchronous networking via mobile technologies may be the best approach. At the same time, refinement and adoption of forest farming practices could compliment efforts to improve the formality and function of NTFP management, markets, and networking. The consistency of formalized farming systems could improve system transparency and increase credibility. Benefits are also possible via systematic NTFP inventory and tracking procedures. Although complex and surely challenging to develop and administer, such procedures could provide a stepping stone

for enhancing NTFP management and markets in the United States more broadly.

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