MEASURING MEDICINAL NONTIMBER FOREST PRODUCT OUTPUT IN EASTERN DECIDUOUS FORESTS

Steven D. Kruger

Dissertation submitted to the faculty of the Virginia Polytechnic Institute and State University in partial fulfillment of the requirements for the degree of

Doctor of Philosophy
In
Forest Resources and Environmental Conservation

John F. Munsell, Committee Chair
James L. Chamberlain
Jeanine M. Davis
Ryan D. Huish
Stephen P. Prisley

September 20, 2018
Blacksburg, Virginia

Keywords: Nontimber Forest Products, Medicinal Plants, Inventory and Analysis, Human Dimensions, Appalachia

MEASURING MEDICINAL NONTIMBER FOREST PRODUCT OUTPUT IN EASTERN DECIDUOUS FORESTS

Steve Kruger

ABSTRACT

Nontimber forest products (NTFPs) play an important role in the lives of people who rely on forests. An absence of data on the size of harvests, their location, and the economic value of NTFPs prevents effective management and full utilization by all stakeholder groups. We set out to measure one important NTFP sector – the medicinal plant trade in the diverse deciduous forests of the eastern United State, by surveying licensed buyers of ginseng (*Panax quinquefolius)* in 15 states about purchasing of other untracked species. To combat potential coverage and non-response bias we created a place-based model that predicted the probability of purchasing non-ginseng medicinals based on buyer location and used this to build more robust estimates. This viable method for estimating NTFP output is a replicable system that can be applied in other regions and for other products.

We reviewed the literature and hypothesized biophysical and socioeconomic factors that might contribute to the prevalence of non-ginseng purchasing, and tested them on the respondents using multinomial logistic regression. The significant variables were used in two-step cluster analysis to categorize respondents and non-respondents in high or low production areas. Volume was assigned to non-respondents based on respondent behavior within each cluster. Both were then summed to estimate total output. The results depict trade volume and prices paid to harvesters for 11 medicinal NTFP species. There was significant variation between products. Two species, black cohosh *(Actaea racemosa)* and goldenseal *(Hydrastis canadensis),* accounted for 72 percent of trade volume and 77 percent of the value paid to harvesters. The total first-order value for all species estimated was 4.3 million $USD. The discrepancy between point-of-sale and retail value implies room for increasing value for all stakeholders at the base of the supply chain. Harvests for most species were concentrated in the central Appalachian coalfields.

We also sought to understand what motivated or deterred participation by conducting qualitative interviews with buyers and other stakeholders. Buyers were interested in knowing the size and value of the trade, but had concerns about losing access to the resource, which was rooted in past experience with land managers and policy-makers, and conflicting discourse between stakeholders about the state of the trade and of wild populations. Many institutional deliverables are not well matched with the realities or priorities of the traditional trade. We describe potential avenues for collaboration and reciprocity, including providing market research and certifying or providing technical support for sustainably wild harvested material in addition to ongoing support for cultivation.

MEASURING MEDICINAL NONTIMBER FOREST PRODUCT OUTPUT IN EASTERN DECIDUOUS FORESTS

Steve Kruger

GENERAL AUDIENCE ABSTRACT

Nontimber forest products (NTFPs) are sources of sustenance and livelihood for people around the world. This broad category includes parts of plants such as barks, roots, and fruits, and fungi harvested for food, medicine, decoration, for use in crafts and cultural and spiritual ceremonies. They are harvested for personal use, and sold into local and global supply chains. Commercially harvested NTFPs have a dual nature. They have the potential for providing income without having the kind of large-scale disturbance caused by logging or other more impactful extractive industry. At the same time, most forests are not managed for NTFP production, and the ecological impacts of most NTFP activity are difficult to assess. Habitat loss and harvesting pressure has led to the monitoring and regulation in the trade of one iconic medicinal NTFP American ginseng (*Panax quinquefolius)* For the majority of NTFPs, the scale, value and distribution of the trade is unknown, presenting a barrier to effective management and institutional investment in the trade. We sought to better understand one important NTFP supply chain, the trade in medicinal plants occurring in eastern deciduous forests using a voluntary survey program. To accomplish this, we surveyed and interviewed registered ginseng buyers in 15 states about the other products they purchase.

This dissertation is divided into three parts with three different objectives. The first is to describe the trade in medicinal NTFPs from eastern forests. This includes what species are being harvested, how harvests are distributed throughout the study area, the value of surveyed species to producers, and market structure close to the point of sale. We found that the majority of the trade was taking place in central Appalachia. The majority of the trade in terms of value and total output was concentrated in two species, goldenseal *(Hydrastis canadensis)* and black cohosh *(Actaea racemosa).* The second chapter seeks to create a replicable method for projecting total volume for the most commonly harvested species, including predicting the buying of the majority of respondents who did not participated. We created a model that predicted the likelihood of a respondent purchasing non-ginseng based on characteristics of their location associated with the trade. The third chapter uses interviews with buyers and other participants to explore how to improve participation in NTFP studies and make the results more useful for stakeholders.

ACKNOWLEDGEMENTS

I am deeply grateful for the support of my family in getting this project over the finish line. My parents, in-laws, siblings, and most of all Kelly and Jacob: Thank You! I love you all very, very much. My committee was incredibly patient and supportive through what has been a long and rewarding, if somewhat circuitous process. They have also been there to help with publishing and presenting our work around the country. John, Jeanine, Jim, Ryan and Steve, thank you! You have all been incredibly generous with your time, expertise, and your empathy. I especially want to thank my advisor and chair John Munsell for giving me this opportunity, and working so hard to get it done, and for often going above and beyond the call of duty to do so. The NTPO began long before I came on board. John and Jim Chamberlain designed the first pilot study and secured funding. To that end I must also thank the U.S. Forest Service's FIA program for their support.

The Department of Forest Resources and Environmental Conservation at Virginia Tech has been a wonderful and supportive place to learn and work. This project would not have gotten done without two FREC employees: the tireless Tiffany Brown, who was always available to put out any fires that came up, and helped us immensely with her knowledge and experience, especially in administering the survey; and Tracey Sherman who did a wonderful job building the RootReport website. I also want to thank my fellow graduate students for their solidarity and support, especially Katie Trozzo and Catherine Bukowski.

Finally, a sincere thank you to all the people who participated in our survey, or who sat down for interviews. This includes the buyers, but also harvesters, state ginseng coordinators, our fellow researchers in the field, forest service employees and activists and community organizers. You all gave us a significant investment in time and effort. In many cases you

welcomed me, a stranger, into your homes and businesses. I am grateful for that, and I hope this work represents what you all do faithfully, and aids in achieving our shared goals in the work we do with the plants, places, and people we care about.

Table of Contents

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1. INTRODUCTION

1.1 Background

Forest plants and fungi are a source of livelihood and sustenance worldwide. They provide food and medicine, and are used in art and religious practices. Beginning in the late 20th century, researchers, land managers, and development agencies began referring to this vast array of species and practices collectively as non-wood and later, as nontimber forest products (NTFPs). This overarching designation reflects both the common threads connecting these species and the practices around them, and their tendency to stand in the shadow of timber, both literally, and in terms of what was considered the most important priorities of forest management (Chamberlain et al. 2000; Emery and McLain 2002). Chamberlain et al. (1998) define NTFPs as: "plants, parts of plants, fungi, and other biological material harvested from within and on the edges of natural, manipulated, or disturbed forests." In the 21st century, the profile of NTFPs is rising, and they are increasingly considered a tool for community-based conservation and sustainable economic development. This is based on the idea that they are an existing resource that can provide income and livelihood in what are often marginalized communities, while keeping forest ecosystems intact (Neumann and Hirsch 2000; Vaughan et al. 2013; Munsell 2014; Shackleton and Pandey 2014; Chamberlain et al. 2018). At the same time, NTFP practices can also be viewed as a threat to species and forest ecosystems if harvests are unsustainable (Robbins 1999; Cunningham 2001; Ticktin 2004; Belcher et al. 2007). A number of strategies have emerged to maximize returns for producers and minimize environmental impacts including formalizing or creating new markets for NTFPs (e.g. Marshall et al. 2006), developing and/or certifying sustainable production in traditional settings (Cunningham 2001), and encouraging the cultivation of NTFPs, both in monoculture and within agroforestry systems (Davis and Persons 2014; Munsell 2014).

The primary obstacle to managing forests for either the production or conservation of NTFP species is a lack of the kind of data that is readily available for other natural resources like timber (Chamberlain 2018a). Most NTFP economic activity is not recorded or tracked, meaning the scope and size of trade are usually not known. This makes it difficult to assess the impact of harvests and other factors such as habitat loss on existing populations, a problem compounded by the lack of data on stocking and regeneration. It also prevents the valuation of both individual NTFP species and the market as a whole Vaughan et al. 2013).

One of the most valuable and iconic NTFP markets in North America is the trade in medicinal plants and fungi occurring in diverse Eastern deciduous forests. This includes perhaps the best known American NTFP: ginseng (*Panax quinquefolius*), a slow-growing perennial woodland herb whose root has been exported to Asian markets since the 18th century (Robbins 1999). Hundreds of additional species have historically been harvested for their roots, bark, aerial parts, and fungi, and sold into domestic and global supply chains. In the 19th century, the hardwood forests of the eastern United States (U.S.) served as one of the world's most productive apothecaries, supplying the conventional medicine of the day in North America and Europe (Manget 2016). Species such as goldenseal (*Hydrastis canadensis*), slippery elm (*Ulmus rubra*), and black cohosh (*Actaea racemosa*) are still in demand due to the growth of popularity of herbal and alternative medicine since the 1960s. Most of these plants are still harvested from forests that are not managed to produce them—a practice referred to as wild-harvesting (Chamberlain et al. 2018). This tends to be a seasonal activity that forms part of a diversified livelihood system that may supplement or provide a temporary substitution for wage work and other earnings (Bailey 1999). Harvesters typically sell to a local buyer who then sells to an aggregator who exports the material out of the region, either to large wholesale operations,

manufacturers, or retailers (Greene et al. 2000). In addition to being a source of income, medicinal NTFP harvesting can be a personally meaningful and culturally significant practice (Hufford 1999; Emery et al. 2002a).

Like most NTFPs, eastern herbaceous medicinal forest plant populations are not systematically inventoried or monitored (Chamberlain 2018a). With the exception of ginseng, which has been tracked since its inclusion in the 1973 Convention on the International Trade in Endangered Species (CITES), not much is known about what species are being harvested, their value, harvest volume, or how production is distributed within the region. Having these data would potentially benefit NTFP stakeholders (Vaughan et al. 2013). The lack of market data increases volatility and risk for producers and sellers in traditional and emergent production systems, prevents effective management because of the inability to assess the impacts of the trade on existing populations, and stymies institutional investment in the trade, primarily because its value and economic and environmental impact cannot be calculated. Finally, and perhaps most importantly, having consistent and trusted data on the size of harvests would allow for the establishment of a baseline for discussion and collaboration between different stakeholder groups, who may disagree about the state of the trade and its future. The primary obstacles to measuring NTFP output revolve around identifying, engaging, and obtaining participation from traditional market actors such as buyers and harvesters operating in what are designated as informal economies (McLain and Jones 2001; Alexander et al. 2002).

1.2 Objectives

This is an applied research project, with a goal of producing a reliable and replicable method to measure output for one NTFP sector: medicinal plants commonly harvested in 15 states in the eastern U.S. We do not include ginseng in our study because it is already tracked

through the CITES program, but we survey ginseng buyers who are listed in public registries created by state agencies complying with CITES. The study region includes the largest areas of contiguous deciduous forest, the majority of the range for most species surveyed, and the regions that are historically identified with the trade. This includes Appalachia, the Ohio River Valley, and the Ozark and Ouachita Plateaus.

We define the measurement of output as an estimate of how much plant material is being traded annually. Being able to distribute these estimates spatially is important, because it would show where the trade is concentrated, and allows for output data to be correlated with the monitoring of NTFP species in forests. Finally, data on the first-order value of the surveyed species would allow us to estimate the value of individual species and lay the groundwork for assessing the economic impact of regional trade. The method developed is designed to be replicable and transferable to other NTFP sectors and regions.

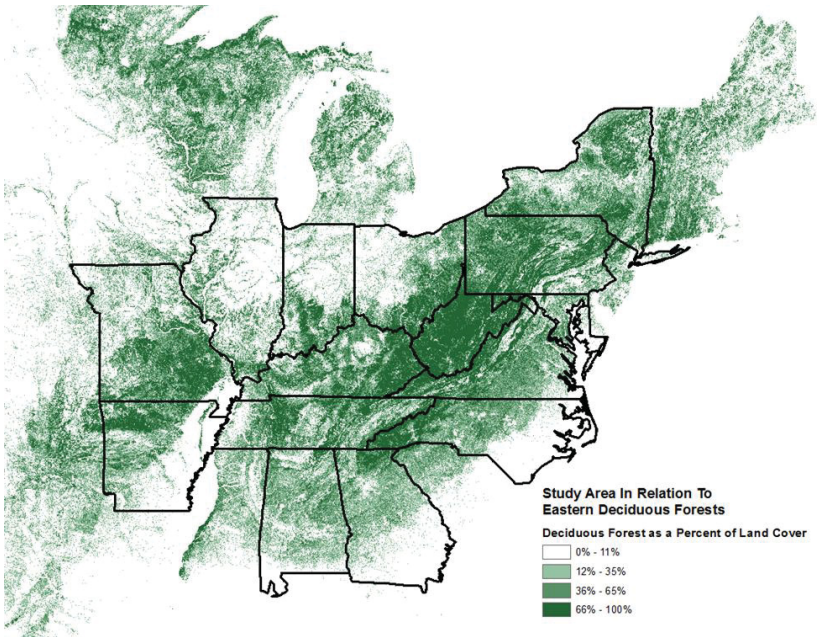
One of the major obstacles to measuring NTFP output is low participation rates from user groups (Emery and McLain 2002), and the resulting risk of nonresponse bias. We take two approaches to address low participation rates in addition to standard non-response bias testing (Rogelberg and Stanton 2007). We assessed the likelihood that a non-responding buyer would purchase products other than ginseng. We then used those findings to attribute volume for non-respondents with greater precision. To accomplish this, we built a place-based model that predicts purchasing based on the dealers location, incorporating biophysical and socio-economic factors associated with NTFP production.

Our final objective was to understand what motivates the decision whether or not to participate in studies like our own. By understanding how buyers perceive the risks, benefits, and aversions to participation, as well as their assessment of issues surrounding the trade today, we

sought to address participant concerns when possible and incentivize participation. This effort is situated within an extension and research program seeking to benefit multiple NTFP stakeholders. These include actors in both traditional and emerging supply chains such as harvesters, growers, buyers, land managers, consumers, herbalists, advocates for conservation and sustainable development, and the plants themselves. We intend the data we produce to be a useful deliverable for the people providing the data, as well as other stakeholders.

1.3 Study Area

The deciduous forests of the eastern United States encompass nearly 300 million acres (Oswalt and Smith 2014), and are found from the eastern edge of the Great Plains to the western fringes of the Atlantic coastal plain. They are bounded in the north by the Canadian border, and taper off into pine forests in Northern Alabama and Mississippi. The greatest areas of contiguous forest occur along the Appalachian mountain chain, which stretches from northern Georgia and Alabama into New England (Boettner et al. 2014). Our study began as a pilot study in Virginia and North Carolina in 2012. It expanded outward to eventually include 15 of the 19 states with ginseng programs and the parts of the region most associated with production of the species in question. (Price 1960; Manget 2016) (Fig. 1.1).



-National Land Cover Database (Homer et al. 2015)

Figure 1.1. Deciduous forests of the eastern United States represented as a percentage of total land cover overlaid with the 15 state study area. Forests are widespread, but most prolific in the Appalachian Mountains, along the Ohio River, and in the Ozark and Ouachita Plateaus.

1.4 Organization

The dissertation is structured as a literature review, three independent manuscripts based on original research, and a conclusion. Because of this format, there is redundancy from chapter to chapter, but each has a different focus. Chapter 2 reviews the literature on NTFPs, especially the rationale for tracking them, their inclusion in development and conservation initiatives, and social and cultural contexts of NTFP use and management. It also addresses the history of commercial medicinal NTFP harvesting within the study area. Chapter 3 presents an overview of the regional trade in medicinal NTFPs using results from the survey. We will lay out the basic supply chain structure and data collected for the species surveyed, including total output, frequency of purchase, harvest origin, and prices paid to harvesters. This chapter is designed for

an audience interested in the particulars of the medicinal plant trade, possibly *Economic Botany* or *Herbalgram*, a peer-reviewed publication produced by the American Botanical Council.

Chapter 4 is a methods paper, in which we describe the development of the predictive model used to create our estimates of total output. This place-based model tests the probability of responding ginseng dealers purchasing other medicinal products based on characteristics of their location. These include biophysical characteristics such as the presence of ideal forest habitat, and socioeconomic variables such as an economy dependent on other natural resources. Two-step cluster analysis based on the significant variables from the model sort respondents and non-respondents into categories of high or low buying probability. The central tendencies of respondents in each cluster is used to estimate purchasing for non-respondents. Chapter 4 is designed for publication in journals that cover forestry and management practices such as *Forest Products* or *Sustainable Forestry*. Chapter 5 addresses one of the important issues surrounding NTFP studies and initiatives: low participation from NTFP user groups. The chapter uses qualitative interviews with market actors to identify and contextualize barriers to participation. It discusses the difficulty of addressing these concerns and proposes steps to incentivize participation. It is written in an ethnographic format designed for publication in journals focusing on the intersection of culture, society, and natural resource management, including *Rural Sociology* or *Society and Natural Resources*. Chapter 5 is broader in scope and could potentially be divided into two articles for publication, one focusing on the role of narrative and discourse, and one on policy and deliverables. As is commonly done in ethnographic writing, this article draws on personal experience and is written in first-person. This can be changed for publication with multiple authors.

CHAPTER 2. LITERATURE REVIEW

2.1 Nontimber Forest Products

Definitions and Demographics

NTFPs are a category of "plants, parts of plants, fungi, and other biological material harvested from within and on the edges of natural, manipulated, or disturbed forests" (Chamberlain et al. 1998). The breadth of this definition reflects the diversity of NTFPs as a wide array of species used all in nearly every part of the world, with many overlapping purposes. They can be made from bark, sap, roots, rhizomes, fruit, nuts, leaves, flowers, and can also be wood products such as burls, boughs, and branches.

The use of NTFPs in the U.S. is widespread. It occurs in all regions and cuts across social, economic, and ethnic groups. As Watson et al. (2018) observe, "the demographic profile of NTFP users looks like America." A study by Cordell and Tarrant (2002) found that more than 25 percent of Americans harvest NTFPs for recreational purposes. Harvesting, whether for personal or commercial use, occurs in remote forests, rural communities, suburban backyards, and in some of the nation's largest cities. In addition to harvesters, other NTFP stakeholders include the people who trade them, manufacture products from them, consumers, and those who value NTFP species for their intrinsic or ecological value.

NTFP Values

What we now refer to as NTFPs have always been a part of the livelihoods of people living in and around forests, and they are valued in different ways. They have use-value, in that they are directly a source of food, medicine, and materials for artistic expression or decoration and play a role in spiritual and religious practices (Chamberlain et al. 2018b). Some studies suggest that the majority of NTFP activity is for personal use (Emery 2002b; Robbins et al.

2008; Ginger et al. 2012; Watson et al. 2018). Robbins et al. (2008) found that 88 percent of people who harvested NTFPs in a New England survey did so for personal use. The economic value of NTFPs is significant, and commercial NTFP harvests are the subject of the bulk of management and development efforts. Chamberlain et al. (2018c) estimate that in 2013, the total wholesale value for U.S. NTFPs was $963 million, and that the average annual export value was $700 million. The fact that many NTFPs are not tracked or differentiated from other similarly cultivated material in export data would indicate that current estimates are likely to be conservative (Chamberlain et al. 2018b).

NTFPs are sold in supply chains that can include both informal and formal economic exchange (Alexander et al. 2002; Frey 2018). Informal economic activity is defined as that which occurs outside of regulatory oversight or protection. Informal economies often use unreported cash transactions or barter as exchange, and are generally difficult to measure. Informality may be beneficial to market actors because of the low barriers and costs of entry, and a general flexibility regarding labor and time. This may be beneficial because much NTFP work is seasonal, and serves as supplemental or emergency income as part of diversified subsistence strategies (Alexander et al. 2002). The downside of informal markets is their instability, volatility, tendency towards low pay, and lack of benefits or other legal protections for workers. These factors also mean that many commercial NTFP harvesters belong to communities that are politically and economically marginalized, comprised of recent immigrants, indigenous people and the rural and urban poor (Bailey 1999; Weigand et al. 2001; Hufford 2003).

Harvesters may sell raw materials directly to consumers as is often case with ramps (*Allium triccocum*) sold in roadside stands or farmers markets, or they may be made into value-added products, such as bark baskets, or tinctures and other herbal formulas (Crellin and

Phillpott 1997; Greenfield and Davis 2003). In many NTFP supply chains harvesters sell to local buyers, who sell to a small number or aggregators and wholesale buyers. These are the link between the formal and informal parts of the supply chain, selling to manufacturers, exporters and retailers. This hourglass-shaped market structure exists for eastern medicinal NTFPs (Greene et al. 2000; Greenfield and Davis 2003), and mushrooms in the Pacific Northwest (Schlosser and Blatner 1995). NTFPs are also cultivated or otherwise produced in more formal contexts such as Christmas tree farming and maple syrup production (Chamberlain et al. 2018b).

Although it is not as easily quantified, NTFPs have significant social and cultural value (Emery et al. 2002a; Tengberg et al. 2012). The practices of harvesting and using NTFPs occur in social contexts, often passed down within families or communities, and are nested within a larger set of traditional practices that form cultural identity and embody or transmit desirable skills and values. One of these is the traditional ecological knowledge required to find, harvest, and use NTFPs. Harvesting and using NTFPs may also be personally rewarding or pleasurable (Emery 2002a). It is a form of recreation and can be a way to maintain an intimate relationship with nature, forests, and with specific spaces in the landscape. By revisiting and knowing these spaces, they take on meaning and become *places,* and contribute to *senses of place* (Basso and Feld 1996; Hufford 1999). This can be understood as the difference between a stranger passing through a forest and perhaps appreciating its beauty or its economic value, versus someone for whom that experience is heightened by memory and knowledge: memories of the time they spent there, the people who showed it to them, and their knowledge of its past and its ecology. Intangible and material values are not exclusive. Harvesting plants to sell can be meaningful and enjoyable for the same reasons as those harvested for personal use (Emery et al. 2002a).

NTFP Management

For the first several decades of its history, the primary goal of forests management was sustaining and maximizing timber output. Eventually this evolved into a multi-use framework integrating recreation and ecosystem management. Within these frameworks, NTFPs are generally not a management priority (Chamberlain et al. 2002; Chamberlain et al. 2018b). This is due to a lack of knowledge about them, their relatively low value as compared to other priorities, and the lack of organization or political capital among NTFP users. This is not to say that there are no regulations or policies, but these are developed under the pre-existing mandate of ecosystem management, and are most often justified by NTFP production being framed in the context of an ecological threat (Chamberlain et al. 2002; Love and Jones 2008). Logging and hunting, which might be limited or restricted, are considered inherently valuable, and are managed for production or to allow for continual use. By contrast, the majority of NTFP policy has been directed at limiting access to them (De Angelis et al. 2018), which creates conflict between users and land managers, especially on public land (e.g. McLain 2002; Newfont 2012).

While NTFPs remain underrepresented in policy discussions, the rise of sustainable development (SD) and community-based conservation in the 1980s led to a greater visibility for NTFPs, and efforts to include them in development strategies and conservation efforts (Belcher and Schreckenberg 2007; Shackleton and Pandey 2014).Under this paradigm, environmental integrity, economic growth, and social equity are interdependent. NTFPs were adopted as a priority for conservation and development as "non-wood forest products" by the United Nations Food and Agriculture Organization in 1991 (Wickens 1991), and were included in Agenda 21 of the 1992 United Nations Earth Summit, often viewed as the "big bang" of sustainable development (Sitarz 1993). Within this paradigm NTFPs are framed as an ecosystem service and a threatened source of livelihood for indigenous and rural communities in areas under threat of

deforestation or other environmental degradation. NTFPs could meet all three sustainability goals by empowering those marginalized communities and potentially providing livelihood while leaving forest ecosystems intact (Shanley et al. 2002). The strategies emerging under this paradigm include: commercialization, or increasing economic demand for non-timber forest products previously used for subsistence; certification and branding for sustainable production; community-based monitoring and management; and encouraging a shift from wild-harvesting to cultivation.

They face significant challenges. There is still a lack of data necessary for management, including the inventory of existing species and tracking of harvests. Commercializing or otherwise raising demand for species may increase harvesting pressure. Institutions struggle to adapt to working with what are often common-pool resources harvested on lands with open access. Attempts to formalize markets, privatize the commons, or shift to cultivation may result in traditional users losing access, and benefit those with more access to capital and institutional resources—what is known as "elite capture" (Emery 2002b; Belcher and Schreckenberg 2007). In spite of these challenges, these projects have been shown to be effective in many cases, and there is a growing role for NTFPs in development discourse and policy, and as part of the sustainable development toolkit for non-governmental organizations (NGOs), extensions services, and other supportive institutions (Shackleton and Pandey 2014).

2.2 Measuring NTFP Output

The inability to measure the value, scope, or size of harvests remains a primary barrier to the effective management of NTFPs and their full utilization by supportive institutions (Chamberlain et al. 2002; Vaughan et al. 2013; Shackleton and Pandey 2014; Chamberlain et al. 2018). Removals through harvesting, or other factors such as habitat loss and the size and

regenerative capacity of stocks are necessary data for assessing and ensuring species sustainability (Chamberlain et al. 2018a). This is important for all stakeholders who care about or rely on these species, and is a priority for land managers and conservation organizations. Harvesters, growers, traders, and other commercial actors often have limited information about the markets they operate in. A lack of familiarity with a product's value or with trends in production and demand can contribute to risk and volatility, representing a stumbling block for new entrants (Gold et al. 2009; Vaughn et al. 2013). An inability to assess value or scope of the trade also hinders institutional investment and minimizes the agency of NTFP users in policy discussions. Finally, output data that is accepted by all stakeholders can provide common ground for productive collaboration between groups who may hold conflicting views on the state of the trade and its future.

A number of methods have been used to measure output in NTFP sectors, including permit sales, mandatory reporting, industry estimates, and surveys. Each has its advantageous and drawbacks. Nationwide assessments of NTFP production have primarily relied on permit sales on public lands (Alexander et al. 2011; Chamberlain et al. 2018a; Chamberlain et al. 2018c). In this system, harvesters are allowed to remove a set amount of material for a fee based on fair market value (USDA Forest Service 2018d). This has proved the most extensive and consistent data available for many species, and is especially effective in the western U.S., where 70 percent of forestland is publicly owned (USDA Forest Service 2014). While permits are also offered on some private lands, the data are not standardized or aggregated. The disadvantage of permits is two-fold. Not all lands permit NTFP harvesting, or only permit harvesting for a subset of NTFP species. Enforcement of permits is often limited by the sheer size of public lands and

the resources of the agencies overseeing them, meaning that the scale of unpermitted harvesting is difficult to assess.

Some NTFP data collection is mandated under law. The 1973 Convention on the Trade in Endangered Species (CITES) is a multilateral treaty where participating nations are required to track and regulate the harvest of certain species, including NTFPs, which are seen to be at risk of decline or extinction. This is the framework through which data on one important eastern medicinal NTFP, American ginseng (*Panax quinquefolius*), is collected (Robbins 2000; Burkhart et al. 2012). Buyers are required to register with an agency in their state designated to oversee harvests. They collect and report data on their purchases including size and county of origin. Any ginseng leaving the state must be certified by a state representative who confirms the material meets size, age, and other requirements. Data are aggregated federally by the U.S. Fish and Wildlife Service, which also assesses the need for further regulation.

NTFPs are also tracked at the point they leave the country. While most are included in broad categories that include agricultural products, a number of NTFPs such as moss gathered for the floral industry and wild blueberries are singled out as sourced from forests (Muir et al. 2006). Regulatory tracking covers all material except that which is traded illegally. As a result, we know more about ginseng than perhaps any other species (Chamberlain et al. 2013). However, these programs are often time-consuming and complex. Many people involved in the ginseng trade feel that they do not have a say in these policies, and see them as burdensome, poorly enforced, and not well-suited to the way the trade actually operates (Blumenthal et al. 2006; Burkhart et al. 2012). The resulting animosity and distrust in its utility can harm already tenuous long-term relationships between government agencies and NTFP user groups (McLain 2008; Chamberlain et al. 2018a). Robbins (2000) recommends developing more collaborative

methods, and that legally mandated reporting should be considered when other voluntary approaches are inadequate.

Industry and industry advocacy groups also collect data on NTFP output. The non-profit American Botanical Council collects and publishes industry data, including retail sales of herbal supplements, which include some NTFP species (e.g. Smith et al. 2017). The Nutrition Business Journal is another source for market analysis for the herbal products industry (New Hope Network 2018). Data are also gathered by professional membership organizations such as the National Christmas Tree Association (NCTA 2012). The American Herbal Products Association (AHPA), an organization of buyers, aggregators, manufacturers, and retailers, surveys its membership about the quantities of wild harvested material they purchase for some species (AHPA 2012). Industry data can be valuable, and serves as the only estimate for production for some species. However, surveys by membership organizations may not cover non-members, and often do not collect data on harvest location or prices paid to producers. The other downside to industry data is that it comes from an advocacy group with a vested commercial interest in the trade. As a result, it may not be accepted as unbiased or accurate by all stakeholders.

Surveys of market participants by third parties are perhaps the best option for voluntarily measuring NTFP output. These include assessments of mushroom production in the Pacific Northwest (Schlosser and Blatner 1995), medicinal NTFPs in the southeast (Greenfield and Davis 2003), and moss buyers in Appalachia and the Northwest (Muir et al. 2006). These have used both the reporting of individual buyer data and those buyers' estimates for total market output. Surveys must be designed to fit the supply chain being measured, and most tend to focus on the primary point-of -sale. Harvesters can attribute harvest location with the most precision, but they are numerous, spread out, difficult to locate, and may not keep records. At the other end

of the supply chain, manufacturers and retailers operating in the formal economy tend to have better record keeping, but at that point products may have been altered and aggregated, and product origin is not available at high resolution. Surveys usually target primary buyers because they are more centralized and easier (though not necessarily easy) to locate than harvesters. Through their direct interaction with harvesters, primary buyers can provide information on both harvest location and the first-order value paid to producers. Product measured at the first point of sale is also less likely to be counted twice.

The U.S. Forest Service's Timber Product Output (TPO) program can serve as a model for a successful tracking program. The TPO has tracked the timber trade for more than 80 years, surveying mills about how much timber they purchase by volume and by species (USDA Forest Service 2018d). From its establishment, the program was part of a larger effort to manage forests for timber production, and it enjoys high response rates from industry participants (e.g. Piva et al. 2011). Data are provided in a useful format in the form of free summary reports and online searchable data tools. The program is situated within the larger Forest Inventory and Analysis (FIA) program, which has the capacity to correlate output data with thousands of research plots, providing data on the quality, quantity, and distribution of the nation's timber supply. The integration of output and monitoring make this an invaluable resource for managing forests productively.

Unlike the TPO, most voluntary surveys have not been continuously replicated, but instead represent a snapshot of a particular place and time. Surveys tend to be designed and funded as one-off research projects, and the creation of a permanent survey program is cost-prohibitive for most institutions. In markets that undergo dramatic fluctuation, this inability to measure trends is a problem. Unlike the TPO, NTFP surveys and other research programs suffer

from low participation rates (Lynch et al. 2004; Chamberlain 2018a). McLain and Jones (2001) offer insight into barriers to participation from their work with NTFP harvesters in the Pacific Northwest. There may be poor communication between institutions and user groups due to lack of organization of NTFP users, and the lack of funds and resources for institutional outreach. There are often mutual culture barriers to engaging, which may include linguistic barriers, a lack of shared experience, and differing social and political status.

Researchers and participants co-exist in a continuing history of interaction. Negative past experiences may play a role in decisions not to participate. Researchers may gather data and publish in academic journals without sharing results or providing other beneficial deliverables for participants. In addition to the perceived lack of benefit, concerns about losing access to land, NTFP species, or markets play a central role in NTFP users' reluctance to share information (Alexander et al. 2002). This is exacerbated if the data is perceived as being used to shape policy or regulation, which user groups may feel they have no agency in, and may result in harm to their livelihood (Watson 2017). To address these concerns, McLain and Jones (2001) and others (Lynch et al. 2004) have proposed adopting principles of reciprocity, equity, and collaboration into NTFP programs.

2.3 Reciprocity and Community-Based Management

This project and much of the body of socio-economic research on NTFPs is informed by a general movement within natural resource management, environmental science, conservation and extension research to be more inclusive and equitable in the collection, interpretation, and application of scientific data, as well as the design and implementation of programming and policy (Emery and McLain 2002; Watson 2017). Within this broad movement are some common features, a tendency to view humans as a part of nature in what are considered socio-ecological

systems, and to see the needs of humans and non-human life as co-dependent (Berkes 2004). Including the voices of people who are directly affected by environmental policy and development is viewed as both just and necessary for programs and policies to achieve desired ends. The field of political ecology has contributed the idea that the management of natural resources and the production of environmental knowledge is political and subjective whether it is occurring in scientific or traditional contexts. Conflicts around access to and ownership of natural resources, and the design and effects of natural resource policy, mirror the political and economic conflicts in those societies (Robbins 2011). A key goal of political ecology is to describe the power dynamics of those who create the dominant discourse and frame environmental issues, and the power dynamics of those who control and benefit from the resulting policy.

Strategies emerging from this intellectual movement include participatory, reciprocal, collaborative, and community-based research and conservation (Berkes 2004). Under these frameworks, collecting data from a stakeholder group is viewed as an act of exchange, often with material, personal, and political consequences for participants. These techniques involve democratizing the process through direct collaboration from the onset, by identifying the needs and values of participants and either aligning the program with them, or incorporating reciprocity by creating incentives to meet them. One major critique of this approach is the complexity involved. So-called "communities" are not homogenous and have their own internal power dynamics. Another uncertainty is the notion, often taken for granted, that the goals of those communities and formal institutions are aligned or mutually beneficial (Agrawal and Gibson 1999). In response, some have called for giving priority to non-market values of NTFPs (Robbins et al. 2008), considering rights to access alongside traditional property ownership

(Ribot and Peluso 2003; Ginger et al. 2013) or using traditional commons-resource governance systems to develop formal systems for managing common-access resources (Ostrom et al. 1999).

2.4 Nontimber Forest Products in Eastern Forests

The history of medicinal plant use in eastern hardwood forests dates back to the region's earliest inhabitants. Indigenous knowledge was synthesized with the botanical knowledge brought by settlers and enslaved people, creating a local tradition of gathering and growing medicinal plants for personal use (Cavender 2006; Crellin and Philpott 1997). Traditional knowledge was supplemented by various compendiums published for doctors and for home use. Alongside this localized self-care, an export market developed. Sassafras is one of the earliest North American commodities, harvested for both its culinary and medicinal value (Robbins 2000). American ginseng (*Panax quinquefolia*) followed in the 18th century, and continues to be exported, primarily to Asia (Robbins 1999: Manget 2012). From this point on, medicinal NTFP harvests have always been simultaneously a local, traditional practice, and a global extractive industry.

Early botanists such as Asa Gray and William Bartram were collecting, propagating, and exporting species not only for their rarity and beauty but also for medicinal purposes (Slaughter 2005). In the late 1700s and early 1800s, the majority of American medicinal plants were thought to have been cultivated by drug suppliers or sourced locally (Manget 2016). A new discipline of scientific herbalism emerged in the 1830s, with its capital in Cincinnati. The Eclectics based herbal medicine in empirical study, which heavily influenced what became the conventional medicine of it day and was heavily reliant on plants, including native woodland species. Around the same time, Josiah Cowles in western North Carolina developed the earliest large-scale herbal products businesses sourcing plants from eastern forests. It gradually spread

throughout the east, but remained centered in Appalachia (Price 1960; Manget 2016). These companies supplied domestic and growing European markets with shipments going directly to London, Boston, and other large cities (Cowles Papers 2014).

During the Civil War, botanists like Mordeci Hyams developed new herbal formulas and created supply chains to source the military (Freeze 1995). After the war, these botanist went to work for a rapidly growing industry. The development of rail lines in southern and central Appalachia, which preceded the timber companies, helped facilitate shipping of botanical products. The Wallace Brothers in Statesville, North Carolina, and later Wilcox in Boone and Parham Herbs in Asheville, maintained networks of small country stores, which could put out a call for a desired product. Recent work by environmental historian Luke Manget (2012; 2016) suggests that this business was much more extensive than previously thought and may represent the peak in the native herbal industry. For example, at the height of their purchasing in the 1870s and 80s, one firm—the Wallace Brothers—traded more than 2,000 species. Their annual inventory was more than 2 million pounds, and an estimated 40,000 wild harvesters supplied them. While they were the largest at the time, they were one of many. Later the Wilcox Drug Company, based in Boone, North Carolina would be one of the nations largest botanical businesses.

For a time in the 1870s, a significant number of people in the southern Appalachian Mountains may have subsisted exclusively by harvesting medicinal plants, especially during the "ginseng boom," which occurred at the same time. This subsided as plant sources were depleted, large areas of forests logged, and as demand for non-ginseng medicinals began to decline. As the coalfields of central Appalachia opened up to timber and coal production in the 1880s and 90,

that area also became a major supply center for herbal medicines, especially as much of the rest of the east was denuded of forests (Manget 2016).

The dominance of synthetic pharmaceuticals by the mid-20th century shrank the American herbal industry, but markets for some North American herbs remained popular abroad, particularly in Europe. Beginning in the 1960s, a resurgence of interest in herbal and alternative medicine grew the domestic and international trade in medicinal plants. This has also maintained demand for some products sourced from eastern forests, such as goldenseal (*Hydrastis canadensis*) and black cohosh (*Actaea racemosa*). The mainstreaming of herbal and alternative medicine in the 1970s and 80s, as well as the recent popularity of foraging and traditional foodways, have accompanied continued growth in the herbal products industry. In 2016, the industry had over $7 billion dollars in retail sales in the United States (Smith et al. 2017)

While cash payment has supplanted the barter system, the supply chain for woodland medicinal NTFPs in the east still resembles the one that emerged in the 19th century, though at smaller scale. The majority of material is thought to travel through a traditional supply chain based primarily on wild-harvesting (Greene et al. 2000; Greenfield and Davis 2003). An unknown number of widely dispersed harvesters collect plant material from forests and bring them, either fresh or dried, to local buyers. Some of this is done on speculation, but usually buyers will put out a call for a particular product they have an order for. This social network of harvesters is one of the buyer's most important assets.

Ethnographer Mary Hufford (1999) observed what she referred to as the *seasonal round* in the Coal River Valley of West Virginia, where harvesting medicinal plants is one of many interconnected activities occurring in forests throughout the year, including hunting, fishing, cutting firewood, and gathering edible plants for sale and personal use. The knowledge of

harvesting and processing methods, as well the locations and care of patches, is passed down within families, and forms part of a mosaic of local ecological knowledge. Within the coalfields and on timber lands, harvesting roots and herbs was a way to insulate one's self from the boom and bust economy. In agricultural areas, harvesting wild roots was an offseason activity on marginal lands that supplemented subsistence and tobacco or cotton farming. In both cases, harvesting was done on forests treated as commons, a practice protected in some places by law until the early 20th century (Newfont 2012; Manget 2016), and by custom elsewhere (Hufford 1996). This has continued as most land ownership has formalized and de facto commons often are held by absentee owners and corporations, federal and state government, and a patchwork of smaller landowners. More recently, multiple media releases highlight closures to public lands for harvesting, and other commons are being lost as forestlands are subdivided and developed. Some aspects of the trade are changing, and many of the hundreds of products formerly bought have either fallen out of use, or been replaced by cultivated varieties. While a few buyers purchase a wide variety of barks, vegetative material and roots, the majority of the trade is concentrated in a few dozen roots and barks. In recent years, foraging has become more popular, and social networks and documentary shows have raised the public profile of the root and herb trade, adding to growing concerns about the sustainability of the trade in ginseng as well as other medicinal plants.

Despite containing a wealth of natural resources, most of the region's treasure, from timber and coal to ginseng, are exported as raw commodities, and most of the wealth is exported or stays in the hands of the local elite (Eller 1982; Appalachian Land Ownership Task Force 2015). The collapse of extractive industries like coal, as well as manufacturing and agriculture, have further stressed an area suffering long-term economic distress. NTFPs are often portrayed

as part of a safety net of informal economic activity for people in poverty, and those relying on government assistance or disability payments that are threatened by formal earnings (Hansis 1998; Bailey 1999; McCoy 2017). Appalachia, though it is economically diverse internally, has a lower median household income overall, and higher poverty and unemployment rates compared to the rest of the U.S. In 2017, the ARC classified 198 out of 420 Appalachian counties as either economically distressed (84) or at risk (114), indicating a substantial underlying problem and need for sustainable economic development in the region (Pollard and Jacobson 2018).

These realities have generated interest in strategies to create diversified economies, such as tourism, renewable energy, high tech industry, and sustainable agriculture and forestry. Drawing on the rich local tradition of NTFP use and a global movement to commercialize NTFPs as conservation and community-based economic development (e.g., Wollenberg and Ingles 1998; Neumann and Hirsch 2000), agroforestry and NTFPs in general have been identified as having a role in the new economy. Constructive discourse and the strategic direction associated with future NTFP production and trade requires comparable and objective analysis that renders baseline data on the scope, scale, structure of the market and its trends.

Like most NTFPs there is very little data on harvests in eastern deciduous forests other than industry estimates, and no region-wide systematic inventory. There have been studies demonstrating that goldenseal (Mulligan and Gorchov 2004) and slippery elm (Kauffman et al. 2017) are declining in parts of their range. Other plants being harvested, such as bloodroot and black cohosh, are relatively common. Despite being locally abundant, some are considered to be conservation priorities due to a high volume of harvest combined with a slow rate of reproduction or regeneration (Small et al. 2011; United Plant Savers 2018). These concerns have led to restrictions of harvests on public land and form the basis of an argument for increasing

cultivation of medicinal NTFPs (Gladstar and Hirsch 2002; Davis and Persons 2014). Institutional investment and research has been primarily focused on intentionally producing medicinal NTFPs in agroforestry systems utilizing existing plant habitat. This practice is referred to as forest farming (Munsell 2014).

2.5 Summary

NTFPS are diverse and hold significant material and intangible value for a host of stakeholders, including harvesters, growers, traders, manufacturers, and consumers. NTFPs are also perceived to have the potential to generate income from forests while leaving those forests intact, making them an effective tool for poverty reduction, sustainable development, and community-based conservation. At the same time, most NTFPs are not managed for production, and there are threats to the sustainability of NTFP utilization, including habitat loss and overharvesting. A lack of accurate data on the status of existing populations, or for the amount being harvested, hinders effective management and institutional investment, and prevents the full economic value of the trade from being known. Methods for tracking have included permit sales, mandated reporting, and surveys of buyers and other market actors. Measuring output is complicated by the diffuse, informal nature of NTFP economies, and low participation rates from NTFP user groups. Reasons for non-participation include concerns over losing access to plants, lands, and markets through regulation and replacement. Past experiences with land management agencies and other institutional actors also influence decisions to participate. Strategies to address these issues are rooted in principles of participatory community-based research influenced by political ecology that emphasize equity, reciprocity, and an awareness of the creation and consequences of research and policy.

The commercial harvesting of medicinal NTFPs has three centuries of history in eastern deciduous forests. It is a meaningful, traditional local practice, and occurs within a global supply chain feeding a growing demand for herbal products. Eastern medicinal plants include some of the most iconic and highly valued American NTFP species. Today, it is primarily an informal trade at its source, where many harvesters gather an array of roots, barks and other plant parts, and sell them to local buyers. Assessing output for the eastern medicinal NTFP trade would provide benefits to multiple stakeholder groups by demonstrating the economic value of the trade, enabling sustainable management, and providing valuable market research for participants in both traditional and emergent supply chains.

CHAPTER 3. THE MEDICINAL NTFP TRADE IN EASTERN FORESTS

ABSTRACT

Nontimber forest products (NTFPs) are an important but underutilized and undermanaged forest resource. They are a source of income and considered a tool for sustainable economic development in forest-dependent communities. However, most NTFP trade is neither inclusively nor systematically measured. Thus, the scope, scale, structure, and geographical distribution of commercial trade are poorly understood. This paper presents a study that systematically measured the scope and scale of one important NTFP sector in the United States – medicinal NTFPs harvested from eastern deciduous forests. In 2015 and 2016, we surveyed primary registered ginseng (*Panax quinquefolius*) buyers in 15 eastern states about trade volume and prices paid for 14 additional medicinal NTFP species, what are colloquially referred to as *off-roots.* We also used survey data to describe the medicinal NTFP supply chain structure, as well as demonstrate value in $USD paid to harvesters. The majority of NTFP output and value were concentrated in two off-root species: black cohosh (*Actaea racemosa*) and goldenseal (*Hydrastis canadensis*). Results provide much needed regional and systematic characterizations of the NTFP trade in eastern forests, which we argue is necessary to facilitate collaboration between stakeholder groups, grow institutional support for sustainable production, and carry out effective forest management.

3.1 Introduction

Numerous nontimber forest products (NTFPs) are harvested from eastern United States (U.S.) forests for medicine, food, and craft and decorative products (Emery et al. 2003; Chamberlain et al. 2018b). NTFPs are "plants, parts of plants, fungi, and other biological material harvested from within and on the edges of natural, manipulated, or disturbed forests"

(Chamberlain et al. 1998). Despite their importance, little is known about the volume of raw NTFP material that moves through the supply chain (Chamberlain et al. 2018a). We also know little about associated price points and value of individual species, or the economic impact of the trade.

Vaughan et al. (2013) argues that standardized and inclusive annual estimates of the scope and scale of the NTFP market in the U.S. could benefit stakeholders by providing replicable and trackable single-source trade information. Tracking programs can be burdensome for harvesters and producers, but they can benefit from them through the measurement of the economic value of NTFP production, and the reduction of risk and market volatility. Fluctuations in price and demand and the general lack of both landscape and local-level trade data cause general instability within the market from year to year, meaning greater risk for harvesters and buyers (Gold et al. 2004; Munsell 2014). It is also a barrier to entry for farmers, landowners, and managers interested in cultivating or managing woodlands for NTFPs (Gold et al. 2004; Vaughan et al. 2013). For those trying to support development of the NTFP industry, such as extension services, NGOs, or governmental agencies like the Appalachian Regional Commission (ARC), a lack of knowledge about economic impacts and market value hamstrings advocacy and availability of supportive resources (Shackleton and Pandey 2014).

Market participants, land managers, and conservation organizations share an interest in ensuring the sustainable management of wild populations, which requires reliable estimations of output. For consumers of NTFP products, a transparent supply chain provides confidence in the quality and safety of products and resource sustainability. The distribution of NTFP trade across the region is similarly unknown, and Vaughan et al. (2013) and others suggest that if spatial projections using standardized geospatial frameworks existed, the role and relevance of NTFPs

could be integrated into existing programs supporting NTFP users and producers. Ideally, output and data on stocking and removals would be correlated, which would help with overall management of NTFP species.

Inventory and removal is a key component of forest management, and the U.S. Forest Service leads a Forest Inventory and Analysis (FIA) program, which has measured timber output since the 1930s through the Timber Product Output (TPO) program (USDA Forest Service 2018d). TPO uses annual surveys of wood product manufacturers to measure the volumetric flow and type of timber products in the wood products supply chain. FIA data are used to estimate market scope and scale across standardized compartments called FIA units. These units break states into multi-county physiographic areas suitable for landscape analyses. The FIA program also maintains thousands of research plots that monitor standing timber stock nationwide. Together, these datasets provide a basis for studying timber market activity and sustainability. Many stakeholder groups use FIA projections in support of advocacy, and the TPO in general has enjoyed high response rates from industry participants (Piva et al. 2011).

Research on regional NTFP output often surveys and interviews market participants, such as Greenfield and Davis' (2003) assessment of the medicinal NTFP market in North Carolina. Other examples include cross-sectional studies of mushroom trade in the Northwest (Schlosser and Blatner 1995) and supply chain analysis of ornamental moss (Muir et al. 2006). The American Herbal Products Association (AHPA), an industry advocacy group, periodically publishes data on native species that are largely wild harvested (AHPA 2012). However, AHPA surveys include only dues-paying members, do not track harvest origin, are released only to members, and only occur every five years.

Public and private land managers sell permits for NTFP harvests. Permits on public land have been used to estimate total NTFP value (Alexander et al. 2011; Chamberlain et al. 2018c), but not all products are permitted, and not all units offer them. For example, national forests in North Carolina sell permits for harvesting medicinal plants, including a lottery for ginseng, but national forests in Indiana do not (USDA Forest Service 2018e; USDA Forest Service 2018f). Across much of the private land in the region, large undeveloped tracts have customarily been utilized as a commons for NTFP harvesting (Hufford 1997; Newfont 2012; Manget 2016), meaning that substantial activity in the eastern medicinal NTFP trade is not captured through permit sales.

A comprehensive, inclusive, and market-wide reporting system that tracks the scope, scale, structure, and harvest origin of NTFPs is needed. Resulting insight from such a system will benefit resource managers and sustainable development advocates, as well as the NTFP industry and those involved in associated trade. It will also provide analyzable data using FIA units, which allows for spatial depictions of market scope and scale. Lastly, an inclusive NTFP tracking program will benefit all stakeholders by providing a baseline and starting point for dialogue and direction focused on the future of NTFP trade in the eastern U.S. and beyond.

3.2 Goals and Objectives

We sought to measure the scope, scale, and structure of the medicinal NTFP trade in forests in the eastern deciduous forests of the U.S., what is colloquially referred to as the "root and herb" trade. To accomplish our goals, we identified and surveyed potential primary buyers of medicinal NTFPs in 15 eastern states in 2015 and 2016. Resulting data provided a baseline for region-wide estimates, and allowed us to characterize buyer types, and supply chain structure based on scale and product. We identified the following specific data needs:

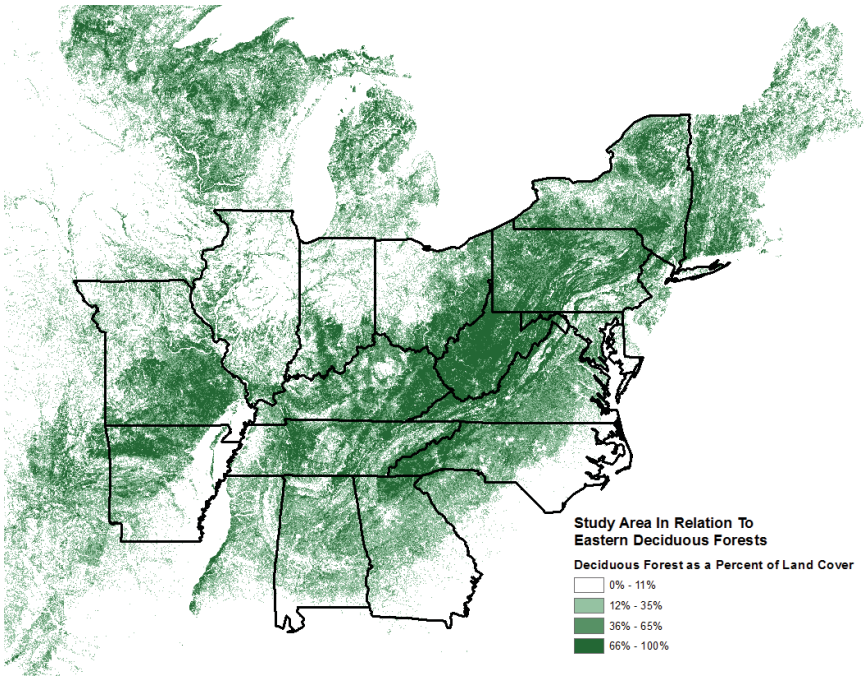
1. What is the front-end structure of the medicinal NTFP market in the eastern U.S.?
2. How do medicinal NTFPs move from forests to manufacturers and retailers?
3. What are the most commonly harvested and most valuable medicinal NTFP species?
4. What are the prices paid to harvesters/producers for those medicinal NTFP species?
5. Where are harvests of medicinal NTFPs occurring?

Geographic data was collected by FIA unit, which allows for integration with existing forest inventory and data on timber production. FIA units are made up of multiple counties, but are drawn along county lines. This allows for respondents in counties with a small number of dealers to remain anonymous, but still allows for the use of aggregated data sets based at the county level. This can allow for harvest distributions to be compared with biophysical and socio-economic data to better describe the places within the study area where harvests are concentrated.

3.3 The Eastern Medicinal NTFP Trade

Deciduous forests cover roughly 300 million acres of the eastern U.S. (Fig. 3.1). They extend from the Piedmont to the Great Plains, and from the Gulf states to the Canadian border. Oak-pine forests extend inland from the southern and eastern borders of the region. Oak-hickory forests dominate in the interior, transitioning to maple-beech-birch in the North. The largest areas of contiguous deciduous forest occur along the Appalachian Mountain chain, stretching from Georgia and Alabama north to New England (Boettner et al. 2014). This area includes most of the major eastern deciduous forest groups and the especially diverse area in central Appalachia known as the mixed mesophytic forest region (Braun 1950). The forests of the eastern U.S. are also valued for their natural beauty, timber, mineral resources, and rich

biodiversity. They are the sites of some of the nation's most popular recreation areas. Compared to the West (30%), more eastern forests (81%) are privately owned (Oswalt and Smith 2014).



-National Land Cover Database (Homer et al. 2015)

Figure 3.1. 15 state study area overlaid with deciduous forest as a percentage of land cover.

Medicinal non-timber forest products have been harvested from these forest for commercial sale since the 1700s. Among the earliest was ginseng (*Panax quinquefolius*), a slow-growing perennial herb highly valued for its root that is primarily exported to Asian markets (Manget 2012). Ginseng is the most valuable and iconic of the eastern medicinal NTFPs and remains the driver of region's medicinal plant trade. Many of the other NTFPs that are still being harvested come from the same rich mesic forest habitat and are referred to as companion species (Davis and Persons 2014).

In the 1840s, traders in western North Carolina began to supply a growing domestic and European market for a growing array of native medicinal plants that formed the basis of the mainstream conventional medicine of the era (Cavender 2006; Manget 2016). This trade gradually spread throughout Appalachia and to parts of the eastern U.S. By the 1870s, large buyers like the Wallace Brothers of Statesville, North Carolina, were buying millions of pounds of thousands of species annually, including roots, barks, foliage, flowers and fungi. The Wallace Brothers sourced their products from a network of hundreds of small country stores, who bought or bartered with an estimated 40,000 harvesters (Magnet 2016). While the Wallace Brothers were the largest buyers of that era, they were one of many. The trade began to subside in the 20th century with the shift to synthetic medicines. However, demand remained, particularly in Europe (Price 1960). The rise of the popularity in herbal medicine in the last quarter of the 20th century created heavy demand for some species like goldenseal (*Hydrastis canadensis*), slippery elm (*Ulmus rubra*), and black cohosh (*Actaea racemosa*) (Greenfield and Davis 2003). The American herbal products industry continues to grow, and now produces an estimated $7.2 billion dollars in retail sales.

While its supply chain is global, harvesting wild forest medicinals in the region remains a local, culturally significant traditional practice (Hufford 1999). Primary buyers often buy herbs and roots as part of a diversified business. Examples of associated trades include metal recycling, sporting goods, fur trading, and country stores (Hufford 1999; Greene et al. 2000). They primarily buy roots and a smaller number of barks from their local networks of harvesters, often paying cash. Primary buyers sell to aggregators, who are the bridge between the formal and informal sectors of the herbal products industry, selling to exporters and manufacturers. Most of

the material leaves the region as a raw commodity and is turned into a variety of consumer goods (Greene et al. 2000).

3.4 Methods

We collected data on the medicinal NTFP trade in eastern U.S. forests by surveying primary medicinal NTFP buyers in 2015 and 2016 about the non-ginseng raw material purchased each year. Registered ginseng buyers were used as the sample frame. Ginseng shares the same historic supply chain as other native medicinal NTFPs, and past studies of the trade have shown that ginseng buyers also buy other medicinal NTFPs (Kruger and Chamberlain 2015). Due to the popularity and relative value of ginseng, it is less likely that someone who bought less valuable herbs and roots would not also buy ginseng (Hufford 1999; Greenfield and Davis 2003). The primacy of ginseng is also evident in the colloquial term sometimes used for other medicinal plants: *off-roots*.

Though ginseng is not federally listed as endangered, it is classified under Appendix 2 of the 1973 Convention on International Trade in Threatened and Endangered Species (CITES) (Robbins 2000). As such, ginseng buyers in the U.S. are required to register and obtain a license annually to legally trade. The same cannot be said for off-root NTFPs regularly harvested in eastern forests, meaning no formal registry for their trade exists. Because of this, ginseng buyers were used as the basis for coverage of active tradespeople as they are easy to identify, and business mailing addresses can be compiled using registries that are publically available. Additionally, because ginseng buyers are involved in primary points of sale for recently harvested raw material, they have the ability to identify harvesting location with more accuracy than aggregators or manufacturers. Harvesters themselves are too numerous and diffuse to effectively sample without significant coverage error. At the same time, manufacturers and

retailers may be easier to locate, but are less likely to know from where products are sourced and may be dealing with medicinal NTFP material in different states of processing (whole roots, powders, tinctures, etc.).

A survey instrument (Appendix B) was designed to measure scope, scale, and prices of off-root NTFP primary purchasing and to assess market structure and buyer type. The instrument was developed and pilot-tested in 2014 for materials harvested in 2013, and administered in subsequent years to gather data for materials harvested in 2014 and 2015. During the course of three years of data collection we surveyed buyers about fifteen iconic medicinal NTFP species with long-standing markets (Table 3.1). Included species had to meet one of the following criteria: they had to be commonly traded; known to be traded in high volume; be high value or rare; or of conservation interest for other reasons (Cunningham 2006). NTFPs were selected by consulting industry sources such as species surveyed by the herbal products industry (AHPA 2012), speaking with buyers, researcher review, and by identifying species considered at risk by organizations such as United Plant Savers (United Plant Savers 2018).

Survey efficacy was assessed following each period of data collection, and input from respondents was evaluated and used to refine the subsequent instrument. This iterative process occurred over the course of the three years of development and data collection. Due to the novel nature of these data and exploratory aspects of surveying primary purchasers in multiple states, data from 2014 were used in a pilot process to identify useful changes and additions to the survey. After receiving feedback from participants about potential double counting, the survey was refined so as to differentiate between products bought from harvesters versus other buyers, and to segment responses based on dried and fresh material. Because of these revisions and the

expansion of the study area, we only used data from 2015 and 2016 (buying years 2014 and 2015) for statistical analysis.

Table 3.1. Medicinal Nontimber Forest Products (NTFPs) included in a survey of primary buyers in 15 eastern states of the U.S. Primary buyers were surveyed in 2015 and 2016 and asked to provide data on rates of volume purchased and average prices paid for these species.

Latin Name	Common Name	Part Purchased
Actaea racemosa	Black cohosh	Root/Rhizome
Aletris farinosa	True unicorn, star root	Root/Rhizome
Aristolochia serpentaria	Virginia snakeroot	Root/Rhizome
Caulophyllum thalictroides	Blue cohosh	Root/Rhizome
Chamaelirium luteum	False unicorn, star grub root	Root/Rhizome
Chionanthus virginicus	Fringe tree	Bark
Collinsonia canadensis	Stoneroot	Root/Rhizome
Dioscorea villosa	Wild yam	Root/Rhizome
Geranium maculatum	Cranesbill	Root/Rhizome
Hydrastis canadensis	Goldenseal	Root/Rhizome
Podophyllum peltatum	Mayapple	Root/Rhizome
*Polygonatum spp.**	Solomon's seal (true)	Root/Rhizome
Sanguinaria canadensis	Bloodroot	Root/Rhizome
*Trillium spp.**	Bethroot	Root/Rhizome
Ulmus rubra	Slippery elm	Bark

* More than on species purchased and not differentiated.

The first section of the survey used binary and short answer questions to collect data on the buyer's business. This included whether the buyer only traded in ginseng or bought nothing (in which case completing the full survey was not necessary), or if they purchased other medicinal NTFPs (off-roots). We also asked if they bought non-medicinal NTFPs such as log moss or edible mushrooms. Respondents reported the number of employees in the business, and if the respondent harvested their own material or made value-added products. Other questions sought to measure the buyers' position in the supply chain by asking if they primarily purchased from harvesters or other buyers, and if they sold directly to consumers, versus other buyers,

manufacturers, retailers, etc. This was intended to contextualize raw data and establish a better sense of market and supply chain structure.

Section 2 of the survey provided a table listing targeted native medicinal species. Buyers were asked to share how many pounds they purchased in wet and dry pounds for each off-root medicinal NTFP in the previous year. This material was broken down into material bought from harvesters versus material bought from other buyers, and whether the material was wild or cultivated. The third section asked buyers to report where the plants they purchased were harvested. A provided map displayed the region broken up into FIA units and a list of the counties in each zone. This geographic scale, which is drawn at the county level but includes multiple counties, was selected to preserve the anonymity of participants (often there may be only one large buyer in a county) and to have data that could be meaningfully and spatially correlated with other existing environmental and socio-economic datasets, which would not be the case at the state level or with arbitrarily created harvest areas. FIA units also have the advantage of being composed of similar amounts and types of forest. Often, though not always, they roughly represent locally understood geographic divisions.

The final section of the survey asked buyers to complete a table on average prices paid to harvesters in $USD per fresh and dry pound for each surveyed species. Price was not originally included in the 2014 survey, even though it was considered a data need, because it was thought to be sensitive information. However, interviews with buyers indicated that this information was of interest. To ensure respondent comfort and maximize responses, only the average price in $USD paid to harvesters in the respondent's area was requested. Separately, buyers were also asked to list other NTFPs they purchase that were not listed in the survey. Space was provided at the end of the survey for open-ended comments and suggestions.

The mail survey was administered using the Dillman Tailored Design Method (Dillman 2009), which includes a data-tested systematic series of mailings and recruitment language designed to increase participation and minimize respondent burden. The survey was first tested in Virginia and North Carolina in 2012, with the rationale that responses would be better using chain referral and outreach directly to buyers locally. The study area was expanded over three years of pilot and formal data collection to include all of the states in the Appalachian region that allow ginseng harvests, as well as other adjacent traditional supply areas in the Ohio River Valley in southern Illinois and Indiana, and the Ozark and Ouachita Plateaus in Arkansas and Missouri. Fifteen states were ultimately included: Alabama, Arkansas, Georgia, Illinois, Indiana, Kentucky, Maryland, Missouri, New York, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, and West Virginia. The population frame included some buyers who outside the study area, but who were registered in one of the surveyed states.

Mailings included a pre-survey recruitment letter, a survey packet with a self-addressed envelope and a cover letter, and two reminders: a post card, and a packet containing a replacement survey. In 2015 and 2016, summaries of the results from the previous round of surveys were provided to buyer respondents with the initial recruitment mailing to help provide useful information for participants and better inform them about the scope and purpose of the study. In 2016, a web-based version of the survey was included as an option, housed on a platform called RootReport (RootReport 2018) that also published results from previous years and provided links to relevant NTFP resources. The response rate improved annually from 17 percent in the 2014 pilot to 24 percent in 2016. We combined data from the last two years (trade in 2014 and 2015) for data analysis, which raised the overall response rate to 26 percent.

Descriptive data on market structure, product value, and year-to-year trends in purchasing are reported directly from the survey results. Harvest distributions were reported by USFS FIA Units. We compared distribution data to plant ranges from Harvard University's eFlora project (eFlora 2018). Two methods were used to measure nonresponse bias based on Rogelberg and Stanton (2007). One used the "wave" method, which assumes late respondents resemble non-respondents. The tendency to buy goldenseal, and how much goldenseal volume was purchased was compared with the date of response. There was no significant correlation. An abbreviated survey administered to a sub-sample of non-respondents (n=18) did not indicate any large outliers in pounds purchased and reflected a similar percentage when compared to respondents (39%). Taken together, both suggest that respondents are relatively representative of non-respondents. These results were validated by comparing projections using different methods from our data, as well as industry figures, and estimates obtained from aggregators (buyers who purchase from other buyers and generally have a wider perspective on the market).

3.5 Results

In 2015, 518 surveys related to trade activity in 2014 were mailed to primary buyers in 11 states. The following year, a total of 576 surveys pertaining to 2015 trade were mailed to primary buyers in 15 states. One hundred and fifteen primary buyers responded in 2015 for a 22 percent response rate, and 131 buyers responded in 2016 for a response rate of 23 percent. Seventy-two of the buyers participated both years. There were a total of 180 unique respondents over the two year period.

There were three main categories of buyers (Fig. 3.2). Twenty-nine percent (n=52) reported that they purchased no medicinal NTFPs at all. Thirty-eight percent (n=69) bought only

ginseng. Thirty-three percent (n=59) reported purchasing ginseng, as well as off-root medicinal NTFPs. No respondents reported buying off-root medicinal NTFPs and not ginseng.

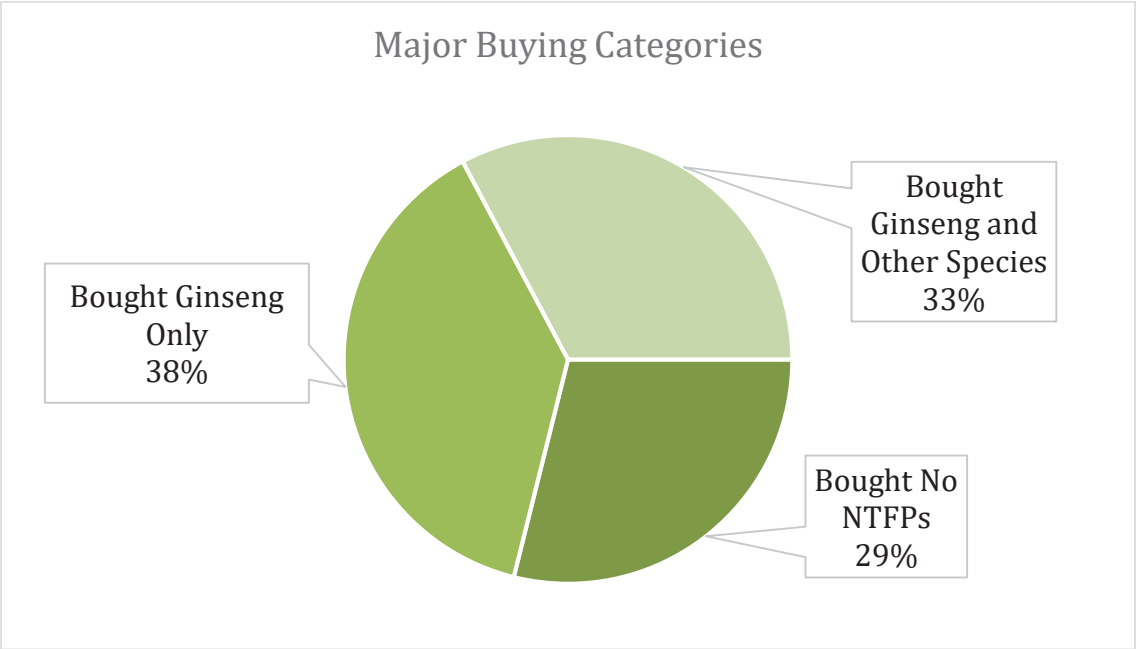


Figure 3.2. Percentage of participating ginseng buyers reporting they purchased ginseng, ginseng and other species, or no medicinal products in 2014 and 2015.

Within these broad groups are several subgroups with their own patterns of purchasing, illustrating the structure of the supply chain (Table 3.2, Figure 3.3). These descriptions were contextualized by conservations with buyers during the course of the survey administration. Data from the 2016 survey (material purchased in 2015) is used for most description due to it having the greatest coverage area, best response rate, and most recent data, unless use of multiple years is relevant.

Table 3.2. Registered ginseng dealers who reported purchasing other species in 2015, categorized by trade volume, and supply chain position. The majority of reported buyers purchased small amounts (less than 100 pounds of most species). Most buyers primarily sold to aggregators. Small buyers were more likely to sell directly to consumers and retailers, while aggregators were more likely to sell to manufacturers.

	Mean Percent Within Buyer Category					
Buyer Category	**Manufacturing Products**	**Harvested By Employees**	**Sold To Other Buyers**	**Sold to Manufacturers**	**Sold to Retailers**	**Sold to Consumers**
	(Yes/No)		**(Percent of Total Volume)**			
Small n=27	13%	21%	82%	24%	8%	22%
Medium n=12	0%	2%	99%	0%	0%	2%
Large Buyer n=3	0%	1%	83%	25%	0%	0%
Aggregator n=2	0%	1%	50%	50%	0%	0%
Total n=44	7%	13%	87%	23%	6%	16%

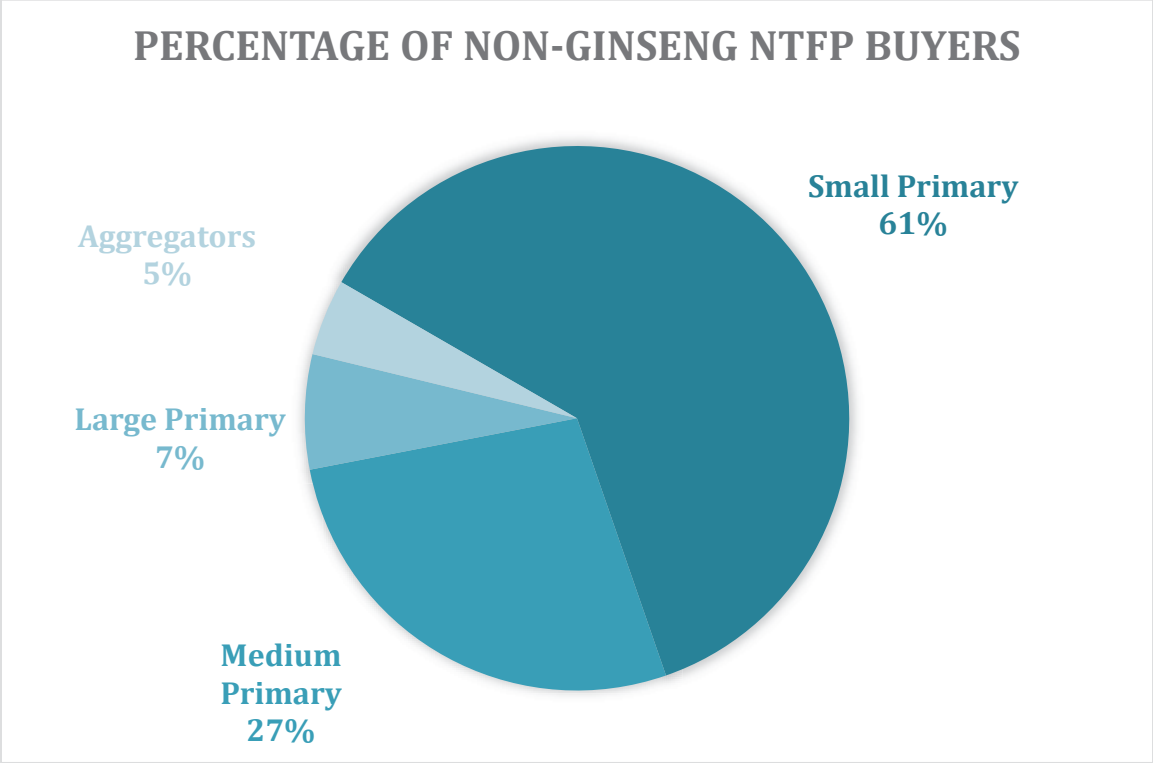


Figure 3.3. Registered ginseng dealers who purchased other species in 2015, categorized by their purchasing volume.

Products and Purchasing

Over the total study period (2014 pilot; 2015 and 2016 actual), 34 percent of those surveyed purchased medicinal NTFPs other than ginseng. Twelve percent voluntarily reported purchased medicinal species not included on the predetermined list (Table 3.3). Respondents reported buying over 50 different additional medicinal NTFPs, including barks (e.g. wild cherry, sumac, and prickly ash); roots (e.g. Indian turnip, wild ginger); aerial parts such as leaves and flowers (e.g. witch hazel, mullein), and medicinal fungi such as reishi (*Ganoderma spp.*) and chaga (*Inonotus obliquus*). In the blank space provided on the survey, some respondents provided their website URLs or wrote "hundreds of others," indicating that there are many more NTFPs that are currently being harvested in the region. Three percent of those surveyed claimed they bought non-medicinal forest products, with the most commonly purchased being decorative products such as log moss, edibles such as ramps (*Allium triccocum*), mushrooms (morels, chanterelles), and sassafras (*Sassafras albidum*) (leaves for filé powder), and craft products such as wood burls.

Table 3.3. Non-ginseng medicinals purchased by ginseng dealers registered in 15 eastern states surveyed from 2013-2015 (n=283). Data were collected from 2014-2016. The table includes surveyed products, and products reported optionally at the end of the survey.

Species	Part	Frequency of Response from 2014-2016	% of total responses 2014-2016 (n=283)
		n	%
Goldenseal*	Root/Rhizome	91	29.1%
Bloodroot*	Root/Rhizome	71	22.7%
Black cohosh*	Root/Rhizome	61	19.5%
Mayapple*	Root/Rhizome	40	12.8%
Virginia snakeroot*	Root/Rhizome	38	12.1%
Bethroot*	Root/Rhizome	30	9.6%
Blue cohosh*	Root/Rhizome	31	9.9%
False unicorn*	Root/Rhizome	27	8.6%
Wild yam*	Root/Rhizome	25	8.0%
Cranesbill*	Root/Rhizome	21	6.7%
Slippery elm*	Bark	23	7.3%
Stone root*	Root/Rhizome	12	3.8%
Solomon's seal (True)*	Root/Rhizome	10	3.2%
Fringe tree *	Bark	8	2.6%
Cherry (Prunus)	Bark	8	2.6%
Sassafras	Foliage/Root Bark	7	2.2%
True unicorn *	Root/Rhizome	6	1.9%
Prickly ash*	Bark	6	1.9%
Reishi	Fungi	6	1.9%
Goldenseal	Foliage/Aerial	5	1.6%
Walnut (leaves, bark, hulls), Indian Turnip/Jack in the pulpit, Queen of the Meadow, Witch Hazel (leaves, bark), Spignet/Spikenard, Black Indian Hemp/Dogbane, Skunk Cabbage, Black Haw(bark), Patridgeberry/Squaw Vine (aerial), Chaga (fungi), Wild Ginger (root), Witch Hazel (leaves, bark) Butterfly Weed/Pleurisy (root), Hellebore (root), Hydrangea (root), Solomon's Seal (False, root),Yellow Dock (root), Fringe Tree (root bark), Sassafras (leaves, root bark) Sumac bark, Boneset (aerial) Ginseng (aerial). Mullein (aerial), Turkey Tail (fungi), Burdock (root), Dandelion (root), Hollow Joe Pye Weed (root), Paw Paw (bark), White Ash (bark), White Baneberry (root), Willow (bark), Bee Balm (aerial) Chestnut (leaves), Poison Ivy Leaf (leaves), Wild lettuce (root), Elderberry (fruit), Bellwort (root) Cicada Shells		n=1-5 (0-1.6%)	

*Product was listed in Survey from 2013-2015

There were three tiers of purchasing frequency for the surveyed species. The most commonly purchased species were goldenseal (29%), followed by bloodroot (23%), and black cohosh (20%). This order was the same in both survey rounds. If a buyer only purchased a single other product, it was most likely to be one of those three. The next tier were products like mayapple and Virginia snakeroot, which were purchased by 5-15 percent of respondents. The remaining products were only purchased by a few primary buyers and the aggregators. Most of these were bought in small amounts, with the exception of slippery elm bark, which was not bought by many buyers, but still accounted for a substantial portion of trade volume.

The majority of trade volume was accounted for by one species, black cohosh, with 53 percent of total reported pounds purchased from harvesters Goldenseal followed, with 20 percent (Table 3.4). The remaining 8 products accounted for less than 15 percent of total trade volume. AHPA proportions were similar, but slippery elm had a larger portion, 43% versus 15%. This change, as well as conversations with buyers indicated that slippery elm bark may have a slightly different, if overlapping supply chain.

Table 3.4. Share of total medicinal NTFP trade volume by species, reported by registered ginseng dealers in 15 states in the eastern U.S. in 2015- 2016, compared with a 5 year mean from 2006-2010, collect by the American Herbal Products Association (2012).

	Black cohosh	Bloodroot	Blue cohosh	Cranesbill	False unicorn	Goldenseal	Mayapple	Slippery Elm	Trillium	VA snakeroot	Wild yam
Percent of Total Pounds Reported	53%	5%	<1%	<1%	1%	20%	2%	15%	<1%	<1%	4%
Percent of Total Pounds in AHPA Survey (2012)	39%	<1%	1%	N/A*	1%	9%	N/A*	43%	<1%	<1%	6%

*Species not surveyed by AHPA

Geospatial Distribution

Medicinal NTFPs in this study were traded alongside ginseng, and most of the species had a similar range (eFlora 2018). Ginseng harvest distributions are tracked through CITES and were mapped by FIA unit in Chamberlain et al. (2013). For ginseng, southern and central Appalachia, as well as the Ohio River Valley were the epicenters of production (Figure 3.4). FIA units in eastern and central Kentucky, western North Carolina and southern Indiana were the units with the highest output.

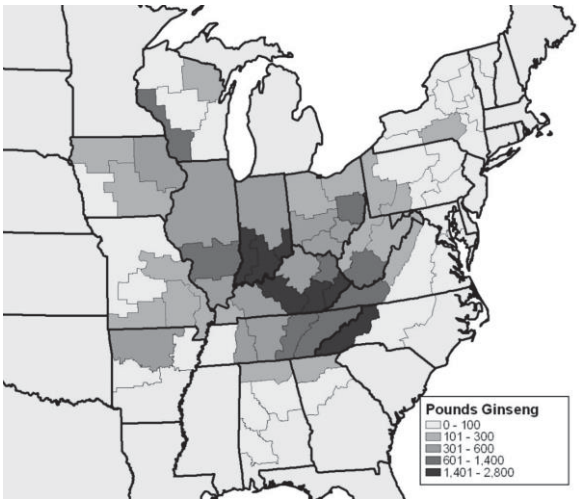


Figure 3.4. Heat Map: Distribution of ginseng harvests by the U.S. Forest Service Forest Inventory Analysis Unit as reported by Chamberlain et al. (2013).

Central Appalachia was the main supply center for the products we surveyed— primarily southern West Virginia, eastern Kentucky, southwest Virginia, and southern Ohio. There were additional concentrations of some products in southern Indiana and the Ozark Plateau of Arkansas and Missouri, as well as some activity in the southern Appalachians, particularly northern Alabama and parts of Tennessee, but overall fewer FIA Units reported harvests of off-root medicinal NTFPs. The most widely distributed species in the study was goldenseal (Figure 3.5), but it, too, had a more concentrated production area than ginseng. The other, more common and widely distributed species such as black cohosh (Figure 3.5) and bloodroot were even less dispersed, with some areas where ginseng is regularly harvested reporting little to no trade.

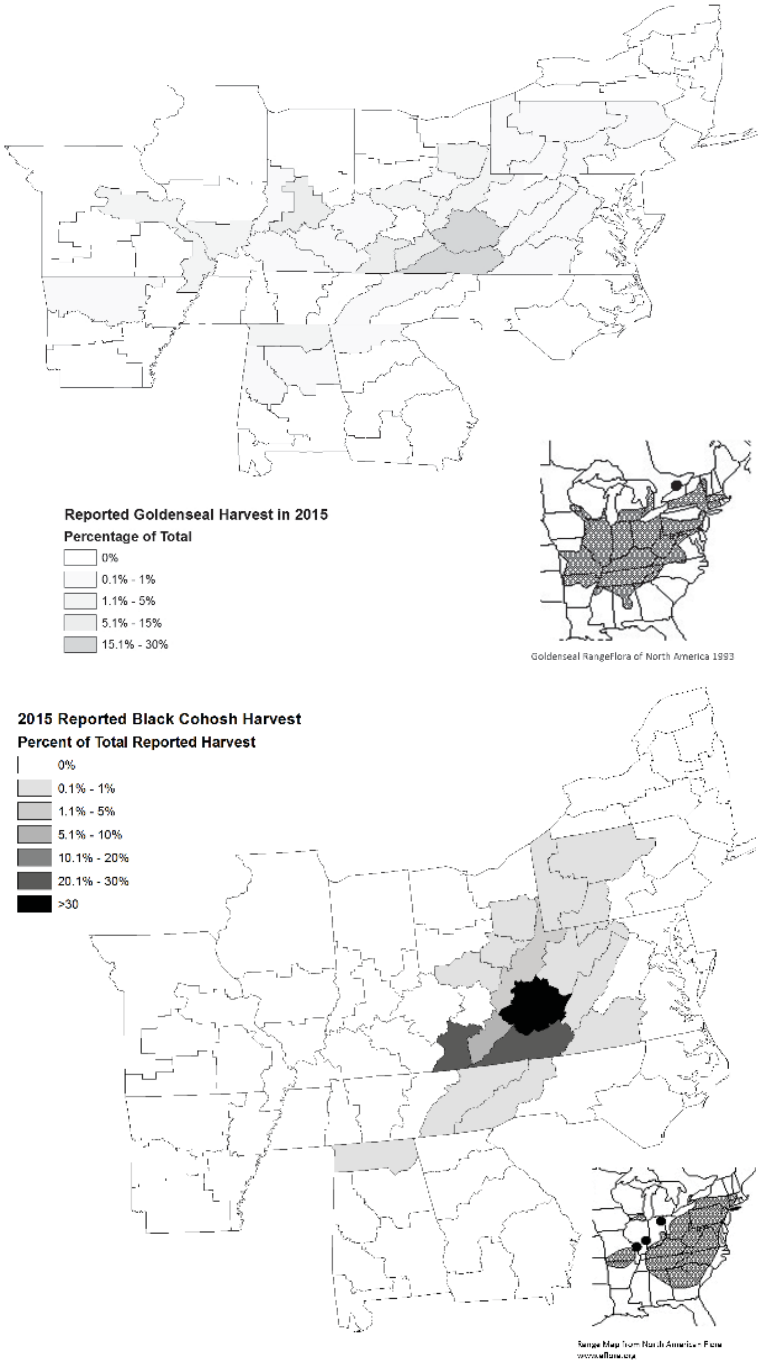


Figure 3.5. Heat maps depicting differences in trade volumes for goldenseal and black cohosh in 2015 across 15 eastern U.S. states. Results indicate strong centralized tendencies for market activity associated with the two NTFP species.

Non-ginseng buyers were also more concentrated, when compared to the distribution of all registered buyers in the sample frame (Fig. 3.6). Unlike ginseng, there were no non-ginseng medicinal NTFP buyers located in urban areas on the West Coast. Buyers were concentrated in

the center of the study area, primarily in the Appalachian region, the Ohio River Valley, and the Ouachita and Ozark Plateaus. Buyers reported harvests from an average of 2 FIA units, most commonly their location and adjacent units. This did not vary over buyer groups with the exception of aggregators, who sourced from an average of 8 FIA zones.

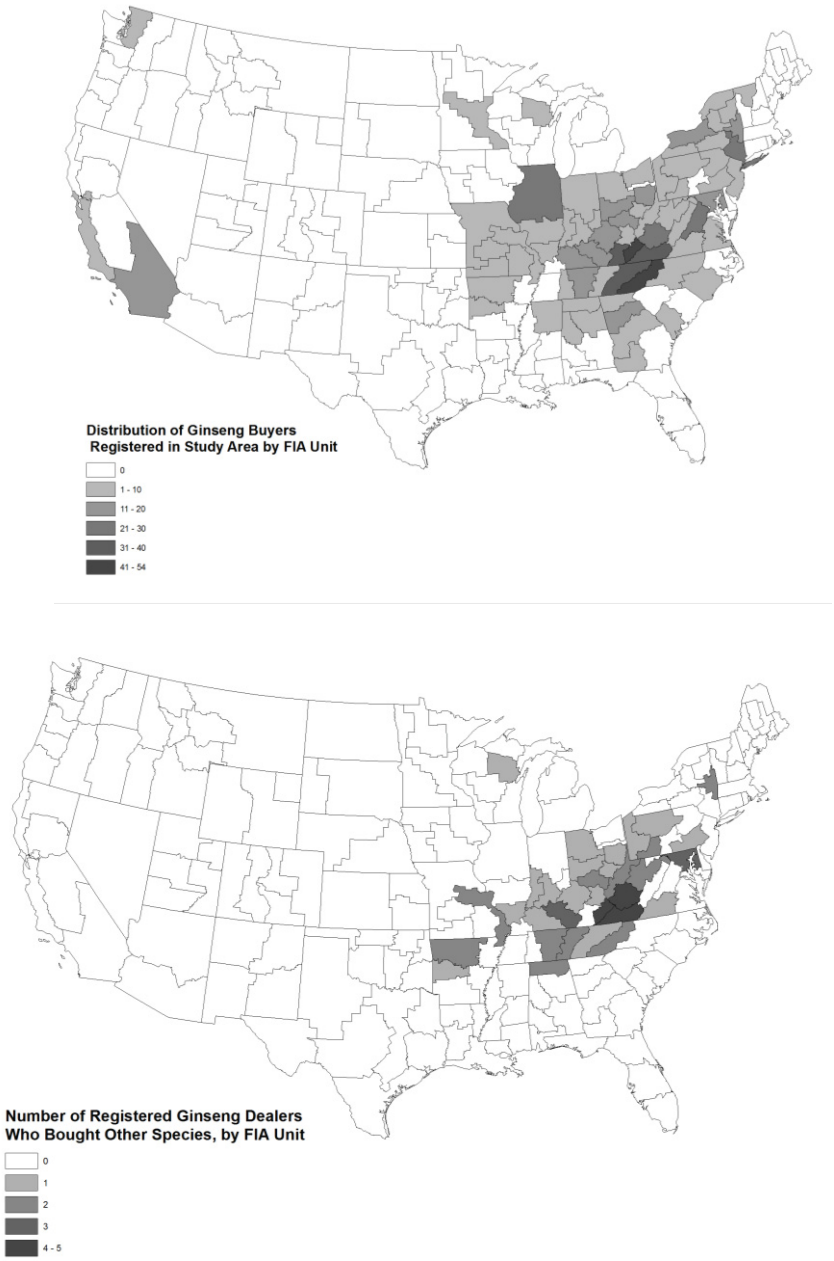
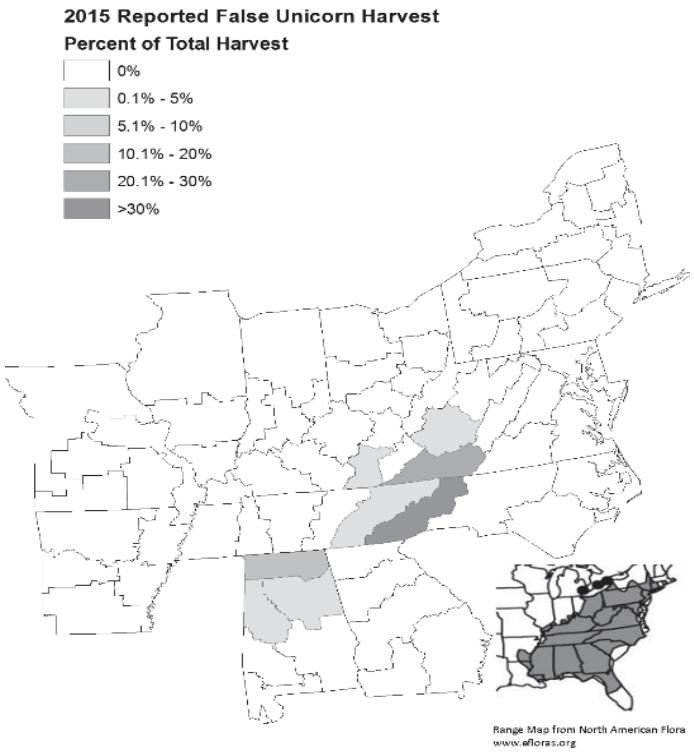


Figure 3.6. Heat maps showing the distribution by FIA unit of all registered ginseng dealers (top), and responding ginseng dealers who bought non-ginseng medicinal NTFPs in 2014 and 2015 (bottom). Respondents who bought other species were more concentrated, especially in the Appalachian Mountains, Oho River Valley, and Ouachita and Ozark Plateaus.

There were exceptions to centralized harvest distribution. False unicorn and fringe tree bark both had more southerly trade (Figure 3.7) with more transactions occurring in Alabama and North Carolina.



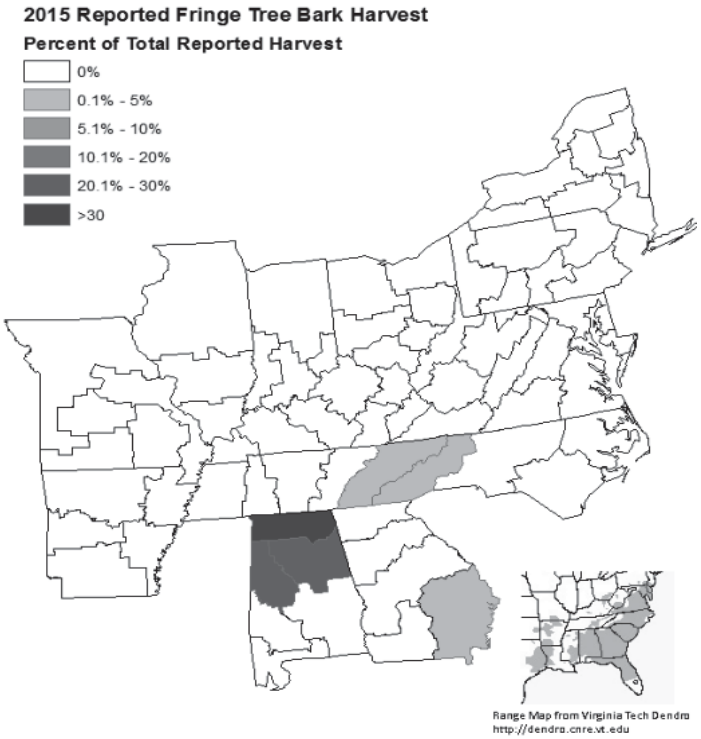


Figure 3.7. Heat maps depicting differences in trade volumes for false unicorn and fringe tree bark in 2015 across 15 eastern U.S. states. Results indicate centralized tendencies for market activity associated with the two NTFP species, which differed from others studied due to a preponderance of southerly transactions.

Product Value

The estimated average price per pound paid to harvesters for the medicinal NTFPs surveyed ranged from 2.44 $USD (dry) / 0.83 $USD (fresh) per pound for wild yam, to 84.65 $USD (dry) / 18.31 (fresh) $USD for Virginia snakeroot (Table 3.5). Nine of the products surveyed were between 2.00 and 5.00 $USD a dry pound. The most valuable product overall by first order sale value (price multiplied by market share) was goldenseal, for which regional harvesters were paid an average of 22.67 $USD per dry pound. This amounted to 53 percent of the total value paid to harvesters for the products surveyed. Black cohosh brought 3.62 $USD a dry pound, but accounted for 25 percent of total value. This was the second highest for the NTFPs surveyed due to its high trade volume. False unicorn, which accounted for 1 percent of total trade volume, was 9 percent of total value for harvesters due to its higher price. A high price did not necessarily lead to a high total value. Virginia snakeroot, though it had the highest price, is a small root, usually purchased by the ounce, and was less than 1 percent of total trade value.

Table 3.5. Reported average prices paid by primary buyers to harvesters of medicinal NTFPs in 15 eastern U.S. states. Amounts represent two-year mean. Averages were factored by reported amounts in the studied species and used to estimate share of market value.

Species	Mean Dry Price 2014-2015 (lb.)	Mean Fresh Price 2014-2015 (lb.)	Percent of Total Value
Black cohosh	$3.62	$0.87	24%
Bloodroot	$10.39	$2.29	6%
Blue cohosh	$2.62	0.8	1%
Cranesbill	$2.73	$28.13	1%
False unicorn	$72.14	$17.88	9%
Fringe tree bark*	$7.30	$2.00	N/A
Goldenseal	$22.38	$7.40	53%
Mayapple	$3.14	$0.82	1%
Slippery elm bark**	$2.68	$1.02	5%
Solomon's seal*	$3.79	$2.00	N/A
Stone root*	$2.50	$1.00	N/A
Trillium	$3.11	$1.28	<1%
Virginia snakeroot	$84.65	$18.32	<1%
Wild yam	$2.44	$0.83	1%

By comparing the purchasing patterns of primary buyers who trade in medicinal NTFPs in multiple years, we were able to observe changes in prices, frequency of purchase, and harvest volume for products bought from 2014 to 2015 (Table 3.6). With a few exceptions, changes in price correspond with changes in volume and frequency of purchase. The two exception were goldenseal and wild yams, which dropped in trade volume and rose in price.

3.6. Two-year trends in trade volume and prices paid to harvesters. Reported by registered ginseng buyers participating in surveys in both 2014 and 2015.

Species	Percent change in total annual purchase from dealers purchasing in 2014 and 2015	Percent Change in Price from Buyers Purchasing in 2014-2015
Black cohosh	+31%	+7%
Bloodroot	-9%	-28%
Blue cohosh	-40%	-8.1%
Cranesbill	+18%	+2%
False unicorn	+18%	+31%
Fringe tree bark*	N/A	N/A
Goldenseal	-29%	+3%
Mayapple	-14%	-5%
Slippery elm bark**	-41%	-6%
Solomon's seal*	N/A	N/A
Stone root*	N/A	N/A
Trillium	+26%	+7%
Virginia snakeroot	+83%	+21%
Wild yam	-54%	+4%

3.6 Discussion

Based on prior surveys of medicinal NTFP tradespeople (Green et al. 2000; Greenfield and Davis 2003), we expected to find that ginseng buyers were purchasing other medicinal NTFPs. This was the case, but that purchasing was not monolithic. Only a third of registered

ginseng buyers purchased other species, and another third of buyers reported purchasing no products at all. The results from the study indicate that while the trade in eastern medicinal plants sourced from deciduous forests includes a variety of buyers and potentially hundreds of species, the majority of material proportionally are accounted for by a few species being harvested primarily within the central Appalachian region, and purchased by a relatively small number of buyers.

Those who bought only ginseng may have done so because of the extra investment in time required, since other products are harvested throughout the year, and require more space and equipment to deal with the larger volumes involved. Since ginseng has a high value and a defined season from late summer through winter, it is possible to buy part-time, seasonally. As long as a buyer possesses the requisite knowledge and capital to pay harvesters, there is little overhead or infrastructure required. There may be also be a lack of familiarity about those species among local buyers and harvesters. Some ginseng-only buyers were also located outside of the plants' ranges, or in urban areas, and may be chiefly engaged in the retail or export end of the ginseng trade, which has a different consumer base in traditional Korean and Chinese medicine, while most of the other species we surveyed are used in western herbal medicine. Ginseng-only buyers may only buy a few pounds or much more, though we do not have data on ginseng purchases and thus cannot divide them into categories. Within the category of buyers of other products, there were an additional differences in activity based on the scale of purchasing. These included aggregators, large buyers, medium buyers and small buyers.

The majority of buyers reported buying less than one hundred pounds of material. These buyers of ginseng and small amounts of other species tend to be located within FIA units where products were reportedly harvested. Sixty-one percent of the buyers who purchased other species

fell into this category. They were responsible for a mean of 4 percent of the three most commonly traded species, black cohosh, bloodroot, and goldenseal bought directly from harvesters. Some purchased other species to attract more ginseng harvesters. This group also included herbalists, and others who were more likely to harvest their own material, manufacture their own products or sell directly to retailers and consumers. On average they purchased 3 of the surveyed products, the least out of the 4 buyer categories. Using the mean purchasing amount, the total revenues paid to harvesters for this group would represent a few thousand dollars annually, implying that even with a mark-up at the next point of sale, herbal products likely only form a part of a diversified income strategy for the majority of medicinal plant buyers. This has historically been the case, as buying at the primary level is usually a secondary function of another business, such as trading scrap metal, sporting goods, and groceries or convenience stores (Greenfield and Davis 2003).

Like small primary buyers, medium buyers are typically based in the unit where they reported harvests. Often their herb and root businesses operate longer than the ginseng season, even year-round, but is still attached to another business. For our project, we considered medium-sized primary buyers as those that bought hundreds of pounds of material. They accounted for 27 percent of buyers who bought other species, and had a mean of 10 percent share of the trade for the 3 most popular products bought from harvesters. Medium primary buyers bought an average of 5 of the surveyed species. They were most likely to sell their products to an aggregator.

The majority of the plant material purchased directly from harvesters came from a small number of large buyers located within the core of the study area. These large buyers, while they accounted for only 7 percent of the sample, bought an average of 86 percent of the three most

commonly bought species, goldenseal, black cohosh and bloodroot. They reported purchasing thousands of pounds of material directly from harvesters. Some of their businesses are entirely devoted to medicinal botanicals. Large buyers tended to sell to aggregators and bought an average of 8 of the surveyed species.

Five percent of the non-ginseng buyers in our sample were aggregators. This group of medicinal NTFP buyers may or may not be located within the harvesting region. Though there were only a small percentage of the sample, they accounted for a majority of the total trade volume for all but one of the products surveyed, and a mean of 51 percent for the three most commonly purchased species in terms of total material reported, but while they bought some material from harvesters locally, they tended to source the majority of their material from a network of primary buyers throughout the study area. They bought from an average of 8 FIA units compared to less than 2 for all other buyer categories. Their businesses tend to be devoted to herbal products, and they bought the highest percentage of the reported species. They are more likely to have more employees, a mean of 3 part-time and 2 full-time, as opposed to a mean of 1 each for all other categories. However, that reflected the number of employees devoted to herb-buying. Because of the part-time nature of the business for small and medium buyers this may have been difficult to report accurately. Aggregators were more likely to sell to manufacturers. They also reported selling to larger aggregators and in conversation, selling to exporters.

While they may share some commonalities, the experience of buying is likely to be very different for someone buying small amounts of a few species for a small proportion of their income, versus someone for whom roots and herbs are a full-time business. This diversity of structure in trade in native medicinals may mean that changes in policy or supply chain structure would have different affects for participants, and has implications for researchers and other

institutions. Aggregators have access to the largest number of harvesters and the greatest impact on the mainstream trade through their supply networks. Unlike most small and medium buyers, large buyers and aggregators may depend on the herbal business for most of their income and therefore may be more invested in the future of the trade, and more likely to be involved in professional organizations such as the American Herbal Products Association. While harvesters and small buyers are numerous and difficult to locate, the participation of even a small number of large buyers an aggregators can have a large impact.

At the same time, some smaller buyers may be more flexible, receptive to adopting, or may already be engaging in emerging practices such as forest farming, certifying sustainable production or the direct-marketing of value-added products, strategies which fit into the potential incorporation of NTFPs into the kinds of sustainable development initiatives that incorporate NTFPs (Belcher et al. 2007; Taylor et al. 2017). Within this group will also be a subset for whom the trade of other species may not be significant enough to devote much time or effort to developing. It is also possible that there may be more of the emergent activity outside of the traditional supply chain connected with ginseng. This could be occurring in small manufacturers targeting the domestic alternative medicine market, who develop their own supply chains for cultivated or sustainably harvested material. Changing demographics in some parts of the region, particularly those close to expanding urban areas may have an increasing impact on these elements of the trade. However the other side of the coin is that a focus on urban areas and more recent entrants may mean that resources are allocated away from the majority of existing user groups who currently rely on the species in the core of the region where economic development is drastically needed.

In terms of where the trade is taking place, there was no prior data on harvest distribution for most of these species. However, we expected our results to mirror the distribution of ginseng, given the sample frame was comprised of registered ginseng buyers and the fact that many of these species are found in the similar habitat. This would place most of our expected output in southern and central Appalachia, as well as the Ohio River Valley, but with some activity occurring throughout the plants' ranges (Chamberlain et al. 2013). The products we surveyed are being harvested from a more concentrated area. The Appalachian FIA units in Kentucky, Ohio, Virginia and West Virginia was the source for 82 percent of reported bloodroot, 99 percent of black cohosh and 83 percent of goldenseal purchased. Buying other species was uncommon in places like Pennsylvania and New York, and even in some of the most prolific areas for ginseng harvesting, such as western North Carolina, which was once a center for the botanical trade (Manget 2017). While there was some purchasing in every state surveyed, the majority of the trade was occurring in central Appalachia, presumably by a smaller percentage of harvesters compared to ginseng. Even aggregators based outside that core production zone were sourcing the majority of their products from central Appalachia. Some species bucked that trend, particularly those with a more southerly distribution. This may be due to the fact that their range extends farther south than other species we surveyed. One species, true unicorn (*Aletris farinosa*), was removed from the latter two surveys because, although it is found in the study area, it was being sourced by aggregators in southern Alabama, Georgia, and Florida outside of the range for ginseng. While the stocking for these species is not known in any detail, the fact that widely distributed NTFPs such as black cohosh and bloodroot are being sourced from some areas within their range and not others raises the possibility that some factors other than the availability of plant material influences harvesting. This could be the strength of the local

harvesting tradition for those species, the presence of an existing network of buyers, or economic factors such as a low price of labor, high poverty or a lack of work that would make harvesting less valuable species more attractive. It could be more a function of the relatively high value of ginseng, and tendency of finding and harvesting ginseng to be viewed as more of a challenging recreational activity in addition to being a source of income. Overall, buyers tended to source products from their own FIA unit, and one or two adjacent units, with the exception being aggregators, as noted above.

The most commonly harvested products were goldenseal, followed by bloodroot and black cohosh which were bought by between 20 and 30 percent of all participants. Products like false unicorn and mayapple were bought by around 10 percent of respondents, and a multitude of species were reported at rates below 5 percent through the write-in option. This indicates that our study is only capturing a part of the picture, but that our surveyed products included the ones most commonly being purchased in the sample frame. Of those, just three products, black cohosh, slippery elm, and goldenseal accounted for over 90 percent of the total reported volume. Slippery elm is an unusual case, the only bark we included in multiple years, and one with a unique supply chain. When taken out of the occasions, black cohosh accounts for 62 percent of the total trade volume, while goldenseal is over 20 percent. While many of the other species, such as trillium and cranesbill were traded in relatively small amounts, this does not suggest a lack of economic or ecological significance to their harvests. The scant data on the state of wild populations prevents drawing any conclusions about the sustainability of harvesting activity. A relatively small harvest may have a high impact on a rare, or slowly generating species. A high volume harvest by contrast, may not have an adverse impact on a more prolific species. Comparisons with the share of trade volume of the same species as measured from 2006-2010 by

AHPA show the same share for black cohosh and similar figures for the other species, with the exception of bloodroot and goldenseal, which had a higher and lower share, respectively.

We expected prices to mirror those provided in recent publications as well (Mudge and Gabriel 2014; Davis and Persons 2014). The means we observed were close to those estimates, with low value species being tending to be within 1 dollar and higher value products within 5 for most species. Six of the surveyed species had increased in value, three decreased and the rest were within range of the earlier estimates. The same authors indicated that a product being certified organic, sustainably harvested or cultivated could potentially receive a higher price point. While our sample frame did not include enough data points to express it with certainty, a majority of the small number of buyers who reported purchasing cultivated material, or who were herbalists or small manufacturers did pay producers more.

What harvesters were paid varied from species to species, but 10 of the 14 species we collected price data for were valued at less than 5 dollars a pound. The two most valuable products, Virginia snakeroot and false unicorn (84 and 72 dollars per dry pound respectively), were harvested in relatively small amounts, implying that a high price did not necessarily mean that species had a large share of total trade value, which may be higher for some low-value species, such as black cohosh, due to their high volume of harvest.

Limitations

A degree of coverage error was inevitable, because our sample (registered ginseng dealers) precluded three groups. Since we expanded gradually, a few states with ginseng programs in the Northern part of the region were excluded. However, we believe that trade in medicinal NTFPs other than ginseng there is relatively insignificant, due to the fact that aggregators sourcing far from home did not buy material from there or adjacent areas in the

study areas (two exceptions being cultivated goldenseal and ginseng). Finally, the survey at this time does not include most cultivated products, and products being harvested and sold outside of the traditional supply chain.

The only product that was reported as cultivated was goldenseal. The amount, however, was less than one percent of total estimated goldenseal production. Data from AHPA suggests that within the conventional supply chain the amount of cultivated goldenseal is closer to 20-30 percent (AHPA 2012). Larger producers focusing on cultivated goldenseal are more likely to be selling directly to manufacturers or large aggregators, bypassing the network of local country dealers tied to the ginseng trade and thus were not included in our survey. Most of the other species on our list were primarily sourced from the wild in the AHPA study, with less than five percent reported as cultivated, so it is likely our data represents the vast majority of output for those species. While our sample may represent 70-80 percent of goldenseal production, it is likely to include the majority of wild harvested material, and over 90 percent of production for the remainder of studied species (AHPA 2012). Some specialized products, such as slippery elm bark, may have a unique supply chain that does not overlap with other medicinal plants.

Our dataset also excludes medicinal NTFPs harvested for personal use or sold directly to consumers. This last group may include many of the growing number of people cultivating NTFPs in wild-simulated systems, who, like small farmers, can get more money for their products through direct marketing (Gold et al. 2004). The unorganized and diffuse nature of this group (similar to wild harvesters) makes it difficult to sample, but this growing demographic will need to be included in systems designed to measure output in the future.

3.7 Conclusion

Our survey methodology allowed us to measure the scope and scale of the medicinal NTFP trade in eastern deciduous forests, including market structure, the relative trade volume of different important species, product sourcing, the economic value of those plants for producers, and the beginnings of trends in value and purchasing. The collection of data on first order-value is a first step towards understanding the regional economic impact of the trade. The industry and its impacts are not evenly distributed within species range, but are concentrated in certain areas, particularly central Appalachia and parts of the Ohio River Valley. This distribution resembles the distribution of ginseng, but is more compact. Our program allows for resources aimed to support the trade and the conservation of NTFPs to be more precisely and effectively allocated, and to better understand the potential effects of any state or local shifts in NTFP policy. We believe that creating this portrait of the eastern botanical NTFP trade can benefit all stakeholders.

The data collected for this study is an important piece of the puzzle for the effective management of medicinal NTFPs in eastern deciduous forests, by providing market research for the industry, and for supporting development initiatives based on sustainable production. A systematic approach to monitoring nontimber forest resources in the forest is also needed, perhaps by incorporation into existing timber monitoring programs, which we have enabled through designing our program to be compatible with FIA and the TPO. This is just one possibility. Other impacts on these populations, including habitat loss should be taken into consideration (Hufford 1997; Mulligan and Gorchov 2004. Foster 2014.). A deeper understanding of how these species regenerate and respond to different harvesting scenarios is also required, both to be able to understand harvesting impacts and to certify sustainable wild harvests. The few existing studies have demonstrated that those impacts are influenced by how

harvesting occurs, including the method, intensity, and even timing of harvest (Sanders and McGraw 2004; Small et al. 2011). How products are actually being harvested is unknown, a possible subject for collaborative research with harvesters or primary buyers, like those in this study.

This study provides a snapshot for the trade in the mid 2010s, but it is imperative that output estimates be replicated in the future. The herbal products industry is volatile. Our results indicate that medicinal NTFP species should be considered individually when possible. There is a great deal of variability in the value and scale of harvest for these species. Some are increasing in demand, others decreasing. From the harvest distribution it is also evident that pressures on populations are not uniformly distributed. These data can be used to both support the NTFP trade and the conservation of NTFP species with greater precision, getting the needed resources to the communities and places where the trade is taking place.

All NTFP stakeholders can benefit from a nuanced and consistent approach to measuring output that has buy-in and participation from the various groups with a vested interest in the root and herb trade. This includes existing buyers and harvesters, new producers, and groups working to conserve plant populations. For stakeholders that often have conflicting views on policy related to NTFPs or the conditions justifying it, the lack of consensus on the state of the trade and of wild populations prevents productive conversation and impactful collaboration. The baseline provided by this study is a step in that direction, and future replications will only strengthen its foundation.

CHAPTER 4. DEVELOPING PLACE-BASED ESTIMATES OF NONTIMBER PRODUCT OUTPUT (NTPO): A CASE STUDY FROM THE MEDICINAL PLANT TRADE

ABSTRACT

Nontimber forest products (NTFPs) are an important source of livelihood and cultural identity in forest-dependent communities in the United States (U.S.), but the economic and ecological impacts of NTFP trade are largely unknown. This is due in large part to the lack of a program that systematically measures harvests and maps where they occur. These findings can benefit market actors, consumers, and organizations seeking to support sustainable production and conservation of NTFP species. This is especially true in the heavily forested and mountainous regions of the eastern U.S. To improve our understanding of NTFP trade in this region, we used a novel approach to measure output for commonly traded medicinal NTFP raw material in 15 states. In doing so, we also address a common problem in NTFP surveys: the difficulty of projecting estimates with a high proportion of non-response. We studied medicinal NTFPs because of their rate of harvest, their cultural significance, their monetary value in the supply chain, and efforts to conserve them. We surveyed American ginseng (*Panax quinquefolius*) dealers because they register to conduct trade in the study region. They also report a business address in the process. That location is the only data available for non-respondents. Using the literature, feedback from buyers, and secondary data, we carried out an iterative analytical process that led to the following hypothesis: the likelihood of trade in medicinal NTFPs other than ginseng can be predicted using business location. That prediction was based on the premise that certain biophysical and socio-economic factors would influence the prevalence of local NTFP activity. We tested this by developing a multinomial logistic

regression model using place-based predictor variables associated with the buyers' business address. We used variables from the regression model to ascribe a probability of purchase to respondents and non-respondents, and used those variables to cluster them into high and low production areas. We ascribed purchase amounts for each product to non-respondents using the probability scores and the central tendencies of respondents in the same cluster, and developed study-wide projections of harvesting using place-based imputation. This paper presents and compares the different methods that were tested leading up to development of the place-based analysis, and also discusses the calibration and interpretation of results. The model provides a more robust and spatially distributed estimate of NTFP trade volume, and in doing so allows for a deeper understanding of the trade, and where it occurs.

4.1 Introduction

Nontimber Forest Products (NTFPs) are defined as "plants, parts of plants, fungi, and other biological material harvested from within and on the edges of natural, manipulated, or disturbed forests" (Chamberlain et al. 1998). Medicinal plants and fungi have a long history of commerce in the diverse hardwood forests of the eastern United States (U.S.). They are sold into local and global markets, generating millions of dollars in retail value (Smith et al. 2017; Chamberlain et al. 2018c). In addition to their value for traditional user groups, NTFPs increasingly are viewed as a multi-faceted asset for economic development and market-driven conservation in areas with extensive forests and struggling economies (Neumann and Hirsch 2000; Jones et al. 2002; Shackleton and Pandey 2014).

Despite increased interest in NTFPs, there is a dearth of consistent, systematic data on the size, distribution, and value of associated trade. This lack of data effectively prevents estimates of market scope and scale, hamstringing management efforts to assess the sustainability of

harvests or quantify existing supply (Vaughan et al. 2013). The "black box" of the supply and value of individual NTFP species, as well as the regional economic impacts of the trade, increase volatility and risk for producers and traders (Gold et al. 2004). The inability to quantify NTFP value and impact also hinders efforts to certify or support cultivation and sustainable harvesting (Vaughan et al. 2013).

This study sought to create and test a method for measuring, geographically segmenting, and projecting annual output in the medicinal NTFP sector. Our goal was to create an exportable model that addresses persistent problems in measuring NTFP harvests: 1) the issue of low participation; and 2) the potential for coverage error and non-response bias often attributed to working with informal supply-chain actors (McLain and Jones 2002; Chamberlain et al. 2018a). After four years of surveying primary medicinal NTFP buyers in 15 states, we observed that even though buyers were widely dispersed, the trade was concentrated within certain parts of the study area, primarily within certain areas of Appalachia and the Ohio River Valley.

To estimate trade volume, we developed a series of simple projections, but remained concerned about potential non-response bias (Rogelberg and Stanton 2007). Observations of geospatial patterns in the data, coupled with the realization that we know the business location of non-respondents led us to adopt a place-based approach to test biophysical and socio-economic variables as predictors of trade and use significant associations to ascribe estimates to non-respondents. To identify potential explanatory variables, we looked to literature and conducted informal interviews with buyers. Findings pointed to biophysical factors affecting potential availability of plant material, as well as socio-economic factors such as low employment, poverty, access to land, and dependence on associated economies like coal mining and logging.

We hypothesized that place-based biophysical and socio-economic variables could be tested against responding buyers to create a model that predicts the probability of non-respondent trade activity. The probabilities could then be used in multivariate statistical clusters of respondents and non-respondents created with predictors from the model to ascribe trade activity estimates to non-respondents. We based our approach on habitat modeling, which uses area observations to estimate the incidence or abundance of rare plant and animal species areas where observations did not occur. This is accomplished by identifying limiting and enabling factors such as climate, site conditions, presence of food sources, and potential nesting sites. Predictive models assign probability scores for the species in question across a landscape that is modeled, but not directly observed. A similar modeling process was used to predict the probability of ginseng poaching in different areas of Shenandoah National Park (Young et al. 2011).

This approach enabled attribution of purchase volume to non-respondents more accurately in output estimates when compared to arithmetic attempts focused on projecting evenly across non-response and study region. It also allowed for the identification and description of areas of high and low production across the study area, and with the collection of price data, estimates of total first-order value for the species surveyed. In this paper, we: 1) present the process leading to development of a testable, hypothesized place-based model of medicinal NTFP trade; 2) describe the method used to develop projections in the study area using model results and a statistical clustering procedure; and 3) present the total projections for volume and first order value for the plants surveyed.

4.2 Literature Review

Tracking Forest Product Trade

Since the 1930s, the U.S. Forest Service has tracked timber trade through the Timber Products Output (TPO) program, which surveys mills about the species and volume of timber they purchase (USDA Forest Service 2018d). This well-established program enjoys high rates of participation (e.g., Piva et al. 2011), and is part of a larger Forest Inventory and Analysis (FIA) program that also monitors standing timber on thousands of research plots across the country. It provides valuable market data for the industry and researchers via reports and public data tools. By contrast, there is very little systematic tracking of NTFP output in the U.S. (Chamberlain et al. 2018a). Overviews of the sector have relied on a mixture of data from permit sales, surveys, data from industry organizations, and, in a few cases, data collected under a legal mandate (Alexander et al. 2011; Chamberlain et al. 2018c).

Each of these systems has advantages and disadvantages. In the case of permits and leases, not all products are permitted and not all public land units offer them. For example, national forests in North Carolina sell permits for harvesting some medicinal plants, but national forests in Indiana do not (USDA Forest Service 2018e; 2018f). Large undeveloped tracts of private land have customarily been utilized as a commons for NTFP harvests across much of the study region (Newfont 2012; Manget 2016), meaning that substantial activity in the eastern medicinal NTFP trade is not captured through permit sales. American ginseng is regulated through the 1973 Convention on the Trade in Endangered Species (CITES) and tracked under its legal mandate, which provides some of the best information about a single NTFP species (Robbins 2000). However, legal mandates require political capital and resources for enforcement. They can often be a burden for participants and lead to strained relationships between user groups and government agencies (Burkhart et al. 2012).

The American Herbal Products Association (AHPA), an industry advocacy group, periodically publishes annual data on native species that are commonly wild harvested (AHPA 2012). AHPA's survey constitutes the best data previously available for many of the products in our study. However, its data are largely derived from dues-paying AHPA members, does not include harvest origin or product value, and is released only periodically to its members. On the other hand, surveys by researchers often take place at the regional or state level, such as Greenfield and Davis' (2003) assessment of the medicinal NTFP market in North Carolina. Surveys are often short-term projects, but provide a valuable snapshot of markets that can fluctuate dramatically. Other examples include surveys of mushroom harvests in the Pacific Northwest (Schlosser and Blatner 1995) and the ornamental moss trade in the Northwest and in Appalachia (Muir et al. 2006).

Systematic data about NTFP trade has the potential to benefit all users and stakeholder groups. Harvesters and buyers often rely on the people they sell to for market information like prices and demand, which weakens their bargaining power and ability to plan for the future. This is especially true for new entrants to the market, who usually have no reliable information on prices or demand (Gold et al. 2004). Reliable output data in the form of a systematic reporting protocol, or nontimber product output (NTPO) reports, along with monitoring supply in forests, are key components for managing NTFPs at the regional level. The inability to put a value on the industry and describe its economic impact is an obstacle to institutional investment (Vaughan et al. 2013). Finally, reliable output data trusted by all stakeholder groups will provide a much-needed baseline for discussion and collaboration between stakeholder groups working for a sustainable and ethical industry, many of whom disagree on the state of that industry and its future.

Iconic Eastern Forest Medicinal NTFPs

While American ginseng (*Panax quinquefolius*) is perhaps the most famous eastern forest medicinal, hundreds of other species of roots, barks, and vegetative materials are also harvested for commercial sale in global markets. Fifty percent of the native medicinal NTFP species with markets in the U.S. are found in one part of the study area, the Appalachian Mountains (Greenfield and Davis 2003). Fourteen out of 22 species in the AHPA survey of commonly wild harvested species are native to eastern deciduous forests. A 2015 list of the most commonly purchased and valuable roots and herbs globally included two species naive to eastern U.S. forests, goldenseal (*Hydrastis canadensis*) and black cohosh (*Actaea racemosa*) (Smith et al. 2017), with the latter valued at over 35 million $USD in retail sales.

Predictive Variables: Forest Habitat and Land Access

Many of the iconic medicinal woodland species in the eastern U.S. forests are most commonly found in the same types of habitat: mesic hardwood forests (Davis and Person 2014), primarily in the oak-hickory and maple-beech-birch forest groups as defined by the U.S. Forest Service (USDA Forest Service 2018a). Due to the slim profit margins for harvesters, primary buyers are likely to be located close to large expanses of potential habitat. Thus, buyers purchasing non-ginseng medicinal NTFPs are likely to be located in counties that are more rural, and more heavily forested with appropriate habitat. Conversely, buyers in urban areas, or rural areas without ideal habitat would be less likely to purchase directly from harvesters.

Regardless of the presence of ideal forests, access to land where appropriate habitat exists in the eastern U.S. forest is not a straightforward proposition. The existence of large swaths of forested land, treated as “de facto” commons in the study region, is tied to the history of land use and land ownership (Newfont 2012). As an example, a groundbreaking study published in 1983

found that over 75 percent of the region's private land was absentee-owned, and 40 percent was corporate-owned, with higher rates in the coalfields (Appalachian Land Ownership Task Force 1983). A 2013 update by the West Virginia Center for Budget and Policy found that, while land ownership in West Virginia had become less concentrated, more than half of the land in many southern coalfield counties is still owned by the top 10 landowners, with most held by Timber Investment Management Organizations (Spence et al. 2013). This pattern is thought to persist throughout the coalfields.

Elsewhere in the study region, forested commons became some of the first national forests in the U.S. (Newfont 2012). Even in places where large landholdings were retained by individuals, there were often expansive absentee land holdings. This type of land ownership results in large tracts of forest, which enabled NTFP use generally, and the commercial harvesting of NTFPs more specifically. Until the 20th century, the right of citizens to hunt, gather herbs, and graze livestock on mast was both customarily and legally protected in much of the study area (Manget 2016). Today, although it is no longer legally recognized, it remains a customary norm to harvest on large undeveloped land holdings (Hufford 1997) and it is reasonable to postulate that harvesting activity is concentrated in areas with greater amounts of forest in public and corporate ownership.

The Socioeconomic Situation

While NTFP harvesting for personal use occur across demographic groups (Robbins et al. 2008), economic hardship and commercial NTFP harvesting are commonly thought to be correlated generally (Jones and Lynch 2000; Neumann and Hirsch 2000; McLain and Jones 2001; Shackleton and Pandey 2014) and in Appalachia specifically (Bailey 1999; Hufford 1999; Greenfield and Davis 2003). Gathering wild plants in forests is hard work with low

compensation. Harvesters are usually paid in cash by weight or volume. This trade often occurs in remote or rural areas, which, due to their economic isolation or reliance on a few industries, are often economically distressed. Within those communities, the most vulnerable people are often depicted as the primary commercial NTFP harvesters: those without steady income, indigenous people, women, and recent immigrants (Jones and Lynch 2002; Emery et al. 2006). Harvesting and selling medicinal herbs and roots typically are part of a safety net or a livelihood strategy that includes other forms of informal economic activity (Hufford 1996; Newfont 2012; McCoy 2017).

Commercial NTFP root and herb gathering and associated trade activity developed to supplement the more formal material livelihood strategies dominant in many of the economically stressed forested regions of the eastern U.S. The prevalence of associated occupations such as coal mining, forestry, and agriculture typically go hand-in-hand with NTFP trade. Often "diggers", or "wild crafters" as harvesters are sometimes referred to, used income or trade from medicinal NTFPs to supplement agricultural income in the off-season, to bolster low-wage or part-time pay, or make ends meet when local mines or mills were overstaffed or not operating (Price 1960; Bailey 1999). By the early 20th century, harvesting medicinal NTFPs for extra income developed into a cultural tradition and livelihood strategy. More recently, media reports and anecdotal evidence suggest a relationship between the dramatic uptick in substance abuse and motivations to exploit medicinal NTFPs in the study region (McCoy 2017).

4.3 Methods

Harvesters are numerous, widely dispersed, and often difficult to locate. Traditionally, they sell the NTFPs to local buyers, who often pay cash. For this reason, we surveyed primary buyers of American ginseng (*Panax quinquefolius*). The state agencies that oversee ginseng hold

and often publish lists of ginseng dealers making them accessible within our study area. Their businesses may be devoted to botanical products, or may be part of a diversified business that include enterprise activities such as buying scrap metal, or selling items at a convenience or sporting goods store. While not all ginseng buyers purchase species other than ginseng, most buyers of other medicinal species with overlapping range purchase ginseng. This has been observed in other studies of the trade (Hufford 1999; Kruger and Chamberlain 2015).

Our study area included every Appalachian state as defined by the Appalachian Regional Commission (ARC) (ARC 2018) that maintains a ginseng program (exceptions: Mississippi and South Carolina do not permit ginseng harvests). We also included adjacent eastern U.S. states with ginseng programs, similar forest habitat, and a history of commercial trade in other medicinal NTFPs. This included the rest of the Ohio Valley in Indiana and Illinois, and the Ozark and Ouachita Plateaus in Arkansas and Missouri.

We used three methods to collect data on four years of production (2012-2015). The main (and first) method was a mail survey. In subsequent years, options to complete the survey by phone through an online platform were offered. The mail survey followed Dillman's (2009) Tailored Design Method and consisted of a pre-survey recruitment mailing (Appendix A), a survey with instructions, a reminder postcard, and a replacement survey. The survey (Appendix B) included four sections, which addressed four goals: 1) identifying a respondent's place in the market and capturing overall market structure; 2) tallying the volume of non-ginseng raw material purchased; 3) determining the point-of-origin of purchased raw material; and 4) measuring the first-order value for purchased raw material.

The first survey section asked general questions about the respondents business, such as whether they bought ginseng, other medicinal NTFPs, or other non-medicinal NTFPs, if they

harvested products themselves, their number of employees, and who they sold their products to. The latter was divided into five categories (consumers, other buyers, manufacturers, retailers, and other). The second section asked buyers to report the amount purchased for 15 herbaceous plants typically harvested for their roots and two trees harvested for their bark (Table 4.1). These products were selected in consultation with respondents, other researchers, and NGOs such as United Plant Savers (United Plant Savers 2018).

Plants were selected if they met one of a number of criteria. They had to be harvested in the same forests, and be valuable, commonly harvested, and/or rare (of conservation interest) (Cunningham 2006). Over the course of the study, two species were removed because they were not commonly purchased in the study area (*Aletris farinosa* and *Cypripedium spp.*) and others added. The final list included ten roots or rhizomes of perennial herbaceous understory plants, and two tree barks.

The third section asked respondents about where the material they purchased had been harvested. It was important to avoid a level of resolution that could result in respondent identification. County-level analysis was desirable, but in some counties there would only be one large dealer. To preserve anonymity and make data compatible with the U.S. Forest Service FIA program, we partitioned the study area into FIA Survey Units. Buyers were supplied both a map and a list of regions and their counties, and asked to attribute percentages of their purchase for each product accordingly.

The final section of the survey asked respondents to report the average price paid to harvesters in their region by the fresh and green pound for surveyed species. The average was used on the basis that a respondent's particular payment transactions are proprietary or sensitive (after Greenfield and Davis 2003). Respondents were invited to write in any additional species

they purchased outside of what was explicitly surveyed, and space was provided for general comments or feedback. We also solicited interviews through the survey materials, and by using a chain referral method. Interviews helped refine the instrument for subsequent surveys and provided information on context, including factors that relate to NTFP harvests.

Table 4.1. Fifteen medicinal NTFP species included in surveys of potential primary buyers 2014-2016. The surveyed primary buyer population consisted of registered ginseng buyers in 15 states in the eastern U.S.

Name	Common Name	Part Used
Actaea racemosa	Black cohosh	Root/Rhizome
Aletris farinosa	True unicorn, star root	Root/Rhizome
Aristolochia serpentaria	Virginia snakeroot	Root/Rhizome
Caulophyllum thalictroides	Blue cohosh	Root/Rhizome
Chamaelirium luteum	False unicorn, star grub root	Root/Rhizome
Chionanthus virginicus	Fringe tree	Bark
Collinsonia canadensis	Stoneroot	Root/Rhizome
Dioscorea villosa	Wild yam	Root/Rhizome
Geranium maculatum	Cranesbill	Root/Rhizome
Hydrastis canadensis	Goldenseal	Root/Rhizome
Podophyllum peltatum	Mayapple	Root/Rhizome
Polygonatum spp.	Solomon's seal	Root/Rhizome
Sanguaria canadensis	Bloodroot	Root/Rhizome
Trillium (*spp.*)	Bethroot	Root/Rhizome
Ulmus rubra	Slippery elm	Bark

In the first year of the study (2012), primary buyers listed in Virginia and North Carolina's ginseng registries were surveyed. One hundred and two surveys were successfully delivered, and the response rate was 10 percent. In 2014, the project was expanded to include six southeastern states with ginseng programs: Alabama, Georgia, Kentucky, North Carolina, Tennessee, and Virginia. A total of 45 responses were received from 264 surveyed buyers, for a total response rate of 17 percent.

These data from 2012 and 2014 were useful, particularly for instrument development, but follow-up surveys in 2015 and 2016 (2014 and 2015 buying years) proved to be most appropriate for scaled projections because response rates rose as the program expanded, buyers developed familiarity, and the survey instrument matured. To maximize analyzable data and response rates, these two years of data were combined into one data set. These data were from responses to surveys mailed to 700 individual buyers, a primary population derived from ginseng registries in 15 states (Alabama, Arkansas, Georgia, Illinois, Indiana, Kentucky, Maryland, Missouri, New York, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, and West Virginia).

A two-year mean was used for buyers who responded in both rounds of surveying. If they did not purchase a particular product in one year, the amount for the year purchased was used. Aggregators, who also purchase volume from fellow primary buyers, were included, but we were careful to only include the amount purchased directly from harvesters to avoid counting the same material twice. The majority of the material purchased was dry, and the relatively small amount of fresh material reported was converted to dry pounds at a rate of 33 percent. Because ratios vary from species to species and also over the course of a buying season, we used a 3-1 ratio, which was considered roughly average across all species. In future iterations an individual rate for each species would be more ideal, but in this case the impact on the overall output estimates is minimal due the smaller amounts of fresh material involved.

Two methods were used to measure nonresponse bias (after Rogelberg and Stanton 2007). In the "wave" method, later respondents are assumed to resemble non-respondents. A significant relationship between date of response and variables of interest would be a red flag. We compared the tendency to buy goldenseal and the amount of goldenseal purchased with the date of response and failed to find a significant correlation. An abbreviated survey administered

to a sub-sample of non-respondents (n=18) did not indicate any large outliers in pounds purchased and reflected a similar percentage of purchased material when compared to respondents (39%). Taken together, both suggest that respondents are relatively representative of non-respondents. Results were validated by comparing different projections from our data, as well as industry figures, and estimates of total market output obtained from aggregators.

The first attempts to use data from this study to project the overall volume in medicinal NTFP trade for the studied species were arithmetic in nature. These analytical steps exposed potential flaws in study-level projections due to double-counting or the possibility of nonresponse bias. We wanted to create a baseline of the lowest possible output by adding observed primary purchases (those bought directly from harvesters) with observed secondary purchases from aggregators we knew were not already accounted for by primary buyer respondents. We were able to make that distinction by looking at where aggregators reported sourcing geospatially by FIA Unit, and only recording the aggregator material that was greater than the primary amounts reported there by other respondents. This conservatively assumes that all primary sales were sold to responding aggregators, and thus were already counted. In FIA units where there was no primary material reported, all aggregator material was counted. This was not a projection of total output, but a baseline. Projecting from that baseline would involve potential double-counting, since aggregators accounted for an unknown number of non-respondents. We created a simple projection to cover the entire study area by leaving out the aggregator material, assuming our sample was representative, and taking our primary amounts purchased and projecting by the response rate evenly over the nonresponse pool.
Projection purely from the primary purchases at 26 percent was deemed to be biased, since it would attribute data assumptions to almost three-quarters of the population. In light of the

situation, we hypothesized that comparing respondents with non-respondents based on their business location would be possible. After seeing patterns in how harvests were distributed, we studied business location as a way to attribute trade volume to non-respondents with greater precision. In other words, we attributed volume based on the buying habits of proximal peers.

Multinomial logistic regression was used to develop the place-based model and test the power of hypothesized independent place-based variables as predictors of whether a respondent purchased nothing, ginseng only, or ginseng and other medicinal species. Multinomial logistic regression was used because dependent variables were non-hierarchal. The output of the model includes a chi-square likelihood ratio test, which indicates the overall significance of the variables in the model, and Nagelkerke R^2 that approximates a measure of goodness of fit. Parameter estimates demonstrate the significance and effect of individual variables.

To develop variables for the place-based model, potential habitat data were taken from the U.S. Forest Service's FIA Program, through their EVALIDator online tool (US Forest Service 2018). We used total acreage and percentage of "ideal" forest type group, by county which we defined as the forest-type groups where study species are commonly found: oak-hickory, maple-beech-birch, and elm-ash-cottonwood. These total figures and percentages were coded as continuous variables.

We also made designations based on FIA units that divide the study area into geographic regions based on geographical features and land use (Fig 4.l). FIA units tended to roughly follow these lines, but in some cases they were designated based on where the majority of the unit was located. The Appalachian and adjacent mountain ranges were broken into 3 categories, Northern, Central and Southern. The Northern Mountains also include the Adirondack, Catskill, and Pocono areas of New York and Pennsylvania. The flatter and more urbanized area to east was

designated as Mid-Atlantic/Northeast. The flatter, less forested region north of the Ohio River and west of the Appalachian region were aggregated as Central Lowlands. The Ozark Plateau in Arkansas and Missouri was treated as a distinct region, as was the rolling areas of mostly deciduous forest along the Ohio, Mississippi, and Tennessee Valleys. The Piedmont area of the southeast was also considered as a distinct region. Areas that were either outside the range of ginseng, or outside the study area were treated as one region. This included dealers based on the west coast, on the southeastern coastal plain, and in states adjacent to the study area that lack ginseng programs. A dealers' location within one of these regions was coded as a categorical variable.

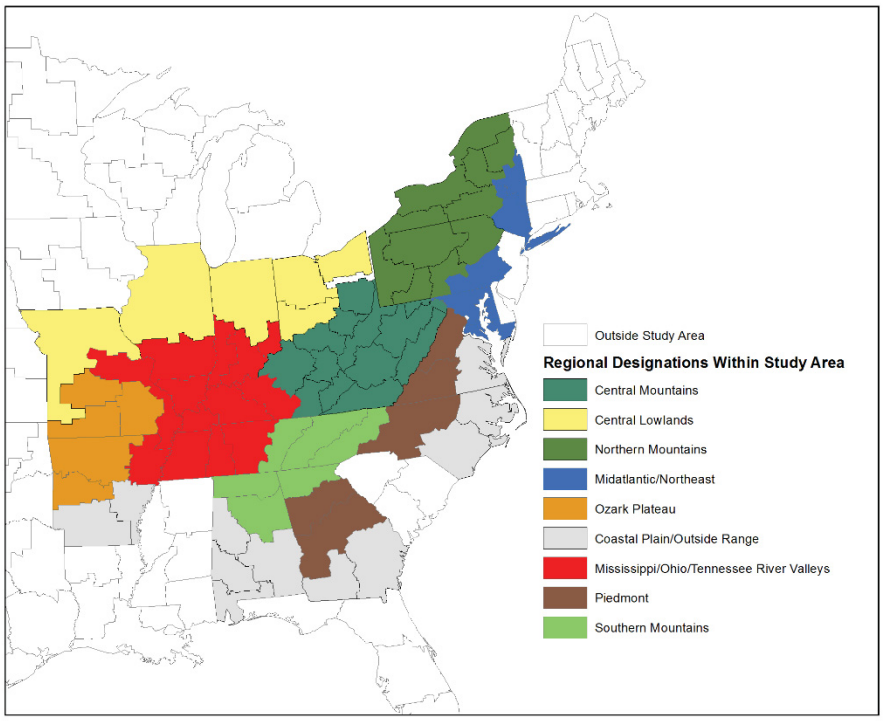


Figure 4.1. Study area broken into geophysical sub-regions based on USDA Forest Service Forest Inventory and Analyses research units. These units were aggregated based on biophysical and geographic conditions.

The U.S. Department of Agriculture's Department of Economic Research Services produces the Rural-Urban continuum (RU), which classifies counties based on their urban population, and on being part of or adjacent to large metropolitan areas. We used data from the most recent dataset (2013) and coded RU as an ordinal categorical variable.

The U.S. Forest Service's National Woodland Owners Survey (NWOS) provided ownership data (USDA Forest Service 2018c), such as the percent of corporate forest ownership at the FIA Survey Unit level. Statistics on public versus private forest ownership were queried through the FIA EVALIDator tool, and both were converted to percentages and total acreage at the FIA survey unit level. These data were summed together to create a percentage of FIA unit as potential "commons" forest as a continuous variable.

Socio-economic data were obtained from the American Community Survey (ACS), an annual survey conducted by the U.S. Census (US Census 2015). We used five-year averages from 2015 for median income, poverty rate, rate of SNAP benefit receivers (government assistance sometimes referred to as "food stamps"), and a combination of unemployment rate with the percentage of the population out of the workforce. This "not working" statistic is more applicable because many in the core of the study area have claimed disability, stopped looking for work, or are participating in informal economic activity (Bradley et al. 2001). The rate of drug overdose per 10,000 deaths was obtained from the County Health Rankings Program developed by the University of Wisconsin's Public Health Initiative (UWPHI 2018). These data were coded as continuous variables. Occupational data were provided by the ACS, specifically the percentage of the county working population employed in natural resources, forestry, mining, and agricultural fields and subsequently coded to create continuous variables.

Exploratory factor analysis was used to streamline the regression model. Collinearity diagnostics were run on the resulting variables, resulting in 7 being used in the hypothesized logistic regression model. The model was designed to predict whether a buyer would: purchase no medicinal NTFPs; purchase only ginseng; or purchase ginseng and other medicinal NTFPs (the reference category). None of the recipients reported purchasing other species and not purchasing ginseng. The model was tested to identify final significant variables, statistics of goodness-of-fit, and probability scores for respondents and non-respondents.

Next, we used significant variables in the model in a two-step cluster analysis to characterize the areas where the trade was concentrated. We chose the two-step procedure for its ability to allow processing of categorical and/or continuous data and automatically determine an optimal number of clusters with high cohesion (Wilks 2011). The analysis resulted in four clusters, which were descriptively named based upon observed characteristics in the clustering variables. One-way ANOVA was used to test for statistically significant differences in the variance between all variables.

The mean probability score for each cluster from the regression model was used to estimate the number of non-respondents in each that bought non-ginseng raw material. The frequency of purchase and median purchase amounts for observed cases in each cluster were used to assign output for non-respondents. To account for the variability within each cluster, the observed purchasers for each product were divided into quartiles. The median purchases in each quartile were ascribed to a proportionate amount of non-respondents. The following steps were used in the procedure:

1. Mean Cluster Probability Score x Number of Non-respondents in each cluster = Number of Non-respondent Purchasers (NRP)

2. NRP x Percent of Respondent Purchasers in Cluster Who Purchased Individual Species = Non-respondent Purchasers of Individual Species (NPIS).
3. Observed buyers divided into quartiles based on purchasing for each species.
4. A proportional number of non-respondents assigned to each quartile
5. Non-respondents are assigned the median purchasing amount from their quartile.
6. Non-respondent material + Reported Purchase from Respondents = Cluster Total (CT)
7. Sum of all CTs = Total Output Estimate

Final estimates were calibrated through comparison with industry data, which was available through AHPA reports for some species from 2000-2010 (AHPA 2012), and by looking at a range of potential estimates using different projection methods, including simple projection from initial response rates.

4.4 Results

Surveys were mailed to 700 valid business addresses for primary buyers who registered to participate in the 2014 and/or 2015 ginseng trade (surveys mailed in 2015 and 2016). One hundred and eighty were returned for a response rate of 26 percent. Forty primary buyers were not counted because their addresses were invalid; they were deceased, based outside of the U.S., or were one of multiple buying agents for the same business. Response rates by state ranged from 13 percent in Illinois to 60 percent in Arkansas and Pennsylvania (Table 4.2). The mean response rate for all states was 29 percent.

Table 4.2 Responses and response rates of 700 surveyed potential primary buyers of 15 medicinal NTFPs in 15 eastern states in the U.S. in 2015 and 2016.

State	Respondents	Non-respondents	Total Buyers	Response Rate
AL	5	5	10	50%
AR	3	2	5	60%
GA	6	25	31	19%
IL	4	26	30	13%
IN	5	19	24	21%
KY	26	117	143	18%
MD	4	11	15	27%
MO	2	9	11	18%
NY	29	50	79	37%
NC	13	47	60	22%
OH	11	49	60	18%
PA	15	10	25	60%
TN	14	48	62	23%
VA	23	50	73	32%
WV	14	33	47	30%
Outside Study Area	5	20	25	20%
Total	**180**	**521**	**700**	**26%**

The final logistic regression model was significant, with a Nagelkerke R-square of 0.456 (Table 4.3). In the likelihood ratio estimates, the regional category had the highest significance (p=0.005) (Table 4.4.). The other significant categories were percentage of county employed in agriculture, forestry and mining (p=0.042), and population (p=0.048). Having a greater population in the buyers' county made it less likely that the buyer would purchase other species compared to purchasing nothing or purchasing ginseng (Appendix D). Having having a greater dependence on natural resources and agriculture employment also made purchasing nothing, or only ginseng less likely.

Table 4.3. Multinomial logistic regression predicting the probability that surveyed potential primary buyers of non-ginseng NTFPs purchased raw material from NTFP species other than ginseng, bought only ginseng, or bought nothing. The model used place-based biophysical and socioeconomic variables.

n=180	Independent Variables	Nagelkerke R^2	χ^2	Sig.
	Regional Category Percent Relevant Employment Population	0.456	92	.000

Table 4.4. Likelihood Ratio Estimates for Multinomial Regression model. Location by geographic region, county population, and the percentage of the county employed in agriculture, forestry and mining were significant in predicting whether a buyer bought other medicinal species versus buying only ginseng, or buying nothing.

Variable	Level Of Analysis	Significance
Regional Category	FIA Unit	.005*
% Not Working	County	.524
% Relevant Employment	County	.042*
% Commons	FIA Unit	.328
Median Income	County	.696
% Below Poverty	County	.159
Population	County	.048*
% on Snap Benefits	County	.228
% Ideal Forest	County	.722
Rural-Ordinal Continuum	County	.440

The two-step cluster analysis using variables included in the logistic regression model resulted in four clusters with an acceptable silhouette of cohesion (0.3). The four clusters are referred to as: Core Production, Secondary Production, Low Production, and Outside/Adjacent (Figure 4.1). The most significant clustering variable was the regional category, followed by relevant employment and population at 0.2 and 1.8 respectively.

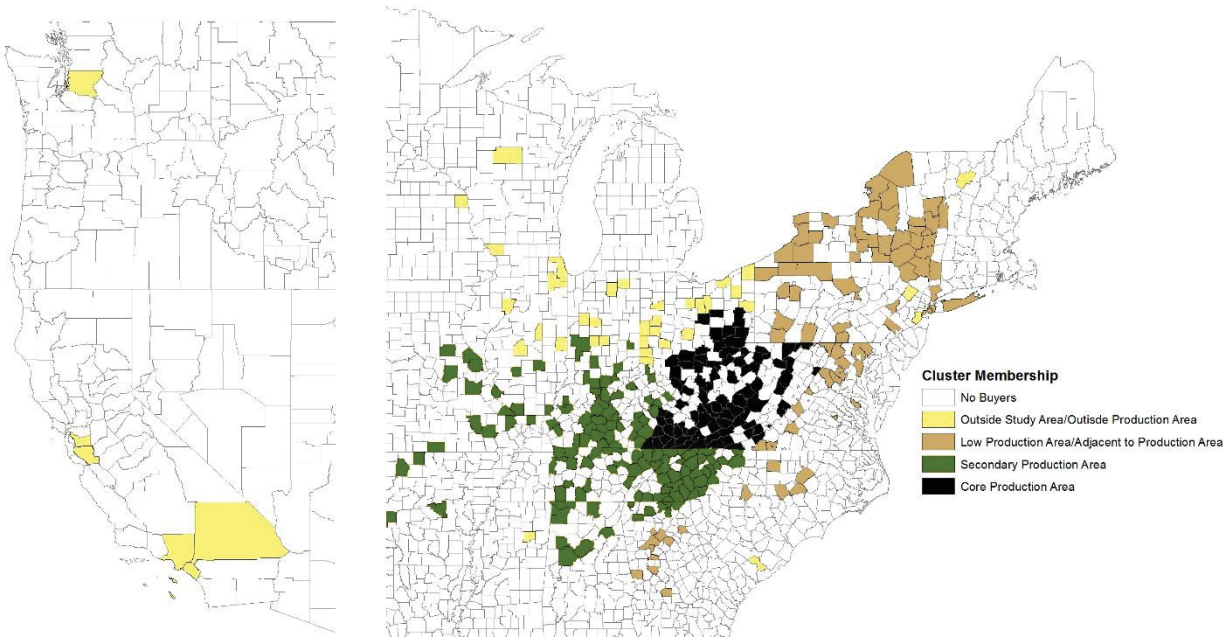


Figure 4.2. Map of cluster membership for counties containing ginseng buyers registered in the study area. The clusters are classified as the Core production area, Secondary production area, Low production area, and Outside/Adjacent production area.

The Core Production area consisted of Central Appalachia, the mountainous counties of Kentucky, Ohio, Virginia, and West Virginia (Fig. 4.1). This area had the highest percentage of relevant employment (7.4%), and the lowest mean county population (32,874) (Table 4.5). The Secondary Production area included Southern Appalachia, the mountainous areas of North Carolina, northern Georgia and Alabama, and eastern Tennessee. It also included areas outside of Appalachia with less mountainous terrain, but still substantial habitat (rolling, mostly mixed deciduous forests), including southern Indiana and Illinois, central and western Kentucky, and the Ozark Plateau in Arkansas and Missouri. The secondary production cluster had the second highest rate of relevant employment and the second lowest mean county population.

The Low Production Area included the entire states of Pennsylvania and New York, the northern Appalachian counties of Ohio, and the piedmont and coastal plain areas of Maryland, Virginia, Georgia and Alabama. This is perhaps the most varied of the clusters, including remote

mountainous areas with potential habitat such as the Adirondack and Northern Appalachian region. However, it also include major urban areas such as the New York, Washington and Atlanta Metropolitan areas. It also includes areas predominantly devoted to agriculture, and counties on the fringe of potential range for the species surveyed: the piedmont and coastal plain. Most of the buyers those areas were located in large urban areas such as Atlanta, Washington D.C. and Baltimore. This cluster had the second highest mean population for county (542,967), and tied for the lowest relevant employment at 1.4 percent.

The Outside/Production Adjacent category included all of the buyers based outside the study area. This included buyers in the west coast states, and those in adjacent states with no ginseng programs (e.g., South Carolina and Mississippi), and those based in states with ginseng programs that were not part of our study area (e.g., Vermont and Wisconsin). In addition to the catch-all "outside" designation, the category also included buyers and buyers based in the relatively less-forested plains areas of Indiana, Ohio, and Illinois, which also included buyers in urban areas such as Chicago. This cluster had the most urban respondents, and the highest mean county population (2.6 million). It was tied for the lowest amount of workers in relevant employment at 1.4 percent.

Table 4.5. Division of all registered ginseng dealers registered in 15 eastern states into 4 clusters using two-step cluster analysis. The most common (categorical) and mean (continuous) values in each cluster for the clustering variables are presented.

		Clusters of Registered Ginseng Buyers 2014-2015 (n=700)			
County-level Variables Ranked by order of importance in cluster	**Category***	**Core (n= 226) 32%**	**Secondary (n=220) 31%**	**Low (n=174) 25%**	**Outside/Adjacent (n=80) 11%**
Region	1-9**	Central Appalachia (100%)	Mississippi/Ohio/ Tennessee River Valleys (52%)	Piedmont (24%)	Central Lowlands (34%)
Relevant Employment	% Workforce in County	7.3%	2.84%	1.38%	1.4%
Population	Number of Residents in County	32,827	74,178	542,967	2,671,480

* Sorted by Rank of Importance

While the rest of the variables were not significant in the regression model, they did differ significantly between production clusters (Table 4.6 and 4.7). The Core Production area had the most ideal forest habitat for most of the species surveyed, as measured by mean total acres of ideal forest and mean percent of the county comprised of ideal forest cover. These counties were on average, 70 percent covered in ideal forest, with 31 percent of their territory being either public or corporate owned forest. Seventy-five percent of the counties were coal-producing, the only cluster with a majority of respondents in coal-producing counties.

The Core Production cluster also was the most rural, and had the highest poverty, lowest employment and workforce participation, and highest overdose deaths. The Secondary Production cluster was behind the Core Production area in all economic indicators with the exception of medium earnings, which were slightly lower in the Secondary Production area. It was the second most rural cluster, and scored second-highest in the land-related variables, being 46% covered in ideal forest and 20 percent forest commons.

The Low Production and Outside/Adjacent clusters both averaged as large metropolitan areas on the RU continuum. They exhibited similar socio-economic conditions, being above the study area average in terms of earnings and workforce participation/employment and below the mean in poverty, overdose rates and with below average poverty and higher earnings compared to the study area as a whole, lower over dose rates, and higher workforce participation and employment.

Table 4.6. Mean values for land-related variables in production clusters (Core, Secondary, Low, Outside/Adjacent) that were not significant in the hypothesized multinomial regression model. One-way ANOVA was used to test for statistical differences between values for each cluster in each category.

	% Coal Producing Counties*	Ideal Forest Acres in County*	% Ideal Forest in County*	% Forest Commons*	Urban-Rural Continuum*
Core	75%	210,422	70%	31%	6.3
Secondary	12%	155,773	46%	20%	4.9
Low	6%	131,021	35%	20%	2.4
Outside-Adjacent	3%	50,817	13%	5%	2.3
Total	29%	152,958	47%	20%	

*ANOVA test significance (α=0.05)

Table 4.7. Mean values for socio-economic indicators in NTFP production clusters (Core, Secondary, Low, Outside/Adjacent) that were not significant in the hypothesized multinomial regression model. One-way ANOVA was used to test for statistical differences between values for each cluster in each category.

	% Not Working*	Poverty Rate*	Median Earnings*	Snap Benefits*	Overdose Deaths Per 10,000*
Core	63%	24%	$25,393	24%	25
Secondary	53%	19%	$25,258	17%	20
Low	44%	14%	$34,551	13%	11
Outside/Adjacent	43%	15%	$31,621	12%	11
Total	52%	19%	$28,338	18%	21

*ANOVA test significance (α=0.05)

Ginseng was purchased by a majority of respondents throughout the study area (71%), with lower buying rates in the Outside/Adjacent (56%) and Low Production clusters (57%), and

more frequent purchasing in the Secondary (81%) and Core clusters (83%) (Table 4.8). Purchasing of other medicinal NTFPs was more concentrated. Respondents in the Low Production cluster had the lowest observed frequency of purchasing non-ginseng medicinal NTFPs (18%) and the lowest mean probability of buying non-ginseng medicinal NTFPs as generated by the regression model (6%). The Outside/Adjacent cluster was second lowest, (25%; 31%) followed by the Secondary Production area (40%; 36%). The Core Production area had the highest observed frequency of purchase and the highest mean probability score (48%; 62%). The observed frequency of purchasing non-ginseng medicinal NTFPs for respondents in the entire study area was 33% and 39% of the entire sample was predicted to be buying other products based on the regression model. This pattern followed for both commonly purchased species (goldenseal, black cohosh, and bloodroot) and less commonly purchased species (all others).

Table 4.8. Purchasing frequency and probability for purchasing among surveyed ginseng buyers. The first section of the table presents results for observed purchasing by respondents among cluster types (e.g. whether the respondents bought ginseng, bought less common products etc.). The second section lists the proportion of buyers predicted to purchase non-ginseng species based on the place-based regression model.

	Participating Registered Ginseng Buyer Clusters 2014-2015 (n=179)				
	Core (n=48)	**Secondary (n=53)**	**Low (n=62)**	**Outside/Adjacent (n=16)**	**Study Area (n=179)**
Response Rate	22%	23%	36%	20%	26%
Bought Ginseng	81%	83%	51%	56%	71%
Bought Nothing	19%	17%	44%	44%	29%
Bought Other	48%	40%	18%	25%	33%
Bought Common Species	44%	34%	13%	25%	28%
Bought Less Common	38%	15%	8%	13%	18%
	All Registered Ginseng Buyers in Cluster Types7 2014-2015 (n=700)				
	Core (n=220)	**Secondary (n=226)**	**Low (n=174)**	**Outside/Adjacent (n=80)**	**Study Area (n=700)**
Proportion predicted buyers	62%	36%	6%	31%	39%

The total reported amounts in each cluster followed the same pattern (Table 4.9). The Core Production area accounted for the majority of total volume or all species except trillium, of which a majority was purchased in the Secondary Production area. The Secondary and Core Production areas shared roughly the same amount of reported mayapple output. For the remainder of the species the Core Production area accounted for most of the reported product. Individual buyers also tended to buy in greater volumes in the Core Production area, in some cases by an order of magnitude. While it was a small amount of the total, the Outside/Adjacent area produced more material than the Low Production cluster.

Table 4.9. Mean and total purchased volume of 11 NTFP species reported by respondents in a combined data set from surveys taken in 2014 and 2015. Respondents are categorized in clusters determined using predictors of buying behavior based on location.

	Clusters of Registered Ginseng Buyer Respondents 2014-2015 (n=180)				
	Outside/Adjacent (n=16)	**Low (n=62)**	**Secondary (n=53)**	**Core (n=48)**	**Total (n=179)**
Mean Black Cohosh Purchase (n=32)	157 lbs.	51 lbs.	242 lbs.	3,344 lbs.	1,839 lbs.
Observed Black Cohosh Purchase	314 lbs.	258 lbs.	1,693 lbs.	56,851 lbs.	58,841 lbs.
Mean Bloodroot Purchase (n=43)	33 lbs.	11 lbs.	31 lbs.	218 lbs.	115 lbs.
Observed Bloodroot	100 lbs.	68 lbs.	428 lbs.	4,351 lbs.	4,947 lbs.
Mean Blue Cohosh Purchase (n=17)	0 lbs.	17 lbs.	4 lbs.	65 lbs.	42 lbs.
Observed Blue Cohosh	0 lbs.	51 lbs.	17 lbs.	653 lbs.	721 lbs.
Mean Cranesbill Purchase (n=11)	2 lbs.	3 lbs.	2 lbs.	16 lbs.	10 lbs.
Observed Cranesbill Purchase	2 lbs.	3 lbs.	6 lbs.	94 lbs.	105 lbs.
Mean False Unicorn Purchase (n=12)	1 lbs.	0 lbs.	75 lbs.	141 lbs.	96 lbs.
Observed False Unicorn Purchase	1 lbs.	0 lbs.	449 lbs.	705 lbs.	1,155 lbs.
Mean Goldenseal Purchase (n=47)	79 lbs.	16 lbs.	324 lbs.	787 lbs.	461 lbs.
Observed Goldenseal Purchase	314 lbs.	94 lbs.	5,508 lbs.	15,732 lbs.	21,648 lbs.
Mean Mayapple Purchase (n=23)	5 lbs.	17 lbs.	147 lbs.	144 lbs.	122 lbs.
Observed Mayapple Purchase	9 lbs.	33 lbs.	1,026 lbs.	1,732 lbs.	2,801 lbs.
Mean Slippery Elm Purchase (n=10)	0 lbs.	0 lbs.	112 lbs.	2,619 lbs.	1,616 lbs.
Observed Slippery Elm	0 lbs.	0 lbs.	448 lbs.	15,715 lbs.	16,163 lbs.
Mean Trillium Purchase (n=16)	0 lbs.	21 lbs.	28 lbs.	13 lbs.	18.8 lbs.
Observed Trillium Purchase	0 lbs.	42 lbs.	140 lbs.	119 lbs.	301 lbs.
Mean VA Snakeroot Purchase (n=20)	10 lbs.	<1 lbs.	2 lbs.	1 lbs.	1.8 lbs.
Observed VA Snakeroot Purchase	10 lbs.	<1 lbs.	13 lbs.	14 lbs.	37 lbs.
Mean Wild Yam Purchase (n=16)	2 lbs.	7 lbs.	237 lbs.	299 lbs.	243 lbs.
Observed Wild Yam Purchase	2 lbs.	7 lbs.	1,184 lbs.	2,688 lbs.	3,882 lbs.

We created projections for annual output for the species in our study area using cluster analysis and the iterative estimation method where non-respondents were assigned value based on purchasing trends of observed buyers within their cluster (Table 4.10). Overall projected totals for annual output for surveyed species varied in the study, the highest volume product at 264,445 pounds (dry) for black cohosh to a low of 201 pounds for Virginia snakeroot, a valuable but lightweight root. There were multiple tiers in terms of trade volume. The three most common were: black cohosh, bloodroot (21,991 pounds), and goldenseal (106,105 pounds). Less commonly purchased products accounted for less than 10,000 pounds each, with several estimated at under a ton in total output. Wild yam and slippery elm had higher volume, but were purchased less frequently (i.e., by fewer buyers).

Over 90 percent of total output was estimated to be purchased in the Core Production area in central Appalachia. A majority of every species purchased was attributed to dealers from that region. Nine percent of the remainder was estimated to be purchased in the Secondary Production cluster, while less than 1 percent was purchased in the Low and Outside/Adjacent categories. The Secondary Production cluster accounted for between 20 and 50 percent of several individual species: goldenseal, false unicorn, mayapple, trillium, Virginia Snakeroot, and wild yam. The Outside/Adjacent and Low Production areas accounted for a negligible amount of all the species, with the exception of Virginia snakeroot, of which 32 percent was reportedly purchased in the Outside/Adjacent cluster.

Table 4.10. Projected purchased volume of eleven medicinal NTFPs for 15 states in the eastern U.S. The overall volume is reported, as well as volume values by respondent clusters determined using predictors of buying behavior.

	Clusters of Registered Ginseng Buyers 2014-2015 (n=700)				
	Outside/Adjacent (n=80)	**Low Production (n=174)**	**Secondary Production (n=226)**	**Core Production (n=220)**	**Total Output (n=700)**
Black cohosh	507 lbs.	415 lbs.	8,406 lbs.	255,126 lbs.	264,455 lbs.
Bloodroot	597 lbs.	118 lbs.	2,009 lbs.	19,266 lbs.	21,991 lbs.
Blue cohosh	0 lbs.	85 lbs.	79 lbs.	3,536 lbs.	3,701 lbs.
Cranesbill	12 lbs.	5 lbs.	17 lbs.	548 lbs.	581 lbs.
False unicorn	7 lbs.	0 lbs.	2185 lbs.	3,951 lbs.	6,143 lbs.
Goldenseal	1,885 lbs.	157 lbs.	21,505 lbs.	82,558 lbs.	106,105 lbs.
Mayapple	54 lbs.	54 lbs.	4,208 lbs.	9,300 lbs.	13,616 lbs.
Slippery elm	0 lbs.	0 lbs.	2,126 lbs.	75,995 lbs.	78,121 lbs.
Trillium	0 lbs.	68 lbs.	617 lbs.	653 lbs.	1,338 lbs.
VA snakeroot	65 lbs.	<1 lbs.	60 lbs.	77 lbs.	201 lbs.
Wild yam	13 lbs.	14 lbs.	5,584 lbs.	11,063 lbs.	16,675 lbs.

Using the price data from the survey, we were able to estimate the total amount of USD$ paid to harvesters (Table 4.11). Seven of the products surveyed were valued at less than 5 USD$ a pound. The most valuable was Virginia snakeroot, valued at an average of 84.65 USD$ a year at the time of the survey. The most valuable product was Goldenseal, which was the most commonly purchased species other than ginseng, the second largest in terms of trade volume, and the third most valuable in terms of prices paid to harvesters. We estimate the total value to harvesters of goldenseal to be 2.3 million USD$. The second most valuable product was black cohosh, which had a lower mean price of 3.62 USD$ a pound but resulted in 957,327 USD$ paid to harvesters. Together those two species accounted for 77 percent of the total trade value for the

species surveyed. False Unicorn was next in line. This higher-priced species (72.14 USD$ per pound) accounted for only 6,143 pounds but 443,156 USD$ paid to harvesters. By contrast, the most valuable species, Virginia Snakeroot, accounted for only 17,014 USD$ in primary trade value due to its low trade volume. The lowest valued product was trillium (4,161 USD$), of which an estimated 1,338 pounds was sold at 3.11 USD$ a pound. The total first-order value of the products surveyed was 4.3 million USD$. By comparison, the mean annual value of the total U.S. trade in wild ginseng for harvesters is estimated at 27 million USD$ (Chamberlain et al. 2013).

Table 4.11. Total mean annual estimated value in USD$ paid to harvesters by ginseng dealers registered in 15 state study area, based on mean prices reported, and by total amounts estimated by place-based model for material bought in 2014-2015.

Species	Total Pounds	Mean Dry Price	% of Total Value	Total Value USD$
Black cohosh	264,455	$3.62	22%	$957,327
Bloodroot	21,991	$10.39	5%	$228,486
Blue cohosh	3,701	$2.62	0%	$9,697
Cranesbill	581	$2.73	0%	$1,586
False unicorn	6,143	$72.14	10%	$443,156
Goldenseal	106,105	$22.38	55%	$2,374,630
Mayapple	13,616	$3.14	1%	$42,754
Slippery elm	78,121	$2.68	5%	$209,364
Trillium	1,338	$3.11	0%	$4,161
VA snakeroot	201	$84.65	0%	$17,014
Wild yam	16,675	$2.44	1%	$40,687
Sum				**$4,328,864**

In addition to using different projection methods, we compared our results with the most recent figures from the AHPA Annual Tonnage Survey (AHPA 2012) (Table 4.12). Proximity to AHPA estimates varied, and it should be noted that AHPA numbers fluctuate significantly from year to year due to changes in demand. Projections in this study were very close to AHPA five-year means (2005-2010) for black cohosh, false unicorn, trillium, and Virginia snakeroot.

Slippery elm, wild yam, and blue cohosh were lower, and bloodroot and goldenseal were higher. The model-based method resulted in slightly higher estimates than the simple projection.

Table 4.12. Total amount purchased in dry pounds for 11 NTFPs from different projections of data derived from surveys of registered ginseng buyers (n=700) in 15 states in the eastern U.S.

	Baseline of Confirmed Purchase	Simple Projection	Model Projection	AHPA 5 year mean
Black cohosh	90,552 lbs.	229,845 lbs.	264,445 lbs.	259,530 lbs.
Bloodroot	6,340 lbs.	19,319 lbs.	21,991 lbs.	5,086 lbs.
Blue cohosh	453 lbs.	2,816 lbs.	3,701 lbs.	5,563 lbs.
Cranesbill	1,222 lbs.	409 lbs.	581 lbs.	-
False unicorn	2,173 lbs.	4,512 lbs.	6,143 lbs.	4,608 lbs.
Goldenseal	18,405 lbs.	84,561 lbs.	106,105 lbs.	60,638 lbs.
Mayapple	2,451 lbs.	10,939 lbs.	13,616 lbs.	-
Slippery elm	35,389 lbs.	63,136 lbs.	78,121 lbs.	287,503 lbs.
Trillium	630 lbs.	1,174 lbs.	1,338 lbs.	1,377 lbs.
VA snakeroot	11 lbs.	143 lbs.	201 lbs.	46 lbs.
Wild yam	7,617 lbs.	15,164 lbs.	16,675 lbs.	36,911 lbs.

4.5 Discussion

Location proved an effective predictor for the probability of purchasing other species in relation to purchasing only ginseng, or purchasing nothing. Location by sub-region was the most important predictor variable, followed by relevant employment and the population size at the county level. Clustering based on those variables resulted in 4 different categories of production area: Core, Secondary, Low, and Outside/Adjacent. The majority of the buying activity occurred in the Core area, which had the lowest mean population and the highest dependence on natural resource and agricultural employment. It encompassed central Appalachia, with 75% of buyers coming from coal producing areas. Buyers in these areas were responsible for 90 percent of the total trade volume and a majority of all species surveyed. Around 9% of the total material came from the Secondary area, and 20-40% of some individual species. Less than 1% of the total trade

volume came from the Low and Outside/Adjacent buying areas, which had the highest mean population and lowest dependence on natural resource and agricultural employment.

When harvesting occurs within a minority of a population, overall trends do not necessarily reflect realities for buyers or harvesters. However, there are some patterns that describe the local contexts in which the trade operates. The Low and Outside/Adjacent areas tended to be more urban. This is due to the many businesses located in cities both outside the study area (Los Angeles, Seattle) and within it such as Atlanta, Washington D.C., and New York. The latter are close enough to habitat to potentially purchase from harvesters willing to travel a few hours to sell product, but also include many ginseng-only businesses, particularly those which may export to Asia or serve Asian-American markets which may not commonly use other native North American NTFPs. In conversations with buyers, many cited the low profit margins for many of the other species as an impediment for harvesters to travel far to sell their material. The Low Production area also included places such as the Catskills, Adirondacks, and northern Appalachian Mountains, which do contain habitat and some purchasing activity. It appears that these areas are not as significant for production despite having plant material available. There were also non-urban areas in the Outside/Adjacent area, primarily in less forested rural areas in the plains part of Ohio, Indiana, and Illinois who were possibly purchasing from adjoining FIA units that contained a greater amount of potential habitat. Non-urban areas in the Low and Outside/Adjacent areas also tended to score higher in economic health and lower in natural resources employment compared to the Core and Secondary Production areas.

While it is not surprising that urban areas farther from available habitat were not important sources for non-ginseng NTFPs, the differences between Secondary and Core Production areas were not as obvious. While the Core area had the most extensive amount of

potential habitat, there were areas in the Secondary Production area such as western North Carolina, which are as sparsely populated, with similar patterns of forest cover, and were not important supply sources for commonly purchased species like black cohosh, bloodroot, and goldenseal. Output for some species may be more sensitive to range differences. Goldenseal, while present in places like North Carolina and New York, is considered more common in the center of its range in the coalfields and Ohio River Valley (Davis and McCoy 2000).

Other fairly common plants such as bloodroot and black cohosh are found throughout the region, implying that in their case something other than plant availability is playing a role. Buyers commonly cited the "safety net" factor as a motivator for non-ginseng medicinal NTFP buyers more than ginseng, which has a recreational association more akin to hunting. Buyers who bought only ginseng often cited the low value of other products as the reason. Dealers in Pennsylvania and New York claimed in open-ended comments that ginseng diggers in their region would not dig species that only brought in a few dollars a pound.

Because harvesters are likely a minority, their influence on county-level socio-economic statistics may not be measurable. A survey of harvesters would be required to understand their motivations. However, there were significant differences between the higher and lower production areas relative to the socio-economic variables. Central Appalachia had the highest rates of poverty and substance abuse and the lowest rate of work force participation. At the same time, areas outside the coalfields that suffered economically were not centers of production. Instead, the data seem to support the notion set forth by Hufford (1996) and others that the interrelated set of biophysical, cultural, economic, and historic conditions that occur in central Appalachian counties and contribute to the strength of the medicinal NTFP harvesting tradition may be related to the historically dominant industries there.

Central Appalachia is more dependent on coal and increasingly timber than Southern or Northern Appalachia. The rugged topography that contained those resources were covered with rich forests full of medicinal plants, and the region was among the last cut in the eastern U.S. The economy has continued to depend on those resources, meaning that even as land has been timbered and strip-mined there have always been huge swaths of the right kind of forests. Absentee and corporate ownership has kept those lands in large tracts available for harvesters. The historical instability of those industries and the lack of economic diversity have kept traditional informal subsistence strategies relevant, and the decline of those industries without replacement have created a dire need for income and intensified substance abuse issues.

This argument is used conversely by buyers in northwestern North Carolina, once the center of production for non-ginseng NTFPs, (Price 1960; Magnet 2017), who cite the decline of the harvesting tradition as part of an overall change from "old-time" ways of living, which in that region was centered on subsistence farming and raising burley tobacco. Today that agricultural system has been largely supplanted by tourism, construction, and other service industries. While the region is heavily forested, much of the old private commons have been subdivided and developed for vacation and retirement homes and expanding urban areas. Poverty and joblessness is still an issue in the region, especially with the loss of the furniture and textile industries in the 1990s and early 2000s. However, harvesting non-ginseng medicinal NTFPs has not seen a resurgence as a subsistence strategy in the area in comparison to the coalfields, although western North Carolina remains a major source of ginseng.

Whether or not the reasons are fully understood, identifying the geographic variability in probability and observed tendency to purchase non-ginseng medicinal NTFPs allowed for greater precision in our estimates. In the case of this study, there was a greater proportion of potential

buyers in the Core Production area, due to the lower response rate in that area and a larger pool of registered ginseng buyers in those states. Kentucky and Ohio, two states with territory in the Core Production area, had two of the lowest response rates (18%), and Kentucky, due to its large number of registered buyers, had 117 non-respondents, which accounted for an outsized 22% of total non-respondents.

The clustering and attribution of volume by tendencies within clusters addressed the variability in response rates, the number of buyers, and how much buyers purchased, which was also higher in the Core Production area. As a result, our estimates were slightly higher than they would have been for a simple projection. This fine tuning also means that estimates for share of market value and the proportion of trade represented by each product will be slightly different in final estimates as opposed to figures taken strictly from the observed data (e.g., Table 3.4 and Table 3.5).

The survey results show that the trade in medicinal plants in Eastern deciduous forests is concentrated in terms of both trade volume and trade value within a small number of species, at least for producers within the traditional supply chain. Looking at our final estimates, 72% of the total trade volume and 77% of the total volume was in just two species, black cohosh and goldenseal. The total value of the trade for harvesters was roughly 4.3 million $USD. This amount may seem small compared to the 27 million $USD paid to ginseng harvesters (Chamberlain et al. 2013), but there are a few differences. Most wild-harvested ginseng is exported from the region and sold to consumers as a whole root, primarily in Asia. Most other species are also exported from the region, but they are processed into value-added products such as tinctures, pills or teas, and sold domestically in addition to foreign markets. Black cohosh, which was one of the most popular native botanical products in North America, has an annual

retail value of 35 million $USD (Smith et al. 2017). According to our survey, harvesters were paid less than 1 million $USD for the raw material. The total economic value of these species is likely to be much higher.

Limitations

Using a two-year mean built the most robust model by increasing the sample size and associated data, but fluctuations in volume from year to year make an annual output estimate more desirable. Creating such an annual estimate would be easier if the project was to continue and more years of data were available. Data from respondents who participated in both years can give an idea of annual fluctuation, which would continue to be valuable as years accumulated for returning respondents.

One issue with the data used in this study is the potential effect of a small number of large primary buyers, due either to inclusion or exclusion. Less than 10 buyers reported buying some of the less commonly purchased products. For all the species, a small number of large primary buyers purchased the majority of product volume. This led to the decision to not report total estimates for species that we had only one year of data for, or too few data points (e.g., stoneroot, Solomon's seal, fringe tree bark). The similarity of estimates produced by a simple projection versus the model, the method using aggregators (who buy from multiple primary buyers), and AHPA data suggests that our iterative process led to representative projections.

Where estimates diverged, it is important to consider the possibility of changes in demand reflected in the fluctuations from year to year, as well as the possibility that suppliers outside of the ginseng buying community may be missed. In the case of bloodroot and blue cohosh, numbers in this study reflect recent changes in demand, perhaps related to an uptick in the case of bloodroot due to new uses (Davis and Persons 2014), and a declining demand for blue

cohosh, possibly related to recent issues with toxicity (Datta et al. 2014). Lower estimates for slippery elm are likely to be the result of large-scale producers who focus on bark and do not necessarily work with ginseng, meaning a different sample frame may be required for that species. In the case of wild yam, we are uncertain if the low estimate reflects a drop in demand or if part of the supply chain is missing in our responses.

Continuing the study for multiple years would provide additional data that improves our model, which would better depict changes over time. It will be also be important to reach out to emerging production systems, such as forest farms, which often follow a different path to consumers than traditionally wild harvested production systems. Including this output, with its dispersed, loosely organized network of producers, may require targeting aggregators and manufacturers who buy cultivated material. It is likely that these producers may not be concentrated in the same places, which would require a different model or method for estimation.

4.6 Conclusion

The location of buyer businesses proved to be a strong foundation for predicting purchasing of medicinal NTFPs other than ginseng, and tells us more about the communities that participate in the NTFP trade. Our study evaluated the role of high and low production areas in total NTFP output in the eastern U.S. Results indicated that trade is not uniform, but varies in its intensity and importance throughout the region. The conditions influencing harvests suggested by authors such as Bailey (1999) and Jones et al. (2002) are reflected in the differences between high and low production areas, but there is no single explanation for NTFP harvests. Instead, a combination of natural and socio-cultural factors may influence trade intensity. Understanding these regions can help those seeking to support sustainable production target their efforts to the communities that already rely on these plants, instead of trying to build new constituencies, and

help land managers and policymakers understand the intertwined natural and social forces that influence NTFP trade.

Place-based modeling has promise for more confidently measuring NTFPs in different product sectors and regions when participation rates are low. While product supply chains and harvesting practices may vary, assessing the likelihood or scale of production across a pool of non-respondents can be achieved by understanding the contexts, the limiting and enabling conditions surrounding the supply chain, and the practice of harvesting and selling material. This may work differently based on product pathways to consumers. In this study, we had the advantage of a known, bounded population of ginseng buyers. In a system where buyers or harvesters are transient (as is the case with mushroom and berry harvests in the Pacific Northwest) or in a direct sale system, such as roadside stands selling ramps or burl wood bowls, creating a sample frame and estimating the size of the potential respondent pool will come with a different set of challenges.

The idea of combining the availability of product by modeling habitat and integrating characteristics of the supply chain or harvesting community is broadly applicable, as long as other relevant information is obtainable from non-respondents, either by data collected on a permit form, public listings such as buyer advertising, or any registry or method used to identify potential participants. These estimates have an additional benefit as they are based on the unique conditions of the trade. The process to build this model was iterative and only emerged after observing patterns in distribution among respondents. For researchers working with NTFP communities, the conversations required to build these models may result in valuable knowledge sharing. In situations where stakeholder groups are often at odds over the state of the industry,

results may also be more acceptable as grounded or conservative and lead to more nuanced understandings of the reactions between people and plant communities.

CHAPTER 5. UNDERSTANDING AND ADDRESSING BARRIERS TO PARTICIPATION IN NTFP RESEARCH

ABSTRACT

In the last few decades, nontimber forest products (NTFPs) have received increased attention from research institutions, land managers, development agencies, and conservation organizations. Because NTFPs can be harvested from forests without removing timber, they are considered a potentially sustainable economic resource in economically struggling forest-adjacent communities. Attempts by formal institutions to measure the scope and economic impact of the trade are hindered by low participation rates from traditional user groups. We interviewed medicinal NTFP buyers and other stakeholders in the eastern United States as part of an effort to improve response rates for a survey program measuring medicinal NTFP output. Our goals were to: 1) understand barriers to participation; and 2) identify potential incentives, drawing on a framework influenced by participatory management, political ecology, and reciprocal ethnography. Barriers included past experiences with researchers and land management agencies, conflicting narratives about the state of the trade and of wild plant populations, and concerns over the interpretation and use of data. Respondents' major concerns included losing access to the trade through regulatory changes, lack of agency in land management policy, and a perceived bias against wild harvested material in emerging discourse. Institutions seeking to support the utilization of NTFPs for sustainable development may be reluctant to support informal or common-resource economic activity, and the shift to cultivation encouraged by many formal institutions may not be well suited for traditional user groups. In this paper, we discuss potential deliverables with mutual benefits for stakeholders, including providing market research and increasing product value within the traditional supply chain.

5.1 Introduction

Medicinal nontimber forest products (NTFPs) have been sourced from deciduous forests in the eastern U.S. for more than two centuries (Manget 2012; 2016). With the continued growth of the market for natural and alternative medicine, the trade has drawn attention in recent years from a number of directions. Forest adjacent communities in this region have historically suffered from greater poverty and slower economic growth than the rest of the nation, especially in Appalachia, which is home to the largest areas of contiguous forest, and remains the center of production for most medicinal NTFPs harvested in eastern forests (Boettner et al. 2014; Manget 2016).

Much of the area has historically been dependent on a small number of extractive industries, such as coal and timber, as well agriculture and manufacturing (Eller 1982; Newfont 2012). The decline of these have led to efforts to diversify the economy utilizing the region's rugged beauty, unique culture, and wealth of natural resources, including tourism, sustainable agriculture, and forestry. As they have been elsewhere (Neumann and Hirsch 2000), NTPFs are increasingly a part of this conversation, due to their perceived ability to provide income from forests without destroying forest ecosystems, when they are produced sustainably.

NTFPs are defined as "plants, parts of plants, fungi, and other biological material harvested from within and on the edges of natural, manipulated, or disturbed forests" (Chamberlain et al. 1998). Efforts to support the sustainable production of NTFPs, including the medicinal plants harvested in eastern forests, are hindered by the fact that the sustainability of the current state of production is difficult to assess, since neither harvests nor existing stocks of plants are systematically measured (Vaughan et al. 2013; Chamberlain et al. 2018). Additionally,

perceptions about the decline of the most valuable and iconic species, American ginseng (*Panax quinquefolius*) (Van der Vort and McGraw 2006) and goldenseal (*Hydrastis canadensis*) (Mulligan and Gorchov 2004), and the trade in other species (sometimes colloquially referred to as "off-roots") and barks has led to increasing concern among conservationists (Robbins 1999; United Plant Savers 2017). A lack of output data also obscures the value of the trade and its economic impact—hindering institutional investment. Existing support has focused on cultivation and wild stewardship by landowners, while a significant number of harvests are "wild harvested" on lands utilized as a de facto commons (Hufford 1997; Newfont 2012; Manget 2016). The lack of formal market data are a barrier for new entrants into the market, and creates elevated risk and volatility for people who already harvest and buy products (Gold et al. 2009). Both collaborating and divergent stakeholder groups suffer from the absence of universally accepted data about the demand, value, and volume of trade for medicinal NTFPs. As a result there are different, often disparate, narratives about the state of the industry and the health of plant populations.

We developed a method to measure output for a number of the most commonly traded medicinal species harvested in eastern deciduous forests by surveying ginseng dealers, who are required to be licensed under the 1973 Convention on the International Trade in Endangered Species (Robbins 2000). The project was situated within a larger extension program to support sustainable management and production of NTFPs. NTFP studies and other surveys of informal economic activity have had low participation rates (McLain and Jones 2001; Lynch et al. 2004). To build trust and increase participation, we conducted both qualitative interviews and informal conversations with off-root buyers and other NTFP actors. Our goals were to understand what motivates or discourages participation in a study measuring output, and identify potential ways to

address those barriers. We were working within a framework that acknowledged the need for reciprocity and equity in extension services generally, and in NTFP programs specifically. This meant trying to understand and address the broader concerns about the implications of our work; the perceived risks and benefits for the people who were providing the data; and the historical political, economic, and socio-cultural contexts that shape them. Finally, we sought to create collaboratively designed deliverables that could incentivize participation without compromising our goal to provide objective analysis of the trade for use by all stakeholder groups. While our own survey response improved over the course of four years of data collection from less than 10 percent in two states to 26 percent coverage in 15 states, we found both potential for further collaboration and a number obstacles to achieving a viable, long-term, voluntary, and effective method for measuring NTFP harvests in this sector. In this paper we will lay out the results of those discussions that seek to present the relevant issues from the vantage point of different stakeholder groups, with a focus on the buyers whose participation we were seeking.

5.2 The Duality of Nontimber Forest Products

While NTFPs have always been a part of the human experience, the interest in them from the perspective of researchers, land managers, and other formal institutions dates from the 1980s and 1990s (Belcher et al. 2007; Shackleton and Pandey 2014). NTFPs, which had largely flown under the radar for academics and land managers, became viewed as a pathway for market-driven and community-based conservation within the new paradigm of sustainable development. This shift coincided with a rise in mainstream interest in traditional NTFP sectors such as herbal medicine, artisanal crafts, and wild foods. The interest in the power dynamics associated with NTFP production and policy also resonated with emerging academic discourse, especially political ecology and post-colonial studies (Hansis 1998; Watson et al. 2018) NTFPs were

perceived as having the ability to provide marginalized communities with the means to maintain income and livelihood from forested lands while leaving those forests relatively intact. At the same time, the potential for NTFPs to be exploited flags them as a conservation issue or risk, which can be exacerbated if demand increases (Cunningham 2006).

In the developing world, much of the NTFP discourse focuses on empowering marginalized harvesting groups and certifying and managing forests where harvesting occurs (Neumann and Hirsch 2000; Marshall et al. 2006). In the U.S., policy discussions have emphasized the management of NTFPs on public lands (Robbins et al. 2008). Even in these discussions they remain a low priority unless ecosystem health is threatened, meaning that resulting policy tends to be restrictive rather than productive (Chamberlain et al. 2002). The cultivation of NTFPs on private lands is also more encouraged in North American NTFP advocacy, both in conventional operations and increasingly in agroforestry systems where NTFPs are grown under the canopy in existing forests, a practice known as forest farming (Davis and Persons 2014; Mudge and Gabriel 2014).

Perhaps the primary obstacle to the full, sustainable utilization and management of NTFPs is the inability to accurately measure harvests or inventory the stock of plants in forests (Vaughan et al. 2013; Chamberlain et al. 2018b). The perception of NTFPs as low value and a low priority, especially in comparison to conventional forestry, recreation, and conservation impedes its inclusion in monitoring programs (Chamberlain 2002). The difficulty of measuring output has been attributed to the tendency for many NTFPs be bought and sold in informal economic markets. The *informal* economy is a somewhat contested term that generally refers to economic activity that occurs with less oversight from the state than other economic activity (Alexander et al. 2001; McLain et al. 2008). *Formal* institutions are those that fall under the

jurisdiction of state regulatory regimes. They have the ability to access state resources and have standing and agency in policy-making decisions. They include government agencies and land managers, but also research institutions, non-governmental organizations (NGOs), and industry actors, in this case those in the formal part of the NTFP supply chain.

"Informal" is often considered to have negative connotations, because it does not enjoy the benefits of institutional support, and participants have little power or recourse for grievances, and tend to not have agency in policy-making. When informal economies are based on natural resources, there is the added question of how to manage those resources when the scope and scale of the activity is unknown (McLain et al. 2008) These economies can also be beneficial for participants. The cost of entry is low and participants generally have flexibility and control over their time and labor. That flexibility means informal economic activity is often part of a diversified strategy for providing or supplementing livelihood, particularly for people who lack access to formal economic and political institutions. The association of NTFPs with informal markets makes them difficult to measure because transactions often take place in cash or trade, and data keeping is not standardized. Most information on the market travels through supply chains through word of mouth (Greenfield and Davis 2003). Market actors are difficult to count or locate.

Programs designed to support sustainable NTFPs or NTFP theoretically have benefits for all stakeholder groups. Traditional supply chain actors often have to rely on their own customers and suppliers for basic market data, including product value and demand. The ability to place their own experience in a larger context would help mediate risk and market volatility (Gold et al. 2009). The ability to assess the scope and value of these products may give them greater weight in management decisions and provide a rationale for institutional support, including aid

agencies, NGOs, and extension services (Chamberlain 2018a). For all stakeholder groups with an interest in the future, and specifically for conservation organizations, land managers, and the plants themselves, understanding output is key for assessing the impact of harvests and other threats, such as habitat loss and land use change. Actors in emerging production systems would benefit from more data on the value and demand for these plant species. Above all, having data on output that could correlate with potential plant inventory and was trusted by all stakeholder groups could provide a stable foundation for productive conversation and collaboration between groups with often-divergent views on the state of the industry and its future.

5.3 Barriers for Participation in Nontimber Forest Product Programs

There is a temptation to described NTFP users as "secretive," and leave it at that. There is a parallel tendency to describe certain cultural groups or geographic areas as having predisposition to being closed off or distrustful of outsiders (Scott and McSpirit 2014). However, this notion is critiqued on two grounds, one that it is ahistorical, often ignoring the history of interaction between what are often marginalized groups and researchers, private industry, land management agencies, and NGOs. In addition to the political conflict or inequality that may be motivating distrust, attributing it to "culture" simplistically renders it unchangeable, and therefore easily dismissed. McLain and Jones (2001) identify specific barriers for participation in research and management based on their fieldwork with NTFP harvesters working on public lands (2001). These include poor communication or other cultural barriers between users and institutional actors; negative experiences with researchers or land managers; lack of recognition and agency given to those groups in comparison with more powerful stakeholders; and when the desire to do so is there, the absence of the resources or knowledge needed to build lasting relationships. These conflicts are often framed in terms of concerns over a threat of losing access

to NTFPs, either due to commons enclosure, the criminalization of harvesting NTFPs, or a loss of access to markets through formalization or commercialization (Neumman and Hirsch 2000; Shackleton and Pandey 2014).

5.4 Community-Based Research

This is an applied research project. As such, part of its goal is rooted in the idea that is persistent in ethnographic fieldwork that research is an act of social, political, and economic exchange. It merits equity, collaboration, and reciprocity, not only for the sake of improving the work, but for ethical considerations (Cushman 1998; Lassiter 2001). This notion dovetails with a trend in environmental science, conservation, and natural resource management to be more inclusive in scientific management and research. This involves an examination of how natural resource discourse and policy is formed: who has agency in that process and who benefits or suffers from its consequences. Many NTFP researchers have brought this perspective, strongly influenced by political ecology, into their work with groups that are often marginalized by formal institutions and land managers (Jones 2000; Hurley et al. 2015; Watson 2017). Community-based development, participatory management and collaborative research are some of the strategies adopted in this framework (Emery and McLain 2001).

5.5 Medicinal NTFPs in Eastern Deciduous Forests

Medicinal plants have been commercially harvested from eastern deciduous forests since the 18th century (Chamberlain et al. 2018b). American ginseng (*Panax quinquefolius*) was one of the earliest. It is highly valued for its root in traditional Chinese and Korean medicine, and over 90 percent of the harvest is still exported to Asian markets. Ginseng is the most valuable eastern medicinal, and the one that is most widely harvested, both in terms of the number of harvesters and buyers who purchase it. Hundreds of other roots and rhizomes, as well as barks, aerial parts,

and fungi are harvested commercially, and are often referred to collectively as *off-roots*. Many of these have retained their popularity including herbaceous plants such as goldenseal (*Hydrastis canadensis*), bloodroot (*Sanguinaria canadensis*), and black cohosh (*Actaea racemosa*) and the barks of woody plants such as slippery elm (*Ulmus rubra*).

What is colloquially referred to as the *root and herb trade* developed in the early- to mid-19th century, when a number of buyers located primarily in Western North Carolina began to source products that had previously been cultivated or locally sourced from forests, and to supply new markets for what became the conventional pharmaceutical industry of its day in the United States and Europe (Manget 2016). By the late 19th century, it had spread but remained concentrated in the southern and central Appalachian Mountains, and along the Ohio River Valley and the Ozark region of Missouri and Arkansas. The scale of this industry was considerable. In the late 19th century, the North Carolina-based Wallace Brothers annually purchased over 2,000 species of plants and bought over 2 million pounds of material. They maintained a network of local buyers, usually small country stores, who could put out orders to their own networks of local harvesters, often referred to as *diggers*. An estimated 40,000 harvesters in western North Carolina alone were gathering medicinal plants for the Wallace Brothers at that time.

Over the course of the trade's history, the majority of these materials provided supplemental income or were bartered for dry goods at the country stores. This was part of a seasonal strategy of livelihood that varied across the region. In agricultural economies, harvesting medicinal plants provided in the off-season. In areas dependent on coal and timber production, the money earned from selling medicinal plants supplemented low wages and

insulated from periodic unemployment during downturns in the boom and bust economy. It also provided opportunities for women, children, and the elderly to earn income (Newfont 2012).

The majority of harvesting took place in large tracts of forest, which were both customarily and legally regarded as commons. In places like Appalachia, these were often absentee-owned (ALOTF 1982; Newfont 2012). In many parts of the region, unfenced forests were legally accessible by anyone and were used explicitly for economic activities such as grazing livestock on mast, trapping, and gathering NTFPs until legislation such as the hotly contested "stock laws" were passed in the early 1900s (Newfont 2012). After being timbered, many commons lands became publicly owned national forests.

Today in some coalfield counties, more than 90 percent of the land is forested, and more than 60 percent of the forest land is corporate-owned (USDA 2018b;d). These types of landscapes continue to be the center of production for medicinal NTFPs. While the protection and cultivation of ginseng on small private properties began in the late 19th century (Manget 2012), the idea that NTFP activity was a general management issue, especially on public lands, can be dated to the expansion of the increased regulation of species in the 1980s and 90s and the expansion of wilderness areas under the aegis of ecosystem management and the protection of endangered species (Emery and McLain 2001; Newfont 2012).

While the trade is thought to have declined with the rise of modern medicine in the mid-20th century (Price 1960), the practice never died out. The Asian ginseng trade was not affected, European markets remained, and demand for domestic products increased with the rise of natural and alternative medicine beginning in the 1960s and 70s. Studies documenting the supply chain today show a similar system in place in the early 21st century (Greene et al. 2000; Greenfield and Davis 2003). A large number of harvesters scattered across the region typically gather plants in

the forest and sell to a local buyer. There are a few devoted botanical businesses, but typically root-buying is a part of diversified business—another tradition in the area (Newfont 2012). Country stores, gas stations, and sporting goods stores continue to buy roots and herbs. Medicinal plants sales are still tied to the also diminished fur trade in the region. Scrap metal recycling is another common crossover business, which reflects its similar nature as an informal cash-based trade.

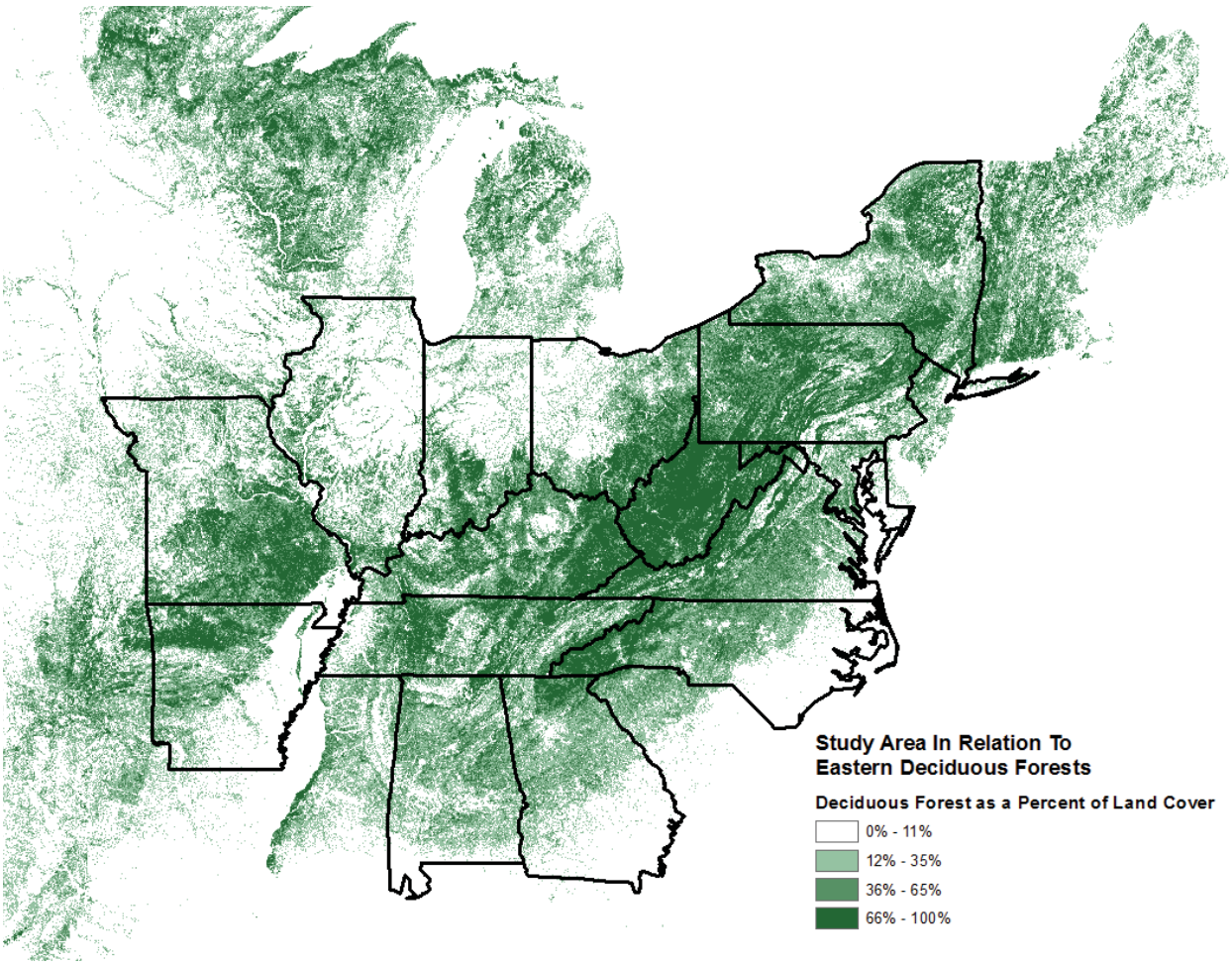
Mary Hufford, who worked with buyers and harvested in West Virginia in the 1990s, described the "seasonal round" within which commercial NTFP harvesting supplemented formal economic activity throughout the year, and was meaningfully intertwined with other outdoor activities, such as hunting, trapping, fishing, gardening, and gathering NTFPs for personal use, most often edibles such as morel mushrooms and ramps. Hufford, and Bailey (1999); as well as popular media (McCoy 2017); documented the notion that the root and herb trade, in addition to padding annual income, also serves as an economic "safety net," in the study area as it does in other regions (Shackleton and Shackleton 2013). However, harvesting and trading NTFPs can also be a meaningful and enjoyable activity with a cultural significance similar to other traditional lifeways. Many NTFP users are motivated by an enjoyment of the practice of wild harvesting. They love being in the woods and value the knowledge of the landscape and plants themselves, something often passed down from their parents and grandparents (Bailey 1999; Emery et al. 2003).

This traditional wild harvested supply chain and the traditional practice of harvesting medicinal NTFPs from the wild remains the primary source for most medicinal NTFPs (Greenfield and Davis 2003; AHPA 2012). Since the 1980 and 90s, there has been growing interest in cultivating some of these species based on an assumption that the wild harvesting of

some slow-growing and slow-reproducing species is unsustainable at current rates (Gladstar and Hirsch 2000; United Plant Savers 2018). While some production of ginseng and goldenseal occur in large conventional field-grown operations under artificial shade, growing NTFPs under the canopy of existing forests, or forest farming, is being promoted for its additional conservation benefits (Munsell 2014). Extension services and NGOs supporting both conservation and community development have increasingly provided technical support for this method of production, which is seen by some as the future of the industry (United Plant Savers 2018).

5.6 Methods

*



-Forest Cover Data from the 2001 National Land Cover Database

Figure 5.1. Deciduous forests of the eastern United States represented as a percentage of total land cover overlaid with our 15 state study area. Forests are widespread, but most prolific in the Appalachian Mountains, along the Ohio River, and in the Ozark and Ouachita Plateaus.

The methodological framework for qualitative data collection was modeled on grounded ethnography (Charmaz and Mitchell 2001). The ethnography approaches research within a broader community or cultural context. It places an emphasis on understanding and communicating the emic, or the perspective of that group (Lassiter 2001), and the way practices take on shared meaning within it. Participant observation is commonly used for data collection. This means that, in addition to traditional interviews, the researcher will also draw on their experience witnessing and participating in the practices or cultural activities being studied. A grounded ethnographic approach allows for continuous reflexive analysis of the material collected and an inductive process to applying theory to understanding it. Although we began our study with a specific set of issues in mind, we took an open-ended approach to our methods, adjusting conversations to focus on the themes that seemed most important to participants.

Interviews were ongoing between 2013 and 2016. Potential participants were identified using the chain referral or snowball method. The initial points of contact were established NTFP researchers and activists, people working in the state agencies that regulate the ginseng trade, and buyers who had already been involved in Virginia Tech's ongoing agroforestry research programs. These informants were asked to recommend other buyers, targeting those who purchase off-roots—although buyers who bought only ginseng were also included, as were other coordinators, researchers, and conservationists. Our goals were to improve participation in our own study, a survey program intended to measure medicinal NTFP output, so there was a focus on buyers in that category. We also solicited buyer interviews in our survey materials. All

participants are kept anonymous due to the contentious and sensitive nature of some of the subject material.

Interviews took four forms. Under the most ideal circumstances, we conducted sit-down interviews, which were recorded and logged, usually at respondents' homes or places of business. These tended to average around an hour and a half, but in some cases lasted much longer. Some buyers elected not to be recorded. There were a total of 16 recorded interviews, nine unrecorded sit-down interviews, and roughly 20 arranged interviews over the phone. We had follow-up conversations with many people, checking in each year as the survey project continued. There were roughly 40 shorter phone call conversations that originated from questions about the survey or the results sent out to buyers. We also attended meetings facilitated by NGOs and state ginseng programs, fur auctions, and other events/venues where medicinal plants are sold.

We spoke with people from every identified buyer subgroup, in every state surveyed. In-person interviews took place in Alabama, Georgia, Kentucky, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, and West Virginia. As the author, I continuously discussed these issues as I maintained a degree of membership in multiple stakeholder groups — as an academic studying NTFPs, a conservationist, a resident of Appalachian southwest Virginia with neighbors and friends who harvest NTFPs commercially, and as someone who harvests NTFPs, including medicinal forest plants, for both personal and commercial use.

Interviews were semi-structured, taking a conversational tone. We collected information in four general areas:

Buyer Experience This included how the buyer got into the business, and how it had changed over the course of their career. We also asked why they continued to do it, and what they liked and disliked about the actual work. For off-root buyers, we asked specifically about the trade in non-ginseng medicinal NTFPs. For ginseng-only buyers we asked why they chose not to purchase other species.

State of the Industry

We asked what the buyer perceived as the state of the root and herb trade and what direction, if any, it was moving in. This was discussed in terms of the industry as a whole, and in regards to specific products in terms of demand and availability. We asked about their thoughts on potential changes in policy, and their thoughts on conservation issues surrounding these species, and emerging trends like certification and cultivation of medicinal plants. We also discussed changes in harvester activity and land use.

Study Design

Buyers were asked to review the survey instrument and preliminary releases of data, which accompanied the initial recruitment mailing. This included matching the types of data buyers collect, or consider sensitive, with what we asked for. We solicited suggestions about what additional products to include, how best to measure them, and what other desirable data could be queried. We also addressed structural issues, such as how to preserve anonymity and avoid counting the same material more than once as it moved through the supply chain. We discussed potential context for some unexplained results, such as the concentration of harvests within certain areas and changes in prices and harvest volume from year to year.

Reasons for Non- Participation

We discussed why dealers decided to participate or not in the survey. While this was mostly (and necessarily) done by speaking with willing buyers who gave their opinion on the issue, we also discussed reasons for non-response with people who were cold-called during a non-response bias check, and several more who voluntarily contacted us to be taken off the mailing list or otherwise let us know they would not be participating.

Methods to Increase Participation

Buyers and other respondents were asked what Virginia Tech or other institutions could do to improve participation, and specifically what such institutions such as ours could provide in the way of extension services, technical support, or other resources that would be helpful for them. Results from interviews were logged. Emergent narratives and themes were identified and are described below.

5.7 Results

Buyer Categories

Ginseng-only buyers were the majority of respondents. Since ginseng has a high value and a defined season from late summer through winter, it is possible to do this part-time, seasonally. As long as a buyer possesses capital to pay harvesters there is very little overhead or infrastructure required. Ginseng-only buyers may only buy a few pounds of ginseng, or much more, though we do not have the data on ginseng purchases and thus cannot break them down into categories. In addition to primary ginseng-only buyers located within the production area, there were also specialized exporters, herbalists, and retailers who only purchased ginseng for

selling in Asian and Asian American markets. Many of these buyers are based out of urban areas such as Washington D.C., Atlanta, Chicago, and New York. They do not buy other native species because few of them are used in traditional Chinese and Korean medicine.

Small off-root buyers are based within the region where plants are being harvested. Small primary buyers also buy off-roots. This is sometimes done as a way to attract or retain relationships with harvesters. These small primary buyers tended to only buy 1-3 additional products, usually goldenseal and sometimes bloodroot or black cohosh. A subset of this group were herbalists and others selling directly to consumers.

Medium Primary Buyers are also typically based in the harvest region. Often their herb and root business operates longer than the ginseng season, even year-round, but is attached to another business. Businesses historically associated with medicinal plant buying include scrap and metal recycling, fur trading, general store/gas station, and sporting goods. These respondents were more likely to have employees, but we were unable to measure the percentage of time they spend on botanicals as opposed to other parts of their businesses. For our project, we considered medium-sized primary buyers as those who bought between 100 and 1,000 pounds of goldenseal or bloodroot. They sold their products to larger buyers.

Large Primary Buyers purchase thousands of pounds of goldenseal and other products directly and locally from harvesters. They were more likely to report having employees and also to buy some products from other buyers. They tended to sell to other buyers (aggregators) and bought a wider variety of species.

Aggregators are sourcing most of their products from a network of primary buyers. They may be located within the region or outside it. They are more likely to have a dedicated herbal products business, and have more invested in facilities, equipment and employees. They are the most

likely to be members of trade organizations, and serve as the bridge between the informal base of the supply chain and the formal sector, including manufacturers, retailers etc.

While we did speak to buyers who only purchased ginseng, the majority of the interview subjects were off-root purchasers, including aggregators, and small, medium, and large primary buyers. Within these categories there were a range of experiences with the trade. This is an important point to remember throughout the paper. When speaking of the "industry," one is simultaneously referring to a multi-billion dollar industry that includes giant multinational corporations and harvesters from some of the poorest communities in the U.S. There is very little communication or identity between the poles of that supply chain. Retailers and manufacturers are mostly based outside the region. With the exception of the few companies who maintain their own supply chain, there is little knowledge of where their products come from, and who harvests them and under what conditions.

Harvesters and primary buyers also have little knowledge of how their products end up being consumed, or how much the end product is worth. Even within the region, there is a degree of separation between the larger aggregating businesses—many of which have large processing facilities and many employees—and seasonal ginseng buyers, who may be operating out of a briefcase on the side of the road. Most primary off-root buyers come from the same communities as harvesters, but these communities have their own social and economic classes. While many primary buyers are or have been harvesters themselves, their ability to invest in the infrastructure required, and to have cash on hand, places them economically in a more powerful position than most harvesters. This means that policy changes, or programming directed broadly at the root and herb trade may not have the same effects, or enjoy the same support from different levels of

the supply chain. There were also variations in experiences of the root and herb trade among people who move and operate on the same level. The cost and process of licensure vary from state to state, but for most, the cost is relatively low. Every year, there are a spate of new dealers, many of whom will only last a season or two. While we received phone calls from new dealers, the snowball method tended to prioritize more established byers.

Experience with the Trade and Intangible Values of the Root and Herb Trade

A majority of the buyers we interviewed had a family connection to the business. Most commonly they were continuing an operation that had started with a parent or grandparent. Often a spouse or children would also be employed. Pragmatic motivations were also offered for the decision to get into the herb and root trade, citing that the closing of a plant, a lack of other desirable options after high school, or as a way to make money in retirement. Even when harvests are done for commercial purposes, the enjoyment, meaning, and cultural value of the trade is often a motivator for doing what can be difficult and not necessarily lucrative work (Hufford 1997; Emery et al. 2003). Like other traditional lifeways, the primary motivation may have been material necessity a few generations ago. While this may still be the case for some, almost every buyer interviewed expressed an affinity for the trade and the culture surrounding it. This was expressed in the same terms as the value and knowledge systems associated with hunting, fishing, and trapping practices, which overlap significantly with the root and herb trade. These values included resourcefulness, independence, and a closeness to and knowledge of the woods.

The history of the trade and its place in peoples' lives is also valued, and buyers and harvesters consider their work a means of preserving their cultural heritage. One elderly southwest Virginia dealer had a makeshift museum in a buying shed, which housed artifacts

from his days as a coal miner, and ledgers from the country store his family ran where diggers bartered roots for dry goods. Many of the spaces where buying takes place are adorned with old photos of harvesters, antique digging sticks and mattocks, and photos, paintings, and quilt square of extraordinary ginseng roots. Operating in the root and herb trade maintains a connection to a past, which is both personal—framed in memories going back to childhood—and a shared cultural memory. The latter looms large in areas that have undergone substantial cultural and economic changes in the last few decades, with the dominant ways of life either declining dramatically in the case of coal and manufacturing, or disappearing entirely, in the case of subsistence and tobacco farming.

This sense of tradition for some was mixed with an association with counter-culture. Several buyers we spoke to were back-to-the-landers, people who moved into the region or otherwise got into the trade because of their interests in blending radical and traditional lifeways, including natural medicine, homesteading, and foraging. This subset was more likely to make their own medicinal products. The personal use of native medicinal plants was not necessarily widespread among the interviewees as a whole although a study of harvesters in Kentucky found they harvested more species for personal than commercial use (Hansis 1998). In addition to the herbalists and small medicine producers, we spoke with one traditional root doctor who runs a rural herbal apothecary serving the local community, a once-common but now rare profession (Crellin and Philpott 1997; Cavender 2006). Most took ginseng from time to time, and goldenseal was also commonly used, but few used the less commonly purchased species. For most, the end uses for products like cranesbill and mayapple were not known.

Buyers cited the relationships they build with harvesters and the role they play in that community as being simultaneously one of the largest (non-monetary) benefits of the job and one

of its greatest challenges. The relationship between buyers and harvesters is complex. The network of harvesters is a primary buyer's main asset. Few buyers purchase on speculation. They have their own contacts with trusted aggregators at the next level of the supply chain, who maintain their own networks of primary buyers. Most primary buyers wait on orders placed from above to set their own prices and buying lists, both of which change from year to year. The prices paid to harvesters are based on making a profit on that wholesale value while understanding what it will be worth for the diggers to harvest that species. This requires a dependable and loyal network of harvesters, and an understanding of the availability of the species and the labor required to remove them. While information sharing in these networks primarily works through word of mouth, some buyers maintain mailing lists and are increasingly active on social media. High prices may be the best incentive to attract harvesters, but buyers also hold giveaways, raffles, and contests to attract diggers.

Currently the inputs needed for buying off-roots are fairly low. If a buyer chooses to process fresh material, they must have the practical skills to do so, as well as any required equipment such as industrial dryers and washers. Most buy dried roots and barks, which essentially requires only storage space, scales, and capital for paying harvesters. The main art and skill in addition to assessing the quality of material is social in nature. It is the ability to bargain with and maintain trusting/trusted connections with harvesters and their own customers higher up in the supply chain. Buyers perceive themselves as providing a community service by dispensing capital into cash-poor areas. For people who consider seasonal informal economic activity a small but appreciated part of their annual income, for those living on fixed incomes or government assistance, and for those who suffer unexpected economic woes, say unemployment, a medical expense or car trouble, the presence of roots and herbs offers a quick, reliable, and

direct payout. Although this effort requires higher labor and relatively lower returns as compared to wage work, it calls for little capital investment. Both buyers and harvesters value the ability to work on one's own terms and time. Some buyers were harvesters themselves, and carry that empathy into their work. Others expressed respect for their resourcefulness, their knowledge of the local terrain, and for the toughness of chancing injuries, venomous snakes, and backbreaking labor for a relatively small return. "I just love talking to them," was a common sentiment expressed by one Alabama dealer.

This relationship can also be mutually adversarial. There are diggers who sneak foreign objects in to increase weight, who dig ginseng out of season, or who dig more than their share of the other roots. An association of substance abuse with bad harvesting is well documented (Bailey 1999). People motivated by addiction are seen as more likely to break laws and good stewardship norms. With the rise of methamphetamine abuse in the 90s, and more recently with the opioid epidemic, the influence on harvester culture has become a major concern, often paired with nostalgia for the aging generation of "good" diggers, which is framed within larger patterns of cultural and economic change in the region. Several buyers talked about feeling the need to arm themselves, and during the course of the project, one older West Virginia dealer quit the business entirely out of fear of keeping that much cash and ginseng in his home. Harvesters were not the only accused bad actors. Buyers also criticized their own who are willing to buy ginseng out of season, who price-gouge the desperate or addicted, or would trade drugs for roots instead of cash.

The harvesters we spoke with, and observations of the literature and social media indicate that the ambivalent feelings are mutual. Harvesters will speak of their and their families' loyalty to buyers who treated them fairly and offered good prices. However, the harvester-buyer

relationship is not always seen as beneficial or trusted from the harvesters' perspective, especially when there are few local dealers to sell to, and profit margins are too slim to travel far. Some of this is viewed as the natural competition of two parties trying to get the better of each other. But harvesters speak of greedy dealers who cheat with crooked scales or who paid prices below market value. There is a sense among both buyers and harvesters, which is reflected in the retail value of these products, that the actors above them in the supply chain make most of the profit. While these groups share much of the same concern about the industry, particularly the possibility of being forced out of it, they generally see each other as allied against exterior forces. The blame for various issues, however, and prescriptions for improvement—including policy changes—vary between the two groups, reflecting any relative impact on them.

5.7.3 State of the Trade

Discussions on the state of the trade illustrate the disparate narratives that exist internally within the buying and harvesting community and between NTFP stakeholder groups. Within the institutional NTFP world, the market for forest medicinals is broadly viewed as being at a crossroads. The market for natural medicines continues to grow, and this increased demand is seen as a threat to existing wild populations, which justifies a shift to cultivation (Gladstar and Hirsch 2002; Burkhart and Jacobson 2009). There has been substantial research to show that ginseng and goldenseal are declining in some parts of their range (McGraw and Sanders 2004), and these concerns have been extended to other more common forest medicinals such as black cohosh and bloodroot, which are viewed as at-risk (UPS 2017). There is a sense of unfolding crisis that mirrors the NTFPs as an emerging "issue," which requires some sort of action or shift (Emery and McLain 2002). While the modern North American forest-farming movement shows

respect and connection to traditional herbalism and the ecological and medical knowledge it required, commercial wild harvesting is often portrayed in a different, less positive light.

Buyers did not see the current trade as being in crisis as a whole, and were more likely to discuss the trade in terms of individual products, especially to make a distinction between ginseng and other species, reflected in the use of the term *off-roots* to describe them. Ginseng harvesting is still comparatively popular across the region, and has become more visible in recent years, partially due its presence in reality TV shows (to the chagrin of nearly everyone involved in the trade). Besides the price, ginseng has a more recreational or sporting aspect to it. People "hunt" ginseng. Finding and maintaining patches requires a greater degree of skill. While buyers often expressed the aesthetic beauty of the woods in general, and some species such as the flower of bloodroot or star grub root, talk about ginseng is singular. When the plant is in senescence, bright yellow with bright red berries, it is "the prettiest plant in the woods." Older plants with an unusual number of prongs, or multiple seed heads, or a proliferation of seedlings growing around it are admired and discussed in terms that are often gendered and anthropomorphic. There is a degree of excitement and drama in the ginseng trade: "scouting" new patches throughout the year, what a root looks like when it comes out of the ground (not always matching the top), and the flurry of speculation and activity around the start of the season, when prices are set, and watching them move over the ensuing months. In other words, ginseng is exciting,

While ginseng plants are treated as individuals, the majority of off-roots are harvested and sold as bulk commodities. They are generally not hunted in the same sense, although a harvester will take note if they find a new patch of goldenseal or star grub root while they are out in the woods. Instead, many harvesters have several patches, or particular coves or hollows that they know and harvest from repeatedly, sometimes over multiple generations. The monetary

value is lower, in most cases by two orders of magnitude. Eleven of the 14 species we collected price data for were sold for less than 10 USD$ a dry pound. This requires harvesting much more volume, and more infrastructure for both the harvester and the buyer, who have to wash, dry, and store more material. For the harvester, a major input is in labor. Some will say you can make just as much money harvesting black cohosh as you can ginseng, and some enjoy a days hard work in the woods, but it is a very different kind of work than digging ginseng. While harvesting one root at a time takes a degree of skill and patience, digging black cohosh is more of an endurance activity, though the digger may enjoy working in the woods. Chopping, washing and drying also require significant time and effort.

Many outside the heavy production zones for the low value roots claimed people in their area would refuse to dig them for the low prices being offered, although dealers in the same places, such as Pennsylvania and New York, claimed they used to buy more off-roots. Where they were being dug and bought, people would either say local economic conditions such as a lack of work, high reliance on benefits or disability (which would not be adversely affected by untracked cash payments), and lower wages made the practice worthwhile. Just as common were statements like, it is "in their blood," meaning that in some places the cultural and personal attachment to digging the off-roots had remained or was always stronger there. Across the region, that culture was perceived as in decline. In places like western North Carolina, northern Georgia and East Tennessee, the subdivision and development of land, in this case for vacation, retirement and second-home development and the resulting loss of access to traditional harvest sites, was also considered a limiting factor.

There was a spectrum of belief about the status of ginseng, and what, if anything should be done about it. The majority believed there were good and bad actors, and that ginseng may be

getting scare in some places, but the business was stable and could be shored up by enforcement of existing laws, encouraging better harvesting practices, and planting more ginseng in the woods. While this was the dominant attitude, we also heard arguments ranging from ginseng harvesting being a right that should not be limited, and on the other side of the spectrum, calls for further restricting harvests of younger plants, and even a call for a temporary moratorium on all harvesting. Some, particularly those located on the margins of the production area, saw local declines in goldenseal, and many considered false unicorn to be locally rare (though not necessarily declining). Only one buyer thought that any of the more common off-roots such as bloodroot or black cohosh were being depleted in their area due to harvesting. Instead of the continued rise in demand portrayed in conservation and academic discourse, buyers did not perceive a total trend, and instead viewed products individually, with demand for some rising and falling for others.

Their assessments of wild off-root populations were based on their own local observations in the forest combined with stagnating prices and the fact that harvesters who tend to dig in the same areas every year have not reported a decline or any difficulty locating material. When they talk about the industry as a whole, it was seen as being stable in the center of production, and in decline along the margins, with a reduction in the total number of people harvesting off-roots and the number of species being traded. The last two observations were especially the case with older dealers. Once commonly harvested products like witch-hazel leaves, and balm of Gilead buds, are rarely harvested commercially. One retired dealer in the Catskills talked about buying hellebore and skunk cabbage along with some of the products we were surveying, but that the people who did it, who were the same people that had run trap-lines, had mostly given it up.

To summarize, there are parallel notions of the state the market. One, mostly from outside the traditional supply chain, considers the demand for medicinal NTFPs to be growing (based on the total value of the entire herbal products industry, or of a few native species), putting mounting pressure on wild populations. The threat is presented as a crisis that justifies a shift away from traditional wild harvesting towards sustainably produced products, with an emphasis on cultivation. Another dominant narrative, from within the traditional supply chain, has a spectrum of belief about the state of ginseng, and generally tends to view the off-root market one plant at a time. When generalizations are made, it is, compared to ginseng, small, stable or even declining, with a minimal impact on most species. Presenting this as a dichotomy is a generalization. Many buyers and harvesters, as well as academics, policy-makers, and activist ascribe to aspects of both of these narratives. However, the perception that the wild market is considered a threat, and something to be reformed or even displaced in the discourse coming from land managers, conservation and development agencies, and the academics affiliated with them underlies the reluctance to participate in programs seeking to monitor, track or manage NTFPs.

Risks and Concerns about Participation

For those who did not want to participate, their reticence was tied to a perception that formal institutions were tolerant at best and hostile at worst to the practice of wild harvesting. Providing their data without any agency in how that data would be contextualized was a risk for their continued access to both NTFPs and the trade itself. One dealer at a meeting of ginseng dealers facilitated by the state regulatory agency refused to participate in a research program saying, “What will you say if I tell you what I’m buying? If I buy 1,000 pounds, you could say that’s too much, if I only buy 10 pounds, you’ll say it’s because we’re running out.” We were

often asked why we wanted this information, which is a reasonable request. These concerns were usually not framed in abstract ideas of being against regulations in principle, although the informality of the job was something some of them valued. Instead. Most discourse tended towards the pragmatic and the specific. To use an example that came up during the interviews, the majority of buyers who work part-time or in a diversified businesses (another long-standing regional tradition), are worried about not being able to comply with mandatory manufacturing practices of the variety used for food, because they would be prohibitively expensive to all but the largest buyers. Incidentally, this is one area where they tend to have a lot of solidarity with the small-scale herbalists and forest farmers.

Prior experience with local socio-environmental issues also framed the attitude toward land management, something also observed by Hufford (1997) in her work in the Coal River Valley. Buyers would contrast their impacts with what they perceive as major threats to ginseng in their area: habitat loss, which included strip mining, gas, and oil drilling, and logging; urbanization and vacation home development, especially along the Blue Ridge and near expanding cities; and conversion of hardwood forests to pine plantations in northern Alabama and southern Tennessee. The fact that these more powerful industries face no consequences not only for the extirpation of ginseng, but in some cases for widespread ecological destruction and drastic impacts on the landscape and public health, breeds a degree of cynicism in local communities (Scott and McSpirit 2014). They are likely to feel alienated from management decision-making and resentful towards those who would put the blame for the depletion of ginseng and other forest medicinals squarely on the root and herb trade.

This tendency, seen as either bias or a lack of ability to contextualize information, was connected to past experiences with researchers, regulators, and other institutional actors. Some

dealers expressed survey fatigue, that periodically researchers came and asked for information and there was never any return on that investment. Some buyers had good experiences with universities, which actually motivated participation in a few cases. Others had explicitly negative experiences. One Indiana dealer refused to participate because he had helped a researcher connect with harvesters working on public land, and it had subsequently been shut to harvest. During the process, the researcher refused to return contact with harvesters seeking help appealing the decision. These kinds of experiences contribute to an idea that forest management on public lands prioritizes conservation, recreation, and logging, while effectively reducing wild harvests of NTFPs.

Much of the worry about further regulation and policy changes reflects a fear that there will be a program for off-roots that resembled the regulatory framework around ginseng. While the ginseng program provides some of the best data available for any North American NTFP (Chamberlain 2018a), it is controversial. Our conversations reflect other work done on this subject by Robbins (2000) and Burkhart et al. (2012) who argue the program is seen as underfunded, and ill-suited to how the trade actually works. It is seen as placing a burden on law-abiding harvesters and dealers, while lacking the means to enforce the laws or punish criminal acts. States have the mandate to regulate harvests and collect data under CITES. The ginseng program in each state may be housed in a different type of agency with a different mandate, such as forestry, agriculture, or conservation. It is illegal for ginseng to cross state lines without being certified, and that process and the regulation for licensure vary from state to state.

The majority of issues were not necessarily philosophical oppositions to all regulation, although the idea that harvesting is a right does exist to a certain extent, but the perception that the program fails to do what it intended to do: accurately measure and effectively manage wild

ginseng. The laws about digging out of season, digging plants of the right age and on permitted property are generally agreed with in principle, but the laws are not enforced, and other threats to the plants are not addressed. The data generated at the federal level is not disseminated to buyers, although some state coordinators make it a point to provide buyers with data summaries. The fundamental issue is that changes to those policies and regulations, as is the case with harvesting on public lands, are seen as occurring without their input and without consideration for how the trade works. As with the perception of much of the conservation discourse, they see the ginseng program as being, at best, tolerant of the wild market, and at worst hostile. The possibility of further regulation of the herbal products industry is potentially a threat, especially in regards to best manufacturing and processing practices.

The tendency for formal institutions, including my own, to push for cultivation may also be perceived as hostile to the traditional supply chain. While traditional buyers and harvesters have been a part of these conversations, many buyers questioned the role they would play in a new cultivated supply chain. For small–scale buyers, their main role in the traditional chain is their access to capital and their ability to source products through their network of harvesters. Lower-income wild harvesters are less likely to be landowners, or do not own the right amount or type of forest to make cultivation in a small-farm context profitable. Wild harvesters are also less able to invest capital or take on the risk of cultivation, especially when the prices remain low and species are locally abundant in the commons. Additionally, the length of the production cycle for most species does not fit with the traditional reliance on roots and herbs as a short-term or emergency income source.

Narrowly defined cultivation as a practice may not meet the non-monetary values in the same way as wild harvesting, just as ranching and hunting are enjoyed for different, if sometimes

overlapping reasons. Given the patterns of land use and ownership where many of them are located, building a new network of small farmers is not an easy task. This is reinforced by skepticism among both small buyers and aggregators about the demand for and profitability of forest-farmed material. Without seeing a demand or a higher price point from their customers, and no drop in demand or availability for the products they currently buy, there is little incentive to invest in such a shift that would exclude their existing constituency of harvesters.

Within the forest farming community, similar concerns with slim profit margins (Burkhart and Jacobsen 2009) have led to efforts to increase demand for cultivated material by arguing that is safer, more consistent, and more sustainable than wild harvested material, and arguments that wild harvesting is the primary threat to medicinal NTFP species. While the forest farming community may see that as raising the value of their own products and providing consumers with additional choices in a market with plenty of room, some in the traditional supply chain see it as an effort to devalue and decrease demand for wild harvested material. While institutions may recognize the room for both, aiding these kinds of programs fails to incentivize traditional supply chain actors to provide their purchasing data. They may also disagree with the underlying assumptions that this shift in the market is justified or inevitable, and instead see it as being consciously advocated for despite a current lack of demand or an impending crisis in the forest.

A lack of shared experience between the traditional root and herb world and researchers and policy-makers also contributes to the problem. Very few of the researchers of medicinal NTFPs or those working with related NGOs we encountered have worked in the traditional supply chain. There was also very little practical experience with digging or trading ginseng among ginseng coordinators, who often oversee that program as only a portion of their duties.

Only one ginseng coordinator I spoke with had ever dug ginseng to sell. This may be seen to some as positive, as it would present a conflict of interest, but it is in stark contrast to the institutional frameworks that govern agriculture and forestry, where many researchers work in the private sector, and a background in either farming or logging is a source of pride.

Both inventory and extension services were originally created to support commercial farming and forestry. Few in the traditional supply chain would believe that any research program existed to enable continued wild harvesting of NTFPs. From talking to people from both groups, I have observed a mutual ambivalence about the value of the others' knowledge and skill set. Buyers may value technical scientific knowledge, but may also be dismissive because of their lack of experience in the woods or with the trade. Academics and activists in turn may dismiss buyers' knowledge as anecdotal, or unscientific. Both could be said to have material or professional capital invested in the narratives they tell. Both were also more likely to consider their own groups less powerful than the other. Some academics thought of buyers as an organized industry, and that private enterprise has more political capital than conservation or academia. In the discourse of other NTFP stakeholders, harvesters (and primary buyers to a lesser extent) occupy a paradoxical position as marginal, informal and disorganized, and simultaneously as a powerful extractive industry. For buyers, the power of academics is the role that researchers play in guiding policy and regulation, especially on public lands, and shaping the overall narrative about the state and direction of the trade. The access researchers and NGOs have to state and other institutional resources and their political and socio-cultural alignment with them can be seen as a power imbalance.

Institutions and organizations supporting NTFP production, especially ones working with multiple stakeholder groups, have their own obstacles to working with the traditional supply

chain. This is due to three factors: working with multiple stakeholder groups simultaneously, working within formalized markets and legal frameworks, and cultural barriers. Full collaboration, as defined by Emery and McClain (2002), would involve letting the participants have equal agency in the design and implementation of the process from the beginning, and in the presentation of the results. This kind of total collaboration may be perceived as collusion in the case of producing data about such a contentious subject. From the perspective of many conservationists, this kind of involvement with the industry may be akin to self-regulation, reflecting the ambiguity of the industry simultaneously as a marginalized "other" and a powerful lobby. Since the totals need to be trusted by all stakeholder groups, a degree of independence is required. For this reason our own project chose to pursue a framework of reciprocity as opposed to total collaboration.

Cultural barriers may also be an issue from the standpoint of supportive institutions. This is often framed in terms of whether marginalized people feel comfortable utilizing institutional resources. This may be the case for some harvesters and buyers, but it may also work in the other direction. Researchers and workers in NGOs, many of whom have limited experience in the industry, or who live or grew up outside the center of production, may end up with constituencies of their own experience, education, ideology, and class. Fixing this may require developing more inclusive social networks, and being conscious about how and where events and programs are organized.

5.8 Discussion

Conversations with medicinal NTFP buyers confirm that buyers feel that the traditional supply chain for medicinal NTFPs is threatened by emerging discourse, policy, regulation, and shifts in the industry that they have little say in. This is not to say that there is no common

ground, or that the conflict is intentional. As was the case in their study of land access rights in Maine, Ginger et al. (2013) found that much of the conflict they observed was inadvertent and a result of lack of communication between groups. I began this project with many of the same assumptions as others in my field, that the changes on the horizon, like formalizing markets and closer management of NTFPs, are inherently beneficial for all involved. With a few exceptions, most of the people we spoke with on all "sides" of these issues felt the same—that their vision of the industry was accurate and good for all in the end. This paper is not advocating for the privileging of one group over the other on merit. It has a specific purpose: trying to understand what motivates or stymies participation within one stakeholder group (buyers), and to try to address these concerns to achieve their participation in a project that has the capacity to help create common ground, or a baseline to begin a conversation. To this end, contextualizing these issues in terms of what can be observed about the current state of affairs and what we can learn from the NTFP literature is useful.

Understanding the state of wild populations and the effect of harvesting and other impacts such as habitat loss requires integrating output data with monitoring across the region (Vaughan et al. 2013). Questions about whether demand is increasing would benefit from a long-term, consistent output model, and a synthesis with historic research on the trade in archives and buyer records. Industry data also show that while the herbal market is growing as a whole, this does not translate to a rise in demand for all wild harvested native species, since many of the products are cultivated or imported. One recent analysis showed that seven of 13 species harvested in Eastern forests declined in total output from 1999 to 2010 (Chamberlain et al. 2018c).

The buyers' perceptions of being shut out of the emerging supply chains enjoying the most formal support are not baseless either. Many organizations advocating forest farming recommend shortening the supply chain to raise prices for producers. This is argued for in the literature on NTFP commercialization (Neumann and Hirsch 2000) and by some NGOs advocating for producers. Sometimes this means explicitly "cutting out the middle man" or "building a new supply chain," which is justified by the shortcomings of the old one (Fig 5.2). In some cases, NGOs are receiving grants to essentially become aggregators by organizing producers and by negotiating contracts with manufacturers. There is nothing inherently wrong with supporting higher prices for producers, or with the idea that there may be niche markets for these kinds of production systems. However, the fact that we as the agency measuring output are also funding and organizing events with these groups without similar investment in the traditional supply chain could be seen as a red flag by buyers or at the least, not an incentive.

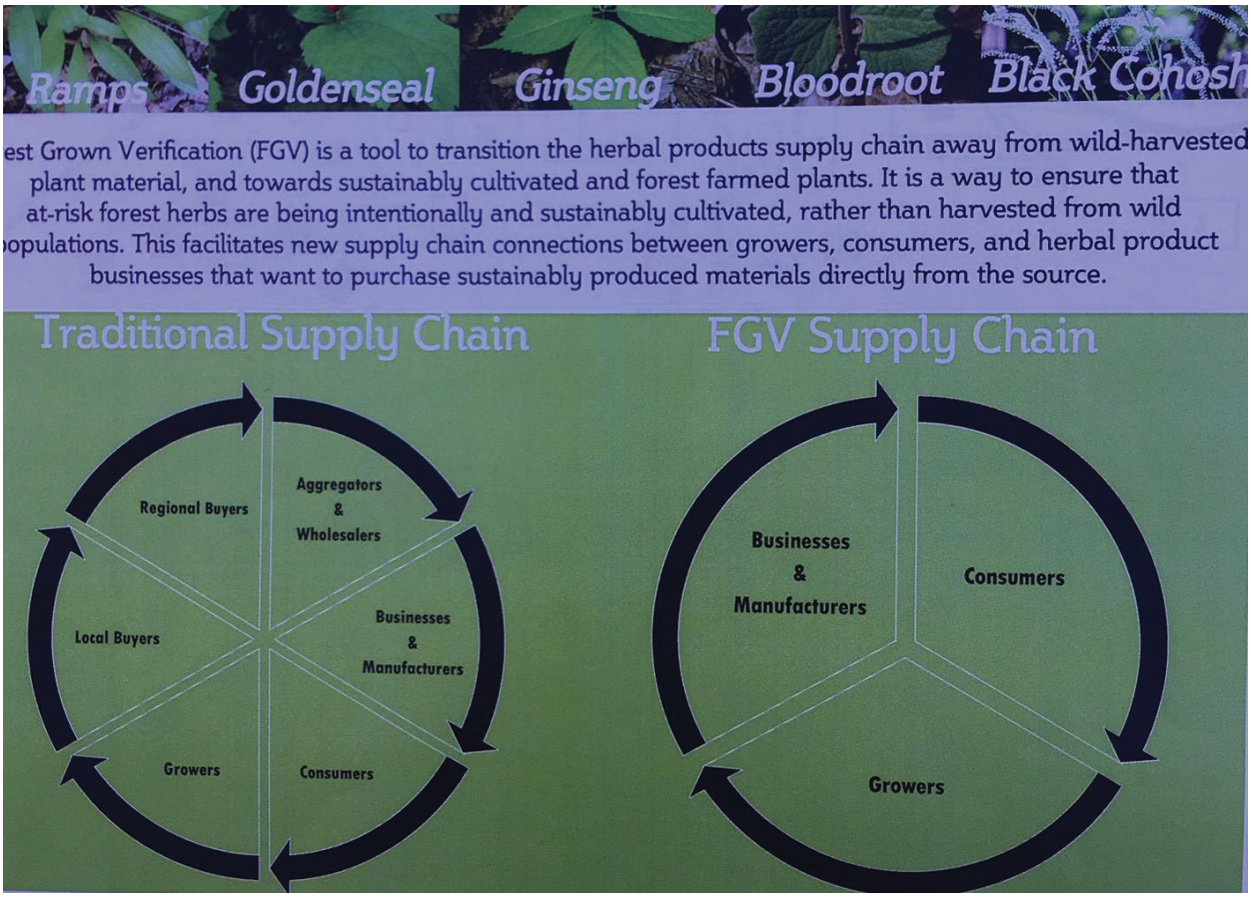


Figure 5.2. Material distributed at a forest farming meeting, Spring 2018. It expresses the desire to replace or substitute wild harvested material with cultivation, and shows the benefits for producers who cut buyers out of the supply chain.

The idea that poorer wild harvesters may be cut out of formal commercialization efforts has also been described in the NTFP literature, in the process known as "elite capture" (Emery 2002b; Belcher et al. 2007). To a degree, the increase in value required to make forest-farmed material profitable is achieved by contrasting it favorably with the traditional wild harvested product, which is presented as inconsistent, of lower quality, and unsustainably harvested across the board. These new production systems are in their early and experimental days, and traditional actors are welcome in the places where conversation is taking place, but in the spirit or being willing to change and adapt to the emerging paradigm. Within that paradigm, there is respect for

the ethnobotanical traditions of herbalists and other harvesters for personal use, but commercial harvesting is seen as needing reform (Gladstar and Hirsch 2002).

The idea that "management" equals limiting wild harvest is not paranoia or an unfounded concern (Watson 2017). More and more public lands have been closed to ginseng harvest in recent years either by wilderness designation (Newfont 2012), or by prohibiting ginseng harvesting on national and state forests, something which has occurred in a majority of the states in our survey area. Other public forest units have reduced or gone to a lottery system, including national forests in North Carolina and Tennessee. An increasing number of states also require written permission from landowners, meaning that in addition to the necessary goal of discouraging poaching from ginseng growers, the practice of harvesting on large tracts of absentee owned land may also be threatened, potentially making criminals—felons in some states—out of very large segment of the harvesting community.

This is a paper about overcoming barriers to participation, so it should be noted that while we focus here on the differences between groups, there is plenty of common ground. This is evident in the shared joy people on all sides take in being in the woods, and the attachment to the plants and the places they grow. I saw several plots near buying sheds where buyers were experimenting with growing ginseng and other medicinal plants, sometimes for a challenge like with lady slipper orchids, and sometimes to learn more about a lesser-known species such as star grub root. While support for cultivation of off-roots was less of an incentive for most buyers, interest in technical support and research of wild-simulated ginseng was significant, and may be fruitful for collaborative research. This technique involves minimal input, primarily planting seed or rootlets in the kinds of sites where that species would grow naturally. The line between wild-simulated production and traditional stewardship methods for ginseng can be blurry. There

is a long history of transplanting plants with desirable characteristics into managed patches, and saving and planting seed, and many of the buyers and harvesters we spoke with maintain their own seed patches. There is an added benefit that the end product ideally can be sold within the same supply chain for the same price, if the root retains a wild character. There is already a precedent for collaboration with traditional practitioners in research on growing ginseng, as well as other NTFPs (Davis and Persons 2014). The people who had a negative view of forest-farmed ginseng were usually concerned about foreign seed changing the character of local plant populations. Potential programs could include increasing local seed production, increasing yields of the right kind of product, and dealing with disease and pest issues.

Providing other extension services as a deliverable was more difficult, because the majority of our resources are currently directed towards forest farming. Part of this is due to extension services being set up to work with producers, traditionally landowning farmers, and forest landowners. The current inability to certify the sustainability of wild harvested material, especially when it is a common-pool resource, hinders direct support for that part of industry, at least in the eyes of most institutional agencies. There are models in the U.S. for certifying wild-stewarded material, and certifying harvests on land owned by someone else, but in these systems explicit and exclusive legal access is a condition. This may work well for harvesters working with individual forest land owners, but is more complicated for large-scale industrial or public lands with multiple harvesters. Other approaches involve attempting to collectivize harvesters and negotiating leases with coal and timber companies. Others are opening processing facilities for making value-added products to both harvesters and forest farmers. Though these are in the early stages of development they have the potential to help some harvesters increase their

products' value. Since the organizations in the latter cases also serve as an aggregator, the benefit or impact on local buyers is less clear.

The same kind of technical expertise offered for cultivating ginseng and some of the less valuable species may also be applicable for wild-stewarded material. One of the more common suggestions from dealers regarding extension services was educating harvesters about best practices for sustainable harvest and good processing for off-roots. In addition to the work done on cultivating off-roots, identifying and testing traditional stewardship practices can help create social norms around the timing and intensity of harvests, and encourage both seed and vegetative propagation at the point of harvest in "wild" production systems. While these methods exist in the harvesting community, they are not universally known, and how commonly they are practiced is anyone's guess. Although some buyers recommended buying off-roots later in the season after seed production, many began buying all species when they emerge in the spring, and some expressed the belief that some species like goldenseal mostly reproduce through root division so waiting was not necessary. Creating a system to certify harvesters or buyers based on training or assessing knowledge of best practices potentially could be based on the point-of-harvest model used in sustainable forestry. This could allow for a higher price point for both harvesters and buyers if consumers were willing to pay for it. In the event of changes in management or regulation that affect production, supporting institutions can also help facilitate compliance.

One of the most effective tools for providing reciprocity at our disposal were the results of the study itself. Most buyers rely on word of mouth through their own supply chains for what to buy and how much, as well as the prices for the year. Social networks like Facebook have augmented this; buyers post prices and discuss changes in demand for certain roots. But many

online groups are controlled or dominated by a small number of buyers. Having region-wide trusted data is helpful for buyers because it places their own data within a larger context. We were able to provide that data for individual species and show trends over the course of data collection. Being able to continue to consistently provide results to participants would likely increase buy-in over time, especially if the buyers found the information useful. We tried to make this possible by asking buyers what additional species they wanted to include and what other information they were interested in. This included collecting data on prices, which we were also interested in, but had avoided because we thought it might be sensitive.

While showing the value of NTFPs increases its visibility, it may also show that the trade matters, thereby increasing its agency in the discourse about what to do in eastern U.S. forests. Having agreed-upon data is also the place from which productive conversations can begin between stakeholder groups. We noticed a bump in participation between 2014 and 2015, when we included a summary of results with our recruitment materials (Appendix C). In addition to providing what is essentially trade research, it also allowed participants to see what we were using the data for, and allowed them to evaluate our methodology by comparing our results with their own experience.

It is important to recognize the power of discourse and language and its role in shaping the debate. Framing the debate with greater precision and honesty by talking about individual species, the variability of harvests, and the other impacts on plant populations in the region is perhaps a more productive approach. In the case of traditional supply chain actors, contextualizing this data in terms of increasing production capacity, the value of those species, and general planning for the future as opposed to reacting to a crisis by limiting access is more likely to resonate. Terms like “wild harvested” are taken for granted and can imply that the

forests being harvested from are pristine or untouched, when these forested landscapes have been altered drastically over the past two centuries, and where there has been constant, sometimes intensive production of medicinal NTFPs. Are trees cut from the same forests "wild harvested?" Similarly, the idea that all unpermitted harvesting is stealing blurs the line between robbing an individual who is intensively managing a crop, violating the integrity of protected lands, and harvesting in the commons.

5.9 Conclusion

With their variety of backgrounds and perspectives on the state of the industry, buyers were not a monolithic group. A perceived bias against the wild supply chain in emergent NTFP discourse, a perceived lack of agency in the management and regulation of NTFPs, and concerns over the interpretations and uses of those data are roadblocks to participation. These concerns are valid, and based on personal experience. Building greater reciprocity into the tracking program by using extension programs to support the traditional supply chain alongside other forms of NTFP production is currently hindered by the difficulty of working with informal markets and a lack of interest in or methodology for certifying the sustainability of traditional production: dispersed harvests occurring within forests are treated as a common-access resource (Hufford 2000; Newfont 2012; Manget 2016). However, if management and extension programs seek to aid those who currently rely on and use NTFPs in addition to creating new constituencies, it is vital to understand the benefits of the existing system for users, which are not limited to the economic, but include personal, social, and cultural value (Shanley et al. 2002; Belcher and Schreckenberg 2007). Programs to train and certify harvesters and buyers, or otherwise increase product value for those actors as well as continued technical support for wild-simulated ginseng production, are potential avenues for increasing participant buy-in. Encouraging dialogue

between traditional producers and institutional agents is important, and should take place equitably, both in terms of where these conversations occur and who shapes them. It is important to remember that the "industry" includes buyers at different levels, and harvesters—no one groups speaks for another. This is especially true for wild harvesters, who could be the largest stakeholder group and currently have the softest voice in the room. While our goal is to increase participation from buyers for the purpose of measuring output, it should be noted that potential deliverables should seek to empower and increase value for this group.

Being able to provide consistency and responsiveness moving forward is key to the sustained success of the project, as is a measured approach that views products individually and within the trade in the context of its place and history. If the project becomes another one-off survey, or if the results are primarily used in an overarching discourse which devalues, or seeks to eradicate the traditional trade wholesale, than future participation in tracking programs will be negatively impacted. Data that is trusted by all stakeholder groups can provide a common ground to start productive conversation, bridging disparate narratives and resulting in more effective NTFP policy and supportive programming.

The conflict between these different discourses about the root and herb trade is not as stark it appears. Most of the proponents of cultivation do not see themselves as hostile to the traditional market, or as occupying positions of power. Similarly, many buyers and harvesters consider themselves conservationists. People in both these groups share a love and a technical fascination with these plants. On the way to my defense, I may see one of my neighbors laying newly dug ginseng roots next to the last of the summer's homegrown tomatoes. He lives on less than an acre of land, but has planted and dug ginseng since he was a kid, following in his father's footsteps on a variety of lands, some owned by extended family, some private, and some public.

Since it will be late September, I am likely to see the yellowing tops and bright red seeds of the 4 and 5 prong ginseng plants he has scattered among the manicured bushes around his house that he uses to seed his “wild” patches. There is great promise in the gray area that exists between wild-simulation and wild-stewardship. In one sense the different groups have much more in common than they do with the majority of Americans who have no idea of the value in the mass of greenery that they see from car windows or hiking trails. One major step is recognizing our shared stake in the endeavor, and the need for supporting institutions to be inclusive to both emergent communities of practice, and the ones that already exist.

CHAPTER 6. CONCLUSION

6.1 Summary

Our survey and predictive model successfully measured nontimber forest product output. The total estimated value for the eastern medicinal NTFPs surveyed was roughly 4.3 million $USD. While this number is a fraction of the value of other forest products (including ginseng, which brings 27 million $USD annually to harvesters) the value paid to harvesters for off-roots represents only a small percentage of its retail value. The volume of products purchased ranged from 124 pounds of Virginia snakeroot to roughly 260,000 pounds of black cohosh. Despite that wide range, 72 percent of the trade volume and 77 percent of the total value was attributed to just two species, black cohosh and goldenseal. We also collected data on harvest location that can be correlated with FIA data on standing timber stocks, and potentially monitoring of other NTFPs (USDA Forest Service 2018b).

Buyer location, described as a mix of natural, economic, and social characteristics, proved to be an accurate predictor for the probability of purchasing medicinal NTFPs other than ginseng. A multi-nomial logistic regression model predicted the probability of purchasing non-ginseng medicinal speices. A two-step cluster analysis based on the same significant variables resulted in four location categories: Core, Secondary, Low and Outside/Adjacent Production. The analysis allowed us to attribute a probability of purchase for non-respondents based on their location, and enabled assignment of product volume based on observed tendencies of similar respondents, resulting in a more nuanced estimate.

While buying occurred across all four clusters, very little off-root purchasing occurred among buyers based in large metropolitan areas. The centers for production tended to be rural, heavily forested with the right kind of forest, and reliant on natural resource economies, especially coal. While some harvesting occurred in the Ohio River Valley and the Ozarks, the

Appalachian Mountains, and particularly the central Appalachian coalfields, were where buyers were most likely to purchase off-roots and where the majority of output was concentrated. These areas were also struggling economically, with low workforce participation, high poverty, and low income. In addition to having large tracts of potential habitat in the center of the range for most off-root species, they also were characterized by a high ratio of corporate land ownership.

We were able to grow participation from under 10 percent in the original pilot to 26 percent of ginseng buyers represented. Part of this was through direct outreach, our method of packaging of data in a useful format, and in the way we framed our own discourse on the trade. Interviews with medicinal NTFP buyers identified some of these strategies. Buyers perceived formal institutions, including research institutions, as being ambivalent or even hostile to the wild harvested supply chain. Many expressed concerns about losing access to the trade through regulation or restrictions on harvesting. Buyers may not be incentivized by deliverables based around formalized production or cultivation, and they may disagree with the narratives about the trade used to justify formalization. Reframing or rethinking deliverables can help build reciprocity into the program. We provided data on markets for users in a useable format. Other possibilities for more attractive deliverables may include finding ways to help buyers comply with new regulation, offering certification programs to increase product value, and providing technical support for growing ginseng and sustainable production of other species in the commons.

6.2 Conclusion

We demonstrated that measuring NTFP output is possible using survey methodology combined with statistical modeling to mitigate nonresponse issues, and direct engagement with market actors. An equally important question is: how will the knowledge generated by output be

used? I have spent the past 150 pages arguing that output measures have the potential to benefit everyone, which I firmly believe. Those benefits are clear, but will they all come to fruition, and if not for all, then for whom? It is not impossible that our data could be used to justify further loss of access for some. At that point would people still participate? What if the loss of access was ecologically justified? The only way to answer these questions is for the program to continue.

The language we use and the narratives we tell matter, and we should pay attention to how NTFP issues are discursively framed, where those narratives originate from and how they position different stakeholders. As stated at the end of chapter five, there is enormous potential for coalition building among the people who care about these plants, even if there are different perspectives about certain things. We have a lot in common, and a lot to talk about. What is important is that everyone is in the room, or has the chance to be if they want to, on their own terms.

6.3 Recommendations for Future Research

There is good reason to include traditional wild-harvesting in the extension tent. The possibilities of creating common-pool extension services are both daunting and exciting. As was mentioned above this could involve certifying practices instead of products, or involve negotiating legal access. The practices also have yet to be developed and may occupy the space between wild stewardship and forest farming. These kinds of programs would let harvesters realize greater value for their labor and help conserve species in the forest.

As alternative methods of production such as forest farming continue to develop, it will be important to quantify the production within those supply chains. This could possibly be tied into a market-wide report that includes data on wild and cultivated material. New methods of

data collection may also be required. The traditional herb and root trade has one foot firmly planted in the past, but changes in technology are having an effect on the trade. The cash transactions that dominate the trade are becoming rarer. Social networks are increasingly being used as tools to trade market information and build the social relationships that underlie the trade. It should be noted though, that many of the (mostly older) buyers we talked to did not maintain a large internet presence. Many of the larger social network pages are dominated by a small number of buyer/administrators and high volume contributors. We had very few users elect to take the online version of our survey, but this may have been partially because it was modeled on the mail survey and was not necessarily more convenient. In any event, times are changing, and creating secure, intuitive digital platforms for gathering data that are easier to work with for users would be helpful as a younger generation of buyers inherit the trade (After Vaughan et al. 2013).

Finally, the usefulness of output is limited without being able to inventory NTFP species in forests. Our data were designed to be correlated with the US Forest Service's Forest Inventory and Analysis program, which maintains thousands of research plots, but currently only records data on trees. This has been useful in analyzing the effect of bark harvests such as slippery elm (Kauffman et al. 2017). Developing ways to incorporate different species, especially herbaceous species is vital, but complicated, as it will be more labor intensive and will require different metrics and methods for calculating values such as the weight of inner bark, or below-ground root-mass (Small et al. 2011). Collaborative monitoring with forest farmers and wild harvesters is place where we might find ourselves on common, shaded ground.

REFERENCES

Agrawal, A. C. Gibson. 1999. Enchantment and Disenchantment: The Role of Community in Natural Resource Conservation World Development. 27(4):629-649.

Alexander, S.J., J. Weigand, and K. Blatner. 2002. Nontimber forest product commerce. *In*. Nontimber forest products in the United States, eds. E.T. Jones, R.J. McLain and J. Weigand, 115-150. Lawrence, KS: University Press of Kansas.

American Herbal Products Association (AHPA). 2012. Tonnage survey results. Silver Spring, MD.

Anonymous Interviews. 2013-2016. Interviews with buyers and other NTFP stakeholders. Interviewed by Steve Kruger.

Appalachian Land Ownership Task Force. 1983. Who owns Appalachia? Land ownership and its impact. Lexington, Kentucky: The University Press of Kentucky.

Appalachian Regional Commission. 2018. The Appalachian Region. Retrieved September 8, 2018 from www.arc.gov/appalachian_region/theappalachianregion.asp.

Belcher, B. and K. Schreckenberg. 2007. Commercialisation of non-timber forest products: A reality check. Development Policy Review, 25:355-377.

Berkes, F. 2004. Rethinking community-based conservation. Conservation Biology. 18:621-630.

Berkes, F., J. Colding, and C. Folke. 2000. Rediscovery of traditional ecological knowledge as adaptive management. Ecological Applications. 10(5):1251–1262.

Billings, D. and K. Blee. 2000. The road to poverty, the making of wealth and hardship in Appalachia. Cambridge University Press London, UK.

Blumenthal, M. 2006. Government increases restrictions on wild American ginseng export. HerbalGram: The Journal of the American Botanical Council. 70:52–57.

Boettner, F.,Vanderburg, M., Donahue, C. [and others]. 2014. An assessment of natural assets in the Appalachian region: forest resources. A report prepared for the Appalachian Regional Commission. Washington, D.C. 88 p.

Braun, L. 1950. Deciduous forest of North America. Blackiston Publishing. Philadelphia, PA.

Burkhart, E.P. and M.G. Jacobson. 2009. Transitioning from wild collection to forest cultivation of indigenous medicinal forest plants in eastern North America is constrained by lack of profitability. Agroforestry Systems 76(2):437.

Burkhart, E.P., M.G. Jacobson, and J. Finley. 2012. A case study of stakeholder perspective and experience with wild American ginseng (*Panax quinquefolius*) conservation efforts in Pennsylvania, U.S.A.: limitations to a CITES driven, top-down regulatory approach. Biodiversity and Conservation. 21:3657–3679.

Carter, J. 1996. Recent approaches to participatory forest resource assessment. Rural Development Forestry Study Guide. 2. London.

Cavender, A. 2006. Folk Medicine in the Southern Appalachia. University of North Carolina Press. Chapel Hill, NC.

Chamberlain, J.L., R.B. Bush, and A.L. Hammett. 1998. Nontimber forest products: the other forest products. Forest Products Journal. 48(10):2-12.

Chamberlain, J.L., R.B. Bush, A.L. Hammett, and P.A. Araman. (2002) Managing for nontimber products in eastern National Forests. Journal of Forestry. January/February. 8-14.

Chamberlain, J.L., J. Davis, W. Duguid,[and others]. 2018a. Nontimber Forest Products and Production. *In* Assessment of nontimber forest products in the United States under changing conditions, eds. J.L. Chamberlain, M.R. Emery, and T. Patel-Weynand. General

Technical Report SRS-GTR-232. U.S. Department of Agriculture, Forest Service, Southern Research Station. 268 p.

Chamberlain, J. L., M.R. Emery, and T. Patel-Weynand. 2018b. Assessment of nontimber forest products in the United States under changing conditions. General Technical Report SRS-GTR-232. U.S. Department of Agriculture, Forest Service, Southern Research Station. 268 p.

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

Chamberlain, J.L, S. Prisley, M. McGuffin. 2013. Understanding the relationships 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.

Cordell, H.K. and M.A. Tarrant. 2002. Forest-based outdoor recreation. *In* Southern forest resource assessment, eds. D.N. Wear, and J.G. Greis, 269-282. General Technical Report SRS-53. U.S. Department of Agriculture, Forest Service, Southern Research Station.

Cowles Papers. 2014. Southern Historical Collection. University of North Carolina at Chapel Hill. Chapel Hill, NC. Accessed July 6 2014.

Crellin, J. K., and J. Philpott. (1997). Trying to give ease. Tommie Bass and the story of herbal medicine. Duke University Press, Durham, NC.

Cunningham, A.B. 2001. Applied ethnobotany: people, wild plant use and conservation. People and Plants Conservation Manual. Earthscan Publications L.T.D., London, UK: 298 p.

Cushman, E. 1998. The Struggle and the Tools: Oral and Literate Strategies in an Inner City Community. Albany, NY: State University of New York.

Davis, Jeanine M., and Joe-Ann McCoy. 2000. Commercial goldenseal cultivation. Horticultural Information Leaflet 131. North Carolina State University. Raleigh, NC.

Davis, J. and W.S. Persons. 2014. Growing and marketing ginseng, goldenseal and other woodland medicinals. New Society Publishers. Gabriola Island, BC: 510 p.

De Angelis, P., S. Nygaard-Scott, and J.L. Chamberlain. 2018. Laws, policies and regulations concerning nontimber Forest products. *In* Assessment of nontimber forest products in the United States under changing conditions, eds. Chamberlain J.L., M.R. Emery, and T. Patel-Weynand. General Technical Report SRS-GTR-232. U.S. Department of Agriculture, Forest Service, Southern Research Station. 268 p.

Dillman, D.A., J.D. Smyth, and L.M. Christian. 2009. Internet, mail and mixed-mode surveys: The Tailored Design Method, 3rd ed. Hoboken, New Jersey: John Wiley & Sons.

eFloras 2018.eFloras plant distribution maps. Missouri Botanical Garden, St. Louis, MO and Harvard University Herbaria, Cambridge, MA. Retrieved May 21, 2015 from: http://www.efloras.org.

Eller, R. 1982. Miners, Millhands, and Mountaineers. Knoxville TN: University of Tennessee Press.

Emery, M. and R.J. McLain, eds. 2001. Nontimber forest products: Medicinal herbs, fungi, edible fruits and nuts, and other natural products from the forest. New York, NY: Food Products Press.

Emery, M.R. 2002a. Historical overview of nontimber forest product uses in the Northeastern United States. *In* Nontimber forest products in the United States, eds. E.T. Jones, R.J. McLain, and J. Weigand. Lawrence, Kansas: University Press of Kansas.

Emery, M.R. 2002b. Space outside the market: implications of NTFP certification for subsistence use. *In* Tapping the green market: management and certification of NTFPs, eds. Shanley, P., A. Pierce, S. Laird, and A. Guillen, 302-312. London: Earthscan.

Emery, M., C. Ginger, S. Newman, and M. Giamusso. 2003. Special forest products in context: gatherers and gathering in the Eastern United States. General Technical Report. NE-306. Newtown Square, PA: U.S. Department of Agriculture, Forest Service.

Emery, M., C. Ginger and J. Chamberlain. 2006. Migrants, markets and the transformation of natural resources management: galax harvesting in western North Carolina. *In* Latinos in the New South: transformations of place, eds. H. Smith and O. Furuseth, 69-88. Burlington, VT: Ashgate Publishing Company.

Escobar, Arturo. 1998. Whose knowledge, whose nature? Biodiversity, conservation, and the political ecology of social movements. Journal of Political Ecology. 5:53-81.

Feld, S. and K. Basso. Senses of Place. School of American Research Press.

Freeze, G.R. 1995. Roots, berries, barks and jews; the herb trade in gilded age North Carolina. Essays in Economic and Business History. 13:107-127.

Frey, G.E., K.A. Blatner, M.G. Jacobson, [and others]. 2018. Economics of Nontimber Forest Products. *In* Assessment of nontimber forest products in the United States under changing conditions, eds. J.L. Chamberlain, M.R. Emery and T. Patel-Weynand, General Technical Report SRS-GTR-232. U.S. Department of Agriculture, Forest Service, Southern Research Station.

Ginger, C., M.R. Emery, M.J. Baumfek, D.E. Putnam. 2012. Access to natural resources on private property: factors beyond right of entry. Society and Natural Resources. 25(7):700–715.

Gladstar R, and P. Hirsch. 2000. Planting the future: saving our medicinal herbs. Rochester, Vermont: Healing Arts Press.

Godsey, L.D., D.E. Mercer, R. Grala [and others]. 2009. Agroforestry economics and policy. *In* North American agroforestry: an integrated science and practice. 2nd ed. HE. Garrett, 315–337. Madison, WI: American Society of Agronomy.

Gold, M.A., L.D. Godsey, and S.J. Josiah. 2004. Markets and marketing strategies for agroforestry specialty products in North America. Kluwer Academic Publishers.

Greene, S.M., A.L. Hammett, and S. Kant. 2000. Nontimber forest products marketing systems and market players in southwest Virginia: crafts, medicinal, and herbal, and specialty wood products. Journal of Sustainable Forestry. 11(3):19-39.

Hansis, R. 1998. A political ecology of picking: nontimber forest products in the Pacific Northwest. Human Ecology. 26:67–86.

Homer, C.G., J.A. Dewitz, L. Yang [and others]. 2015. Completion of the 2011 National Land Cover Database for the conterminous United States, representing a decade of land cover change information. Photogrammetric Engineering and Remote Sensing. 81(5):345-354.

Hufford, M. 1997. American ginseng and the idea of the commons. Folklife center news 19(1–2):1–18. Washington, DC: American Folklife Center, Library of Congress.

Hufford, M. 1999. Coal River Folklife Project collection (AFC 1999/008), American Folklife Center, Library of Congress.

Greenfield, J., and Davis, J. 2003. Collection to commerce: Western North

Carolina nontimber forest products and their markets. Report for Department of Horticultural Science, North Carolina State University, Raleigh, North Carolina.

Hufford, M. 2003. "reclaiming the commons: narratives of progress, preservation, and ginseng." *In* Culture, environment, and conservation in the Appalachian South, ed. B.J. Howell. Urbana, Ilinois: University of Illinois Press.

Hurley, P.T., M.R. Emery, R.J. McLain [and others]. 2015. Whose urban forest? The political ecology of foraging urban nontimber forest products. *In* Sustainability in the global city: myth and practice, eds. G. McDonough, C. Isenhour, M. Checker, 187–212. New York: Cambridge University Press.

Johnson, T. G., Bentley, J. & Howell, M. 2009. Historical trends of timber product output in the South. SRS-138. Asheville, NC. U.S. Department of Agriculture. Forest Service, Southern Research Station.

Jones, E.T. 2002. The political ecology of wild mushroom harvester stewardship in the Pacific Northwest. Amherst: University of Massachusetts-Amherst. Ph.D. dissertation.

Jones, E.T.; Lynch, K. 2002. The relevance of sociocultural variables to nontimber forest product research, policy, and management. *In* Nontimber forest products in the United States, eds. E.T. Jones, R.J. McLain, and J. Weigand, 26-51. Lawrence, KS: University Press of Kansas.

Jones, E.T., R.J. McLain, and J. Weigand. eds. 2002. Nontimber forest products in the United States. Lawrence, KS: University Press of Kansas.

Kahn, S. 2011. Putting ethnographic writing in context. *In* Writing spaces: readings on writing, volume 2, eds. C. Lowe and P. Zelmiansky, 175-192. Anderson, SC: Parlor Press.

Kauffman, J.S., S.P. Prisley, and J.L. 2017. Monitoring nontimber forest products using forest inventory data: an example with slippery elm bark. Journal of Forestry. 115(4):292-299.

Kruger, S. and J. L. Chamberlain. 2015. New methods for estimating non-timber forest product output: An Appalachian case study. *In* pushing boundaries: new directions in inventory techniques and applications, eds. S. M. Stanton and G. A. Christensen, 330-333. General Technical Report PNW-GTR-931. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station, Portland, OR.

Lassiter, L.E. 2005. Collaborative Ethnography. Chicago, IL: The University of Chicago Press.

Love, T. and E.T. Jones. 2001. Why Is Non-Timber Forest Product Harvesting an "Issue?" Journal of Sustainable Forestry, 13:3-4, 105-121.

Lynch, K.A., E.T. Jones, and R.J McLain. 2004. Nontimber forest product inventorying and monitoring in the United States: rationale and recommendations for a participatory approach. Portland, OR: Institute for Culture and Ecology.

Manget, L. 2012. Sangin' in the mountains: the ginseng economy of the southern Appalachians, 1865-1900. Appalachian Journal, 40(1/2), 28-56.

Manget, L. 2016. Nature's emporium: the botanical drug trade and the commons tradition in southern Appalachia, 1847-1917. Environmental History 21(4): 660-687.

Marshall, E., K. Schrenkenberg, and A.C. Newton. eds. 2006. Commercialization of non-timber forest products. Factors influencing success: Lessons learned from Mexico and Bolivia and policy implications for decision-makers. United Nations Environment Programme (UNEP), World Conservation Monitoring Centre. Cambridge, GB.

McCoy, T. 2007. After the check is gone. Washington Post. October 6, 2017.

McLain, R.J. 2002. Business as usual: the exclusion of mushroom pickers in wild mushroom

management in Oregon's national forests. *In* Nontimber forest products in the United States, eds. E.T. Jones, R.J. McLain, and J. Weigand, 375–385. Lawrence, KS: University Press of Kansas.

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

McLain, R.; Hurley, P.; Emery, M.R.; Poe, M. 2014. Gathering "wild" food in the city: rethinking the role of foraging in urban ecosystem planning and management. Local Environment. 19:220–240.

McLain, R.J., and E.T. Jones. 2001. Expanding nontimber forest product harvester/buyer participation in Pacific Northwest forest policy. *In* Nontimber forest products: medicinal herbs, fungi, edible fruits and nuts, and other natural products from the forest, eds. M.R. Emery and R.J. McLain. Food Products Press, New York.

Muir, P., K. Norman, and K. Sikes. 2006. Quantity and value of commercial moss harvest from forests of the Pacific Northwest and Appalachian regions of the US. The Bryologist. 109(2):197–214.

Mulligan, M. and D. Gorchov. 2004. Population loss of goldenseal, Hydrastis canadensis L. (Ranunculaceae) in Ohio. Journal of the Torrey Botanical Society 131:305-310.

Munsell, J.M. 2014. What is forest farming? *In* farming the woods, K. Mudge and S.F. Gabriel, White River Junction, VT: Chelsea Green Publishers.

National Christmas Tree Association (NCTA). 2012. Consumer survey results.

Neumann, R. P. and Eric Hirsch. 2000. Commercialization of nontimber forest

products: review and analysis of research. Bogor, Indonesia: Center for International Forestry Research.

New Hope Network. 2018. Nutrition Business Journal. Homepage. Retrieved October 25, 2018 from www.nutritionbusinessjournal.com.

Newfont, K. 2012. Blue Ridge commons: environmental activism and forest history in western North Carolina. University of Georgia Press. Atlanta, GA.

Ostrom, E., J. Burger, C. Field [and others]. 1999. Revisiting the commons: local lessons, global challenges. Science. April: 278-282.

Ostrom, E. 2015. Governing the commons: The evolution of actions for collective action. Cambridge University Press. Cambridge, UK.

Oswalt, S.N. and W.B. Smith eds. 2014. U.S. forest resource facts and historical trends. FS 10-35. US Department of Agriculture, Forest Service. Washington D.C. 63 p.

Piva, R.J. andG.W. Cook. 2011. West Virginia's timber industry: an assessment of timber product output and use, 2007. Resource Bulletin. NRS-46. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 58 p

Pollard, K. and L. Jacobsen. 2018. The Appalachian region: a data overview from the 2012-2016 American Community Survey. Report prepared for the Appalachian Regional Commission. March 2018.

Price, E.T. 1960. Root digging in the Appalachians: the geography of botanical drugs. Geographic Review. 50(1):1-20.

Reed, F. 1931. The United States Timber Conservation Board: its origin and organization: its purpose and progress Journal of Forestry. 29(8) 1202-1205.

Ribot, J. C. and N.L. Peluso. 2003. A theory of access. Rural Sociology 68: 153-181.

Rogelberg, S., and Stanton, J. 2007. Understanding and dealing with organizational survey nonresponse. Organizational Research Methods 10:195–209.

Robbins, C. 1999. Medicine from U.S. wildlands: An assessment of native plant species harvested in the United States for medicinal use and trade and evaluation of the conservation and management implications. The Nature Conservancy: Washington, D.C., 28 p.

Robbins, C. S. 2000. Comparative analysis of management regimes and medicinal plant trade monitoring mechanisms for American ginseng and goldenseal. Conservation Biology 14:1422-1434.

Robbins, P. 2011. Political Ecology: A critical introduction. Blackwell Publishing. Malden MA.

RootReport. 2018. RootReport website. Virginia Tech Department of Forest Resources and Environmental Conservation. Retrieved September 5, 2018, from www.rootreport.frec.vt.edu .

Scott, S. and S. McSpirit. 2014. The suspicious, untrusting hillbilly in political economic contexts: stereotypes and social trust in the Appalachian coalfields. Practicing Anthropology. 36(4):42-46.

Schlosser, W.E.; Blatner, K.A. 1995. The wild edible mushroom industry of Washington, Oregon, and Idaho—a 1992 survey. Journal of Forestry. 93: 31–36.

Shackleton, C.M. and A.K. Pandey. 2014. Positioning nontimber forest products on the development agenda. Forest Policy and Economics. 38:1-7.

Shanley, P.; Pierce, A.; Laird, S.; Guillen, A., eds. 2002. 302–312.Tapping the green market: management and certifcation of NTFPs. London: Earthscan

Sitarz, D. 1993. Agenda 21: The Earth summit strategy to save our planet. Boulder, CO: Earth

Press. 321p.

Slaughter, T. 2005. The natures of John and William Bartram. Philadelphia PA: University of Pennsylvania Press.

Small, C.J., J.L. Chamberlain, and D.S. Mathews. 2011. Recovery of black cohosh (*Actaea racemosa* L.) following experimental harvests. The American Midland Naturalist. 166(2):339–348.

Smith, T., L. Kawa, V. Eckl, [and others]. 2017. Herbal Supplement Sales Increase 7.7. percent. Market Report. Herbalgram. 115:61-65.

Spence, B., C. Kunkel, E. Schewel [and others]. 2013. Who owns West Virginia. Charleston WV: West Virginia Center on Budget and Policy.

Taylor, B., M. Hufford, and K. Bilbrey. 2017. A green New Deal for Appalachia: economic transition, coal reclamation costs, bottom-up policymaking (part 1). Journal of Appalachian Studies, 23(1): 8-28.

Tengberg, A. [and others]. 2012. Cultural ecosystem services provided by landscapes: assessment of heritage values and identity. Ecosystem Services 2:14-26

Ticktin, T. 2004. The ecological implications of harvesting non-timber forest products. Journal of Applied Ecology 41:11-21.

United States Census Bureau. 2015. American Community Survey. Five year employment and poverty statistics. 2011 – 2015. U.S. Census Bureau's American Community Survey Office, Retrieved May 21, 2018, from http://factfinder2.census.gov

United Plant Savers. 2018. Species at risk. Retrieved September 4, 2018. https://unitedplantsavers.org/species-at-risk/

USDA Economic Research Service. 2018. Rural-Urban Continuum. Retrieved May 21, 2018 from https://www.ers.usda.gov/data-products/rural-urban-continuum-codes.aspx

USDA Forest Service. 2018a. Cut and sold reports. Retrieved January 15, 2018 from http://www.fs.fed.us/forestmanagement/products/sold-harvest/cut-sold.shtml.

U.S. Department of Agriculture Forest Service. 2018b. EVALIDator Tool. Forest inventory and analysis program. Retrieved January 15, 2018 from https://apps.fs.usda.gov/Evalidator/evalidator.jsp.

US Department of Agriculture Forest Service. 2018c. National woodland owners survey. Forest inventory and analysis program. https://www.fia.fs.fed.us/nwos/results/

USDA Forest Service. 2018d. Timber product output. Forest Inventory and Analysis National Program. Retrieved September 8, 2018 from: http://www.fa.fs.fed.us/program-features/ tpo/.

USDA Forest Service 2018e. Hoosier National Forest. Forest product permits. Retrieved September 7, 2018 from https://www.fs.usda.gov/main/hoosier/passes-permits/forestproducts.

USDA Forest Service. 2018f. Pisgah National Forest. Forest product permits. Retrieved September 8, 2018 from: https://www.fs.usda.gov/main/nfsnc/passes-permits/forestproducts.

University of Wisconsin Public Health Institute 2018. Drug Overdoses. County Health Rankings and Roadmap. University of Wisconsin and the Robert Wood Johnson Foundation. Retrieved January 1, 2017 from http://www.countyhealthrankings.org/

Van der Voort, M.E. and J.B. McGraw. 2006. Effects of harvester behavior on population

growth rate affects sustainability of ginseng trade. Biological Conservation. 130:505-516.

Vaughan, R.C., J.F. Munsell, and J.L. Chamberlain. 2013. Opportunities for enhancing nontimber forest products management in the United States. Journal of Forestry. 111(1):26-33.

Watson, K. 2017. Alternative Economies of the Forest: Honey Production and Public Land Management in Northwest Florida. Society & Natural Resources, 30(3), 331-346.

Watson, K., C.S. Christian, M.R. Emery [and others]. Social dimensions of nontimber forest products. *In* Assessment of nontimber forest products in the United States under changing conditions, eds. J.L Chamberlain, M.R. Emery, and T. Patel-Weynand. General Technical Report SRS-GTR-232. USDA Forest Service, Southern Research Station. 268 p.

Wickens, G.E. 1991. Non-wood forest products: the way ahead. FAO Forestry Paper 97. Rome: FAO 37 p.

Wollenberg, E., and A. Ingles, (eds). 1998. Incomes from the forest: methods for the development and conservation of forest products for local communities. Bogor, Indonesia: Center for International Forestry Research.

Young, J. A., F. van Manen, and C. A. Thatcher. 2011. Geographic profiling to assess the risk of rare plant poaching in natural areas. Environmental Management 48(3): 577-587.

APPENDIX A. SURVEY COVER LETTER

VirginiaTech
College of Natural Resources and Environment

September 3, 2018

Greetings,

We recently wrote to you about Virginia Tech's RootReport Project. We sent results from last year and let you know we would be sending out another questionnaire about products purchased in 2015. That time has come, and we hope you will help us in our work with the many businesses and communities that rely on nontimber forest products.

You received our letters because you are licensed to buy ginseng in a state in our study area. There has been very little research on the markets for other native medicinal plants such as goldenseal, bloodroot and black cohosh. Our short, confidential questionnaire helps us estimate the trade for some of these other products and see how the harvest is distributed throughout the region. We also ask questions that help us measure the economic impact of nontimber forest products. We will use the information to create next year's RootReport and for other extension programs and educational materials.

We are required by law to keep all information collected from the questionnaires confidential and we will not share any information that could identify participants with anyone. We want to understand the big picture, so the information will be used to create regional summaries. We will not publish any data that can be traced to an individual business. Your decision whether or not to fill out a questionnaire is also confidential.

If you choose to participate, simply place the completed form in the enclosed return envelope and put it in the mail-no postage needed. If you prefer to answer the questionnaire over the phone, you may send us the enclosed response card. Place the card in the return envelope, and we will contact you at your convenience. Please hold on to the questionnaire to refer to when we call.

This year you can see past results and also take the survey online at www.rootreport.vt.frec.edu. To take the survey, click on Participate and follow the directions. When prompted please enter the following code [Dealer Code]. The information provided online will also be kept confidential.

If you have questions or concerns about our project, we would be happy to talk with you. Conversations with participants have helped improve the project, and give us a better understanding of the data we collect. You can contact us by phone at (828) 719-9477, by mail or by email at skruger@vt.edu.

Thank you for your time and your consideration.

Respectfully,

Steve Kruger, Researcher. Department of Forest Resources and Environmental Conservation, Virginia Tech.

John Munsell, Associate Professor and Extension Specialist. Department of Forest Resources and Environmental Conservation, Virginia Tech.

APPENDIX B. SURVEY INSTRUMENT

Virginia Tech RootReport Questionnaire

Part 1: **The Business.** These questions tell us about the different kinds of companies that purchase medicinal forest products. They allow us to create more accurate assessments of the market and more effective extension services. Questions about employment and whether you sell to other buyers or directly to consumers help us measure the botanical industry's contribution to the regional economy. **Any information you give throughout the survey is confidential and will not be shared.**

1) Which of the following was true in **2015**?

   ❑ I only bought ginseng in 2015 ❑ I bought ***other*** medicinal products in 2015 ❑ I bought ginseng ***and*** other medicinal products in 2015

   ❑ I did not buy ***any*** medicinal forest products in 2015

2) Do you buy any **non-medicinal** forest products (edible plants or products for the floral or craft industry)? These include morels, galax, log moss, ramps, etc.

   ❑Yes ❑No

   If you answered **yes**, what non-medicinal forest products do you purchase?

   _____

   _____

<u>If you bought medicinal products other than ginseng in 2015, please continue. If not, you've completed the survey and can send it in.</u>

3) What **percentage** of your medicinal products do you and/or your employees harvest? _____% } **Should total 100%**
   What **percentage** of your medicinal products are harvested by someone else? _____% }

4) How many people (including yourself) are employed at your company (or the part of your company that works with botanicals)?

   _____Part time _____Full time

5) Do you manufacture your own consumer products from the plants you buy? (as packaged whole root, teas, tinctures, supplements, etc)

   ❑Yes ❑No

6) Approximately what percentage of your non-ginseng products do you sell to the following:

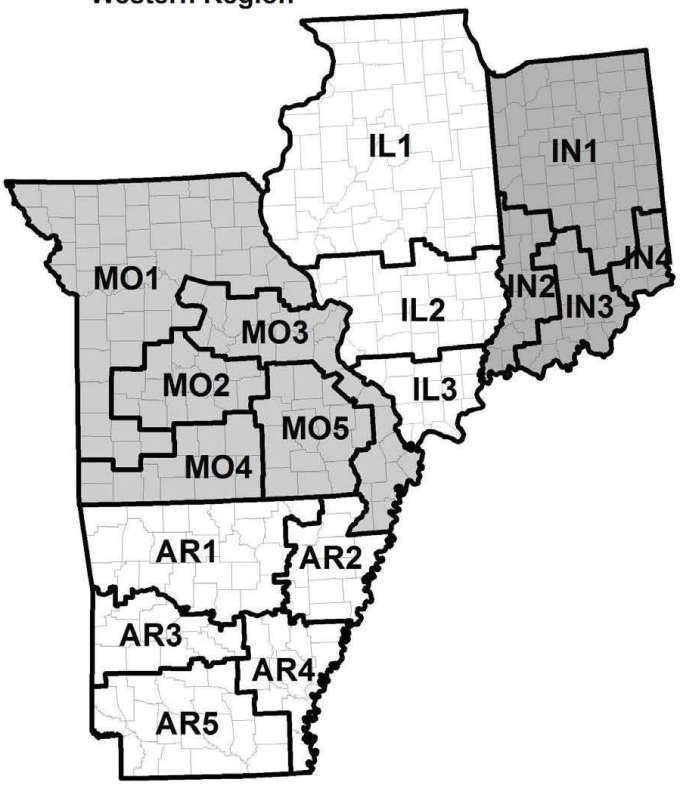
   Other Buyers_____ Manufacturers_____ Retailers_____ Consumers_____ Other(Please Specify)_____

1

Part 2: Your Purchasing With your help, we want to be able to estimate total regional production in 2015 for the plants listed below. To do so, we need to know the total weight purchased, how much was dry vs fresh, how much was bought from harvesters vs other buyers (so as not to count the same product twice), and how much was wild-harvested versus cultivated. We are asking for products bought **between January and December of 2015**. Please fill in the table to the best of your ability. **This information will be kept confidential**.

Product Purchased in 2015	**Total Amount Purchased**		**Amount Bought Directly From Harvesters**		**Amount Bought From a Primary Buyer**		**Wild**		**Cultivated**	
	Dry Pounds	Fresh Pounds	Dry Pounds	Fresh Pounds	Dry Pounds	Fresh Pounds	Dry Pounds	Fresh Pounds	Dry Pounds	Fresh Pounds
Black Cohosh (*Actaea racemosa*)										
Bloodroot (*Sanguinaria canadensis*)										
Blue Cohosh (*Caulophyllum thalictoides*)										
Cranesbill, Wild Geranium (*Geranium maculatum*)										
False Unicorn, Star Grub Root, Fairywand, Devils Bit, (*Chamaelirium luteum*)										
Fringetree Bark *(Chionanthus virginicus)*										
Goldenseal (*Hydrastis canadensis*)										
Mayapple (*Podophyllum peltatum*)										
Slippery Elm (*Ulmus rubra*)										
Solomons Seal *(Polygonatum biflorum)*										
Stoneroot (*Collinsonia canadensis*)										
Trillium, Beth Root (*Trillium spp.*)										
Virginia Snakeroot (*Aristolochia serpentaria*)										
Wild Yam (*Dioscorea villosa*)										

Medicinal Forest Product Harvest Zones
Western Region



7

Congratulations, you're over halfway done…

Part 3: Harvest Distribution This section is about where products are harvested. On pages 5 to 7 you will find maps of the study area divided into multi-county zones. Each zone is given a number (VA1, PA2 etc). Find the zones on the map where your products were harvested in 2015. In the first row of the table on this page (in the cells marked "Zone:"), write the zone numbers where your products were harvested. Then, to the best of your ability please fill in the percentage of each product that came from each zone you listed.

For Example:

Example	Zone: VA1	Zone: NC4	Zone: KY7	Zone: WV3	Zone: NY6	Zone: OH4	Zone: MO3	Zone:	Zone:	Zone:	% All other zones in Study Area	% Outside Study Area	% Origin Unknown	Total (Should Total 100)
Black Cohosh (*Actaea racemosa*)	15	20	20	20	20							5		100%
Bloodroot (*Sanguinaria canadensis*)	20	15	10	10	15	13	17							100%

Please fill out the table below to the best of your ability:

	Zone:	Zone:	Zone:	Zone:	Zone:	Zone:	Zone:	Zone:	Zone:	Zone:	% All other zones in Study Area	% Outside Study Area	% Origin Unknown	Total (Should Total 100)
Black Cohosh (*Actaea racemosa*)														100%
Bloodroot (*Sanguinaria canadensis*)														100%
Blue Cohosh (*Caulophyllum thalictoides*)														100%
Cranesbill, Wild Geranium (*Geranium maculatum*)														100%
False Unicorn, Star Grub, Fairy Wand (*Chamaelirium luteum*)														100%
Fringetree Bark (*Chioanthus virginicus*)														100%
Goldenseal, Yellowroot (*Hydrastis canadensis*)														100%
Mayapple (*Podophyllum peltatum*)														100%
Slippery Elm (*Ulmus rubra*)														100%
Stoneroot (Collinsonia canadensis)														100%
Trillium, Beth Root (*Trilium spp.*)														100%
VA Snakeroot (*Aristolochia serpentaria*)														100%
Wild Yam (*Dioscorea villosa*)														100%

Part 4: Wrapping Up Are there other medicinal forest products you commonly purchase that we did not ask about?

_____

_____

_____

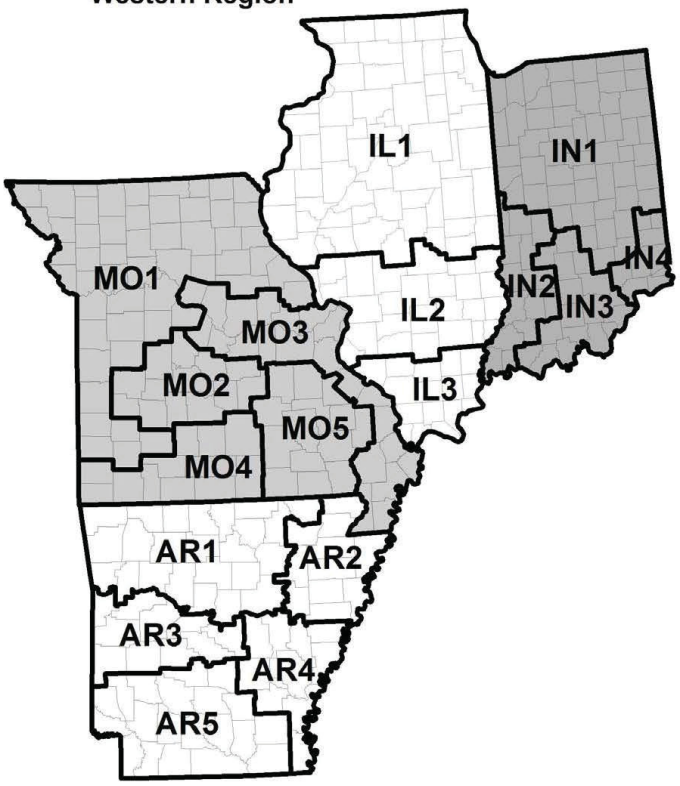
_____

Optional: To understand the impact of non-timber forest products on our region's economy, and how changes in price influence harvesting from year to year we need to have an idea of the value of these products. To do so we are asking for participants to enter the average price (or range of prices) **paid to harvesters** in your area in 2015. **These numbers do not represent your own prices**, just your estimate of the average amount paid in **2015** in your area.

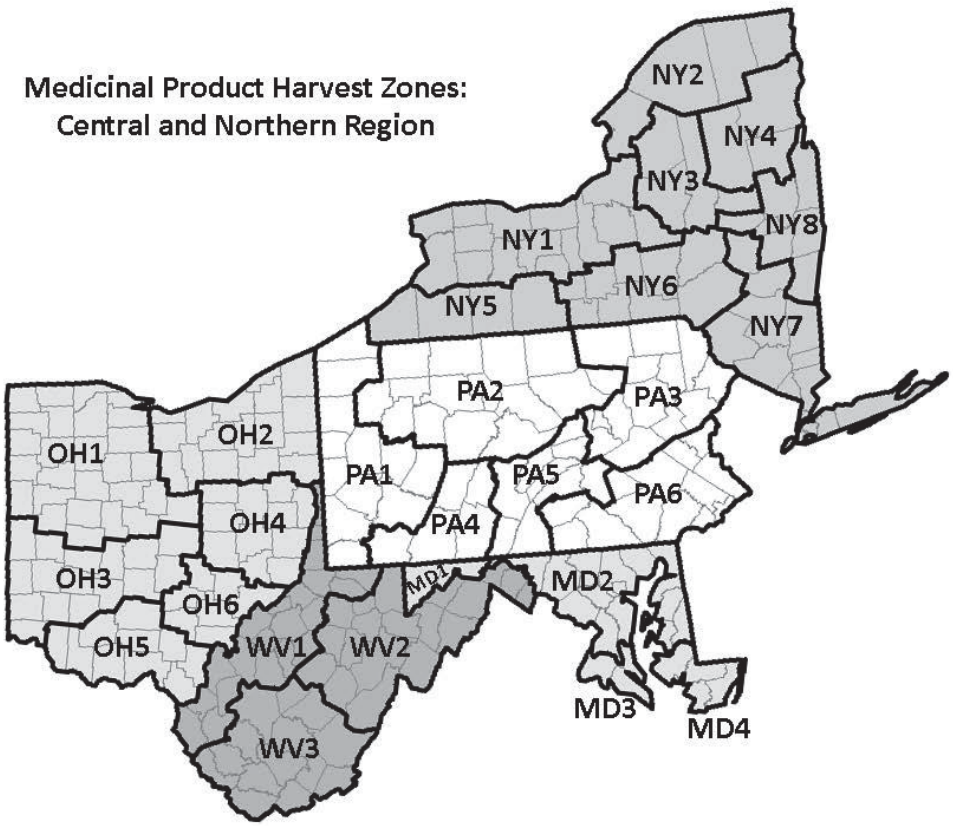
	Black Cohosh	Bloodroot	Blue Cohosh	Cranesbill	False Unicorn, Star Grub	Fringetree Bark	Goldenseal	Mayapple	Slippery Elm Bark	Solomons Seal	Stoneroot	Trillium (Bethroot)	Virginia Snakeroot	Wild Yam
Dry Price														
Fresh Price														

Thank you for taking the time and effort to complete this questionnaire. If you have any additional comments, questions, or feedback on ways we can improve the survey, please feel free to add them below.

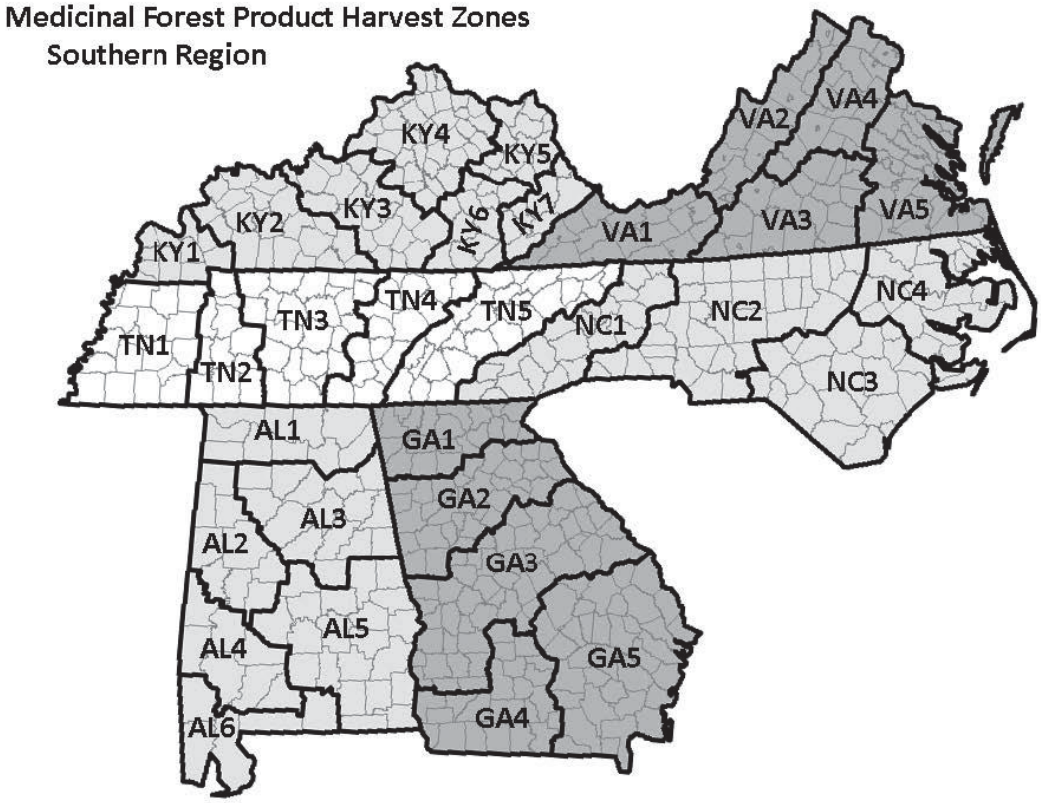
Medicinal Forest Product Harvest Zones
Western Region



7


Medicinal Product Harvest Zones:
Central and Northern Region
NY2
NY4
NY3
NY8
NY1
NY6
NY5
NY7
PA2
PA3
OH1
OH2
PA1
PA5
PA6
OH4
PA4
OH3
MD1
MD2
OH6
OH5
WV1
WV2
MD3
MD4
WV3

6


Medicinal Forest Product Harvest Zones
Southern Region
KY4
KY5
KY2
KY3
KY6
KY7
KY1
VA1
VA2
VA4
VA3
VA5
TN1
TN2
TN3
TN4
TN5
NC1
NC2
NC4
NC3
AL1
GA1
AL3
GA2
AL2
GA3
AL5
AL4
GA5
AL6
GA4

5

Medicinal Forest Product Zones by County

Alabama Zones by County

AL1: Colbert, DeKalb, Franklin, Jackson, Lauderdale, Lawrence, Limestone, Madison, Marshall, Morgan. **AL2:** Bibb, Fayette, Greene, Hale, Lamar, Marion, Perry, Pickens, Tuscaloosa. **AL3:** Blount, Calhoun, Cherokee, Clay, Cleburne, Coosa, Cullman, Etowah, Jefferson, Randolph, Saint Clair, Shelby, Talladega, Walker, Winston. **AL4:** Choctaw, Clarke, Conecuh, Marengo, Monroe, Sumter, Wilcox. **AL5:** Autauga, Barbour, Bullock, Butler, Chambers, Chilton, Coffee, Crenshaw, Dale, Dallas, Elmore, Geneva, Henry, Houston, Lee, Lowndes, Macon, Montgomery, Pike, Russell, Tallapoosa. **AL6:** Baldwin, Covington, Escambia, Mobile, Washington.

Arkansas Zones by County

AR1: Baxter, Benton, Boone, Carroll, Cleburne, Conway, Crawford, Franklin, Fulton, Independence, Izard, Johnson, Madison, Marion, Newton, Pope, Randolph, Searcy, Sharp, Stone, Van Buren, Washington, White. **AR2:** Clay, Craighead, Crittenden, Cross, Greene, Jackson, Lawrence, Mississippi, Poinsett, Saint Francis, Woodruff. **AR3:** Garland, Logan, Montgomery, Perry, Polk, Pulaski, Saline, Scott, Sebastian, Yell. **AR4:** Arkansas, Chicot, Desha, Jefferson, Lee, Lincoln, Lonoke, Monroe, Phillips, Prairie. **AR5:** Ashley, Bradley, Calhoun, Clark, Cleveland, Columbia, Dallas, Drew, Grant, Hempstead, Hot Springs, Howard, Lafayette, Little River, Miller, Nevada, Ouachita, Pike Sevier, Union

Georgia Zones by County

GA1: Bartow, Catoosa, Chattooga, Cherokee, Dade, Dawson, Fannin, Floyd, Fulton, Gilmer, Gordon, Habersham, Hall, Lumpkin, Murray, Pickens, Rabun, Stephens, Towns, Union, Walker, Whitfield, White.**GA2:** Banks, Barrow, Bartow, Carroll, Clarke, Clayton, Cobb, Coweta, DeKalb, Douglas, Elbert, Fayette, Forsyth, Franklin, Fulton, Gwinnett, Hall, Haralson, Hart, Heard, Henry, Jackson, Madison, Meriwether, Newton, Oconee, Oglethorpe, Paulding, Polk, Rockdale, Spalding, Troup, Walton. **GA3:** Baldwin, Bibb, Bleckley, Burke, Butts, Calhoun, Chattahoochee, Clay, Columbia, Crawford, Dougherty, Glascock, Greene, Hancock, Harris, Houston, Jasper, Jefferson, Jones, Lamar, Lee, Lincoln, Macon, Marion, McDuffie, Monroe, Morgan, Muscogee, Peach, Pike, Pulaski, Putnam, Quitman, Randolph, Richmond, Schley, Stewart, Sumter, Talbot, Taylor, Taliaferro, Terrell, Twiggs, Upson, Warren, Washington, Webster, Wilkes, Wilkinson.**GA4:** Baker, Ben Hill, Berrien, Brooks, Colquitt, Cook, Crisp, Decatur, Dooly, Early, Grady, Irwin, Lanier, Lowndes, Miller, Mitchell, Seminole, Thomas, Tift, Turner, Wilcox, Worth. **Zone GA5:** Appling, Atkinson, Bacon, Brantley, Bryan, Bulloch, Camden, Candler, Charlton, Chatham, Clinch, Coffee, Dodge, Echols, Effingham, Emanuel, Evans, Glynn, Jeff Davis, Jenkins, Johnson, Liberty, Laurens, Long, McIntosh, Montgomery, Pierce, Screven, Tattnall, Telfair, Toombs, Treutlen, Ware, Wayne, Wheeler

Illinois Zones by County

IL1: Adams, Boone, Brown, Bureau, Carroll, Cass, Champaign, Christian, Coles, Cook, DeKalb, De Witt, Douglas, Edgar, Ford, Fulton, Grundy, Hancock, Henderson, Henry, Iroquois, Jo Daviess, Kane, Kankakee, Kendall, Knox, Lake, La Salle, Lee, Livingston, Logan, Macon, Marshall, Mason, McDonough, McHenry, Menard, Mercer, Moultrie, Ogle, Peoria, Piatt, Pike, Putnam, Rock Island, Sangamon, Schuyler, Scott, Stark, Stephenson, Tazewell, Vermillion, Warren, Whiteside, Will, Winnebago, Woodford. **IL2:** Bond, Calhoun, Clark, Clay, Clinton, Crawford, Cumberland, Edwards, Effingham, Fayette, Greene, Jasper, Jefferson, Jersey, Lawrence, Macoupin, Madison, Marion, Monroe, Montgomery, Richland, Saint Clair, Shelby, Wabash, Washington, Wayne. **IL3:** Alexander, Franklin, Gallatin, Hamilton, Hardin, Jackson, Johnson, Massac, Perry, Pope, Pulaski, Randolph, Saline, Union, White, Williamson

Indiana Zones by County

IN1: Allen, Bartholomew, Benton, Blackford, Boone, Carroll, Cass, Decatur, DeKalb, Delaware, Elkhart, Fulton, Grant, Hamilton, Hancock, Hendricks, Henry, Howard, Huntington, Jasper, Jay, Johnson, Kosciusko, Lagrange, La Porte, Lake, Madison, Marion, Marshall, Miami, Montgomery, Newton, Noble, Porter, Pulaski, Randolph, Rush, Saint Joseph, Shelby, Stark, Steuben, Tippecanoe, Tipton, Wabash, Wayne, Wells, White, Whitley, **IN2** Clay, Daviess, Gibson, Greene, Knox, Martin, Parke, Pike, Posey, Putnam, Sullivan, Vanderburgh, Vermillion, Vigo

IN3 Brown, Clark, Crawford, Dubois, Floyd, Harrison, Jackson, Lawrence, Monroe, Morgan, Owen, Perry, Scott, Spencer, Warrick, Washington. **IN4** Dearborn, Fayette, Franklin, Jefferson, Jennings, Ohio, Ripley, Switzerland, Union

Kentucky Zones by County

KY1: Ballard, Calloway, Carlisle, Fulton, Graves, Hickman, Livingston, Lyon, Marshall, McCracken, Trigg. **KY2:** Allen, Butler, Caldwell, Christian, Crittenden, Daviess, Edmonson, Franklin, Henderson, Hopkins, Logan, McLean, Monroe, Montgomery, Muhlenberg, Ohio, Scott, Shelby, Simpson, Union, Todd, Warren, Webster. **KY3:** Adair, Barren, Breckinridge, Bullitt, Casey, Clinton, Cumberland, Grayson, Green, Hancock, Hardin, Hart, LaRue, Marion, Meade, Metcalfe, Nelson, Pulaski, Russell, Taylor, Wayne. **KY4:** Anderson, Bath, Boone, Bourbon, Boyle, Bracken, Campbell, Carroll, Clark, Fayette, Fleming, Gallatin, Garrard, Grant, Harrison, Henry, Jefferson, Jessamine, Kenton, Lincoln, Madison, Mason, Mercer, Nicholas, Oldham, Owen, Pendleton, Robertson, Spencer, Trimble, Washington, Woodford.**Zone KY5:** Boyd, Carter, Elliott, Greenup, Johnson, Lawrence, Lewis, Magoffin, Menifee, Morgan, Powell, Rowan, Wolfe. **Zone KY6:** Bell, Breathitt, Clay, Estill, Knox, Jackson, Laurel, Lee, McCreary, Owsley, Rockcastle, Whitley

KY7: Floyd, Harlan, Knott, Leslie, Letcher, Martin, Perry, Pike.

Maryland Zones by County

MD1: Allegany, Garrett. **MD2:** Anne Arundel, Baltimore, Baltimore City, Caroline, Carroll, Cecil, Frederick, Harford, Howard, Kent, Montgomery, Prince George's, Queen Anne's, Talbot, Washington **MD3:** Calvert, Charles, St. Mary's. **MD4:** Dorchester, Somerset, Wicomico, Worcester.

Missouri Zones by County

MO1: Adair, Andrew, Atchison, Audrain, Barton, Bates, Buchanan, Caldwell, Carroll, Cass, Charlton, Clark, Clay, Clinton, Cooper, Dade, Daviess, DeKalb, Gentry, Greene, Grundy, Harrison, Henry, Holt, Jackson, Jasper, Johnson, Knox, Lafayette, Lawrence, Lewis, Lincoln, Linn, Marion, Mercer, Monroe, Nodaway, Pettis, Pike, Platte, Putnam, Ralls, Randolph, Ray, Saline, Schuyler, Scotland, Shelby, Sullivan, Vernon, Worth **MO2:** Benton, Camden, Cedar, Dallas, Hickory, Laclede, Maries, Morgan, Miller, Pulaski, Phelps, Polk, Saint Clair. **MO3:** Bollinger, Boone, Butler, Callaway, Cape Girardeau, Charlton, Crawford, Dunklin, Franklin, Gasconade, Howard, Jefferson, Lincoln, Maries, Miller, Mississippi, Moniteau, New Madrid, Osage, Pemiscot, Perry, Phelps, Pike, Saint Charles, Saint Francois, Saint Louis County, Sainte Genevieve, Saline, Scott, Stoddard, Washington, Wayne. **MO4:** Barry, Christian, Douglas, Howell, McDonald, Newton, Ozark, Stone, Taney, Texas, Webster, Wright. **MO5:** Bollinger, Butler, Carter, Crawford, Dent, Iron, Madison, Oregon, Reynolds, Ripley, Saint Francois, Shannon, Washington, Wayne.

New York Zones by County

NY1: Cayuga, Erie, Genesee, Livingston, Madison, Monroe, Niagara, Onondaga, Orleans, Oswego, Seneca, Wayne, Wyoming, Yates. **NY2:** Clinton, Franklin, Jefferson, St. Lawrence**. NY3:** Fulton, Herkimer, Lewis, Oneida. **NY4:** Essex, Hamilton, Warren**. NY5:** Allegany, Cattaraugus, Chautauqua, Steuben

NY6: Broome, Chemung, Chenango, Courtland, Delaware, Otsego, Schuyler, Tioga, Tompkins. **NY7:** Bronx, Dutchess, Greene, Kings, Nassau, New York, Orange, Putnam, Queens, Richmond, Rockland, Schoharie, Suffolk, Sullivan, Ulster, Westchester **NY8:** Albany, Columbia, Montgomery, Rensselaer, Saratoga, Schenectady, Washington.

North Carolina Zones by County

NC1: Alleghany, Ashe, Avery, Buncombe, Burke, Caldwell, Cherokee, Clay, Graham, Haywood, Henderson, Jackson, McDowell, Macon, Madison, Mitchell, Swain, Transylvania, Watauga, Wilkes, Yancey.**NC2:** Alamance, Alexander, Anson, Cabarrus, Caswell, Catawba, Chatham, Cleveland, Davidson, Davie, Durham, Forsyth, Franklin, Gaston, Granville, Guilford, Iredell, Lincoln, Mecklenburg, Montgomery, Orange, Person, Polk, Randolph.**NC2:** Rockingham, Rowan, Rutherford, Stanly, Stokes, Surry, Union, Vance, Wake, Warren, Yadkin. **NC3:** Bladen, Brunswick, Columbus, Cumberland, Duplin, Greene, Harnett, Hoke, Johnston, Jones, Lee, Lenoir, Moore, New Hanover, Onslow, Pender, Richmond, Robeson, Sampson, Scotland, Wayne.**NC4:** Beaufort, Bertie, Camden, Carteret, Chowan, Craven, Currituck, Dare, Edgecombe, Gates, Halifax, Hertford, Hyde, Martin, Nash, Northampton, Pamlico, Pasquotank, Perquimans, Pitt, Tyrrell, Washington, Wilson.

Ohio Zones by County

OH1: Allen, Auglaize, Champaign, Crawford, Delaware, Defiance, Fulton, Hancock, Hardin, Harding, Henry, Knox, Logan, Lucas, Marion, Mercer, Morrow, Ottawa, Putnam, Sandusky, Seneca, Shelby, Union, Williams, Van Wert, Wood, Wyandot**. OH2:** Ashland, Ashtabula, Columbiana, Cuyahoga, Erie, Geauga, Huron, Lake, Lorain, Mahoning, Medina, Portage, Richland, Stark, Summit, Trumbull, Wayne.**OH3:** Butler, Clark, Clinton, Darke, Fairfield, Fayette, Franklin, Greene, Hamilton, Licking, Madison, Miami, Montgomery, Pickaway, Preble, Warren.

OH4: Belmont, Carroll, Coshocton, Guernsey, Harrison, Holmes, Jefferson, Monroe, Muskingum, Noble, Tuscarawas. **OH5:** Adams, Brown, Clermont, Gallia, Highland, Jackson, Lawrence, Pike, Ross, Scioto. **OH6:** Athens, Hocking, Meigs, Morgan, Perry, Vinton, Washington.

Pennsylvania Zones by County

PA1: Allegheny, Armstrong, Beaver, Butler, Crawford, Erie, Indiana, Greene, Lawrence, Mercer, Washington, Westmoreland**. PA2:** Cameron, Centre, Clarion, Clearfield, Clinton, Elk, Forest, Jefferson, Lycoming, McKean, Potter, Sullivan, Tioga, Venango, Warren **PA3:** Bradford, Carbon, Lackawanna, Luzerne, Monroe, Montour, Northumberland, Pike, Schuylkill, Susquehanna, Wayne, Wyoming.

PA4: Bedford, Blair, Cambria, Fayette, Somerset. **PA5:** Dauphin, Franklin, Fulton, Huntingdon, Juniata, Mifflin, Perry, Snyder, Union. **PA6:** Adams, Berks, Bucks, Chester, Cumberland, Delaware, Lancaster, Lebanon, Lehigh, Montgomery, Northampton, Philadelphia, York.

Tennessee Zones by County

TN1: Carroll, Chester, Crockett, Dyer, Fayette, Gibson, Hardeman, Haywood, Henderson, Henry, Lake, Lauderdale, Obion, Madison, McNairy, Shelby, Tipton, Weakley. **TN2:** Benton, Decatur, Hardin, Hickman, Houston, Humphreys, Lawrence, Lewis, Perry, Stewart, Wayne. **TN3:** Bedford, Cannon, Cheatham, Clay, Coffee, Davidson, DeKalb, Dickson, Giles, Jackson, Lincoln, Macon, Marshall, Maury, Montgomery, Moore, Robertson, Rutherford, Smith, Sumner, Trousdale, Williamson, Wilson.**TN4:** Bledsoe, Campbell, Cumberland, Fentress, Franklin, Grundy, Marion, Morgan, Overton, Pickett, Putnam, Scott, Sequatchie, Van Buren, Warren, White.**TN5:** Anderson, Blount, Bradley, Carter, Claiborne, Cocke, Grainger, Greene, Hamblen, Hamilton, Hancock, Hawkins, Jefferson, Johnson, Knox, Loudon, McMinn, Meigs, Monroe, Polk, Rhea, Roane, Sevier, Sullivan, Unicoi, Union, Washington.

Virginia Zones by County

VA1: Bland, Bristol, Buchanan, Carroll, Dickenson, Floyd, Galax, Giles, Grayson, Lee, Montgomery, Pulaski, Radford, Russell, Scott, Smyth, Tazewell, Washington, Wise, and Wythe. **VA2:** Alleghany, Augusta, Bath, Botetourt, Buena Vista, Clarke, Covington, Craig, Frederick, Harrisonburg, Highland, Lexington, Page, Roanoke, Roanoke city, Rockbridge, Rockingham, Salem, Shenandoah, Warren, Waynesboro, and Winchester. **VA3:** Amelia, Appomattox, Bedford, Bedford City, Buckingham, Campbell, Charlotte, Cumberland, Danville, Franklin, Halifax, Henry, Lunenburg, Lynchburg, Martinsville, Mecklenburg, Nottoway, Patrick, Pittsylvania, Powhatan, and Prince Edward. **VA4:** Albemarle, Alexandria, Amherst, Arlington, Charlottesville, Culpepper, Fairfax, Fairfax City, Falls Church, Fauquier, Fluvanna, Fredericksburg, Goochland, Greene, Loudon, Louisa, Madison, Manassas, Manassas Park, Nelson, Orange, Prince William, Rappahannock, Spotsylvania, and Stafford. **VA5:** Accomack, Brunswick, Caroline, Charles City, Chesapeake, Colonial Heights, Dinwiddie, Emporia, Essex, Franklin City, Gloucester, Greensville, Hampton, Hanover, Henrico, Hopewell, Isle of Wight, James City, King and Queen, King George, King William, Lancaster, Mathews, Middlesex, New Kent, Newport News, Norfolk, Northampton, Northumberland, Petersburg, Poquoson, Portsmouth, Prince George, Richmond, Richmond City, Southampton, Suffolk, Surry, Sussex, Virginia Beach, Westmoreland, Williamsburg, York.

West Virginia Zones by County

WV1: Brooke, Cabell, Calhoun, Doddridge, Gilmer, Hancock, Jackson, Lincoln, Marion, Marshall, Mason, Monongalia, Ohio, Pleasants, Putnam, Ritchie, Roane, Tyler, Wayne, Wetzel, Wirt, Wood. **WV2:** Barbour, Berkeley, Braxton, Grant, Hampshire, Hardy, Harrison, Jefferson, Lewis, Mineral, Morgan, Pendleton, Preston, Pocahontas, Preston, Randolph, Taylor, Tucker, Upshur, Webster. **WV3:** Boone, Clay, Fayette, Greenbrier, Kanawha, Logan, McDowell, Mercer, Mingo, Monroe, Nicholas, Raleigh, Summers, Wyoming

APPENDIX C. SUMMARY OF RESULTS SENT TO RESPONDENTS

ROOTREPORT: PRELIMINARY RESULTS FOR 2014

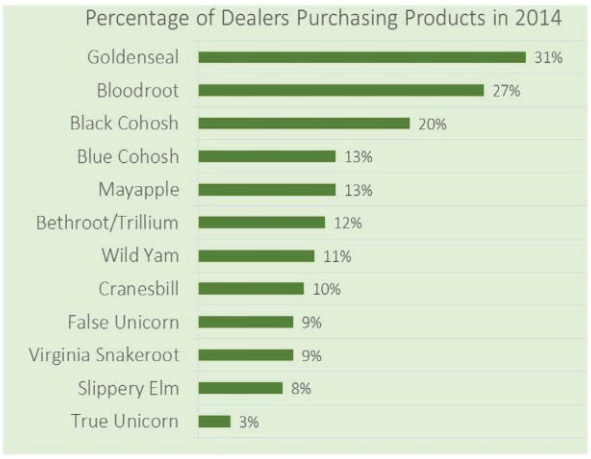
OUR STUDY

RootReport is an ongoing project of the Department of Forest Resources and Environmental Conservation at Virginia Tech. We do market assessment and create extension resources for nontimber forest products. For the last three years we have sent questionnaires to medicinal plant buyers about what products they purchase, how much is being produced and how harvests are distributed around the region. At this stage, we are focusing on medicinal plants in eastern deciduous forests. The data presented here were collected in 2015 and represent products purchased in 2014.

THE PRODUCTS

We received surveys from 22 percent of registered ginseng dealers in our 11 state survey area. Of these, roughly 38 percent reported purchasing other products in 2014. This dropped from the previous year, due to the inclusion of new areas with less production (see below). We asked specifically about 11 roots and one bark (Fig.1). The most commonly purchased were goldenseal (*Hydrastis canadensis*), bloodroot (*Sanguinaria canadensis*) and black cohosh (*Actaea racemosa*), which were also the most commonly purchased in 2013.

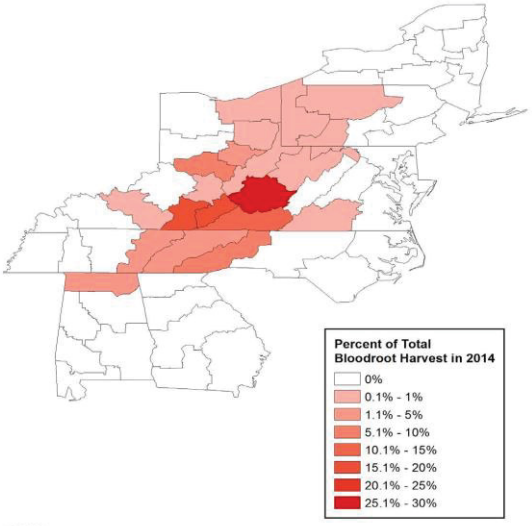
12 percent of respondents reported purchasing other products that weren't on our list including stoneroot, Solomon's seal, queen of the meadow/Joe Pye weed, spikenard, black Indian hemp, indigo, witch hazel, wild hydrangea, and mullein. The most common barks not on our list were cherry, sassafras and fringe tree. Five percent reported purchasing nonmedicinal products with the most common being decorative products such as log moss and burl wood, and edibles such as ramps and mushrooms.



(FIG.1)

DISTRIBUTION

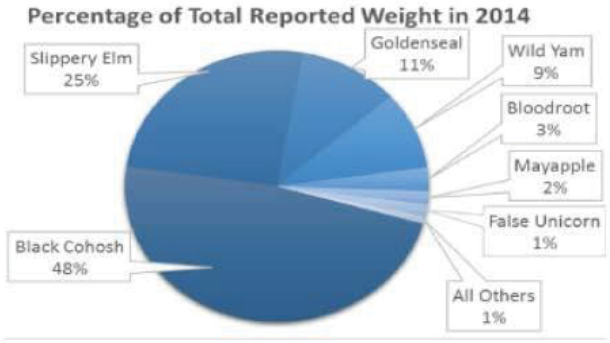
Central Appalachia was again the major supply center in 2014, with southern West Virginia, eastern Kentucky and southwest Virginia producing at the highest rates for most of the species we surveyed. The map below shows the reported distribution for the bloodroot harvest, which is typical of the more commonly purchased species (Fig. 2). Of the new areas added last year, only West Virginia and southern Ohio had significant output for our plant list. Based on conversations with participants, we are continuing to explore possible explanations for distribution including abundance of ideal plant habitat, local economic conditions, a history or tradition of harvesting, and access to land.



(FIG.2)

OUTPUT

Our goal is to be able to provide estimates for total output for all the plants in the survey. We are still working on making those as accurate and representative as possible by eliminating double-counting and creating a projection that takes the wide array of businesses into account –from herbalists to "country dealers" to larger aggregators. For now, we can demonstrate the products' trade in relation to the total weight of all the products, represented in the chart below (Fig. 3). Black Cohosh once again made up more of the trade than any other product, at 48 percent of the total weight, followed by slippery elm bark and goldenseal root. It is important to note that these plants vary in size, abundance and value, and the market shifts annually based on demand and availability. These data alone do not reflect the status of wild populations, only the amount being harvested.



(FIG.3)

CHANGE OVER TIME

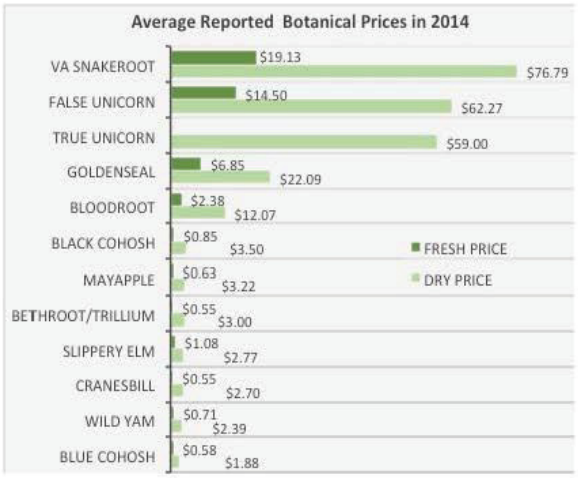
One of the advantages of repeating the study each year is that we can see how trade volume changes over time. The table below represents changes in output for the top three most commonly purchased products between 2013 and 2014, based on people who returned surveys both years (Fig.4). Black cohosh dropped from the previous year. Buyers bought more bloodroot in 2014, and we saw a slight drop in goldenseal.

PRODUCT	CHANGE IN AMOUNT BOUGHT FROM 2013-2014
BLACK COHOSH	-18%
BLOODROOT	+20%
GOLDENSEAL	-5%

(FIG.4)

PRICES

For the first time last year, we asked people to estimate the average price paid to harvesters for the plants on our list in 2014 (Fig. 5). The price per unit does not necessarily reflect the value of the plant itself. Virginia snakeroot had the highest price, but the root is small, whereas slippery elm bark and black cohosh are cheaper by the pound, but are larger in size. While we did see variation in prices, it did not seem to be based on location. A few buyers were willing to pay more for products that were sustainably harvested or cultivated, although cultivated products made up a very small percentage of overall volume. Prices vary over the



(FIG. 5)

season and from year to year. As our project continues we will be able to show how prices change over time, something many respondents said they would like to see.

We want to sincerely thank everyone who participated last year. Without your help, this study would not be possible. The more participation we have, the better our results will be.

In addition to our questionnaire, we have been interviewing people who work in the root and herb trade, and we thank those who took the time to sit down and talk with us. These conversations help us improve our survey and understand the results. People working with roots and herbs are the ones who know the history and current state of the business best, and that perspective is important to us. If you would like to participate, you can contact us at any time for more information.

For more results, a list of nontimber forest product resources and a way to take our survey online please visit us at www.rootreport.frec.vt.edu.

If you have any other questions or concerns please contat us.

STEVE KRUGER, RESEARCHER
SKRUGER@VT.EDU | 828 719 9477

JOHN MUNSELL, EXTENSION SPECIALIST

Virginia Tech
Invent the Future

APPENDIX D. PARAMETER ESTIMATES FROM MULTINOMIAL REGRESSION

Table A.1. A number of socio-economic and bio-physical variables were used to predict whether a participating ginseng buyer either bought nothing, bought ginseng, or bought ginseng and other materials.

		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B)	
								Lower Bound	Upper Bound
Bought Nothing	Intercept	-4.205	4.753	0.783	1	0.376			
	Relevant Employment	-0.305	0.139	4.837	1	0.028	0.737	0.561	0.967
	% Not Working	7.957	7.224	1.213	1	0.271	2855.8	0.002	4021891289
	% Forest Commons	0.008	0.032	0.061	1	0.805	1.008	0.947	1.073
	% Ideal Forest	-1.391	2.045	0.463	1	0.496	0.249	0.005	13.693
	Overdose rate	-0.045	0.037	1.476	1	0.224	0.956	0.889	1.028
	Median Earnings	0.000	0.000	0.027	1	0.868	1.000	1.000	1.000
	Poverty Rate	0.058	0.085	0.463	1	0.496	1.059	0.897	1.251
	Population_County	0.000	0.000	1.437	1	0.231	1.000	1.000	1.000
	% On Snap Benefits	-5.384	8.089	0.443	1	0.506	0.005	5.970 E-10	35249
	Non Coal Producing	0.393	0.790	0.248	1	0.619	1.482	0.315	6.973
	Coal Producing	0[b]			0				
	Rural-Urban Continuum Quartile Most Urban	-0.672	1.529	0.193	1	0.661	0.511	0.026	10.232
	Rural-Urban Continuum More Urban	0.481	1.068	0.203	1	0.653	1.617	0.199	13.116
	Rural-Urban Continuum More Rural	-0.629	1.164	0.292	1	0.589	0.533	0.054	5.218
	Rural Urban Continuum Most Rural	0.217	0.914	0.056	1	0.812	1.242	0.207	7.444
	Rural Urban	0[b]			0				
	FIA Region 1	1.228	0.988	1.545	1	0.214	3.414	0.493	23.668
	FIA Region 2	1.390	1.558	0.796	1	0.372	4.015	0.189	85.081
	FIA Region 3	2.932	1.136	6.666	1	0.010	18.760	2.026	173.696
	FIA Region 4	0.051	1.274	0.002	1	0.968	1.053	0.087	12.775
	FIA Region 5	-1.462	2.384	0.376	1	0.540	0.232	0.002	24.822
	FIA Region 6	0.163	1.157	0.020	1	0.888	1.176	0.122	11.370
	FIA Region 7	3.718	1.518	6.000	1	0.014	41.194	2.102	807.194
	FIA Region 8	0[b]			0				
Bought Ginseng	Intercept	-3.042	4.181	0.529	1	0.467			
	Relevant Employment	-0.099	0.091	1.201	1	0.273	0.905	0.758	1.082
	% Not Working	4.218	6.226	0.459	1	0.498	67.921	0.000	13529489
	% Forest Commons	0.037	0.027	1.832	1	0.176	1.037	0.984	1.094
	% Ideal Forest	-1.303	1.804	0.522	1	0.470	0.272	0.008	9.323
	Overdose rate	-0.016	0.027	0.370	1	0.543	0.984	0.933	1.037

	Median Earnings	0.000	0.000	0.455	1	0.500	1.000	1.000	1.000
	Poverty Rate	-0.101	0.090	1.251	1	0.263	0.904	0.757	1.079
	Population_County	0.000	0.000	2.736	1	0.098	1.000	1.000	1.000
	% On Snap Benefits	8.756	8.037	1.187	1	0.276	6347.011	0.001	44024558326
	Non Coal Producing	0.754	0.695	1.176	1	0.278	2.125	0.544	8.301
	Coal Producing	0[b]			0				
	Rural-Urban Continuum Quartile Most Urban	-1.679	1.527	1.210	1	0.271	0.187	0.009	3.718
	Rural-Urban Continuum More Urban	0.022	0.870	0.001	1	0.980	1.022	0.186	5.619
	Rural-Urban Continuum More Rural	-0.549	1.016	0.292	1	0.589	0.577	0.079	4.227
	Rural Urban Continuum Most Rural	0.888	0.717	1.532	1	0.216	2.430	0.596	9.913
	Rural Urban	0[b]			0				
	FIA Region 1	-0.779	0.781	0.996	1	0.318	0.459	0.099	2.119
	FIA Region 2	-2.012	1.589	1.604	1	0.205	0.134	0.006	3.009
	FIA Region 3	0.251	0.952	0.069	1	0.792	1.285	0.199	8.310
	FIA Region 4	-1.199	1.060	1.279	1	0.258	0.301	0.038	2.409
	FIA Region 5	-1.682	1.973	0.727	1	0.394	0.186	0.004	8.888
	FIA Region 6	-1.540	0.994	2.398	1	0.121	0.214	0.031	1.505
	FIA Region 7	0.187	1.565	0.014	1	0.905	1.205	0.056	25.872
	FIA Region 8	0[b]			0				

a. The reference category is: Bought Non-Ginseng Medincinals

b. This parameter is set to zero because it is redundant.