Chapter 5
Forest Ecosystem Services: Provisioning of Non-Timber Forest Products

James L. Chamberlain, Gregory E. Frey, C. Denise Ingram,
Michael G. Jacobson, Cara Meghan Starbuck Downes

INTRODUCTION AND BACKGROUND

The purpose of this chapter is to describe approaches to calculate a conservative and defensible estimate of the marginal value of forests for non-timber forest products (NTFPs). "Provisioning" is one of four categories of benefits, or services, that ecosystems provide to humans and was described by the Millennium Ecosystem Assessment (MEA 2005) as "products obtained from ecosystems," which include food, fuel, wood, and fiber, as well as products such as remedies and crafts. Clearly, any valuation of ecosystem benefits must include the tangible items, or products, that they supply.

There are very few valuation studies of NTFP provisioning. The main reason is that NTFPs—which are also called "special forest products" in the United States—are typically secondary in importance to timber, so they lack the profile and attention wood products receive. In the United States, forest valuation is almost always based on timber production and a few other items such as grazing, minerals, or hunting leases. Timber price and quantity data have been tracked for many years and are easily available. In contrast, data are available for only a few NTFPs even though there is a wide variety of products and markets. Quality data related to geographic and temporal distribution of NTFP species and their harvests are quite limited.

Most studies of NTFPs report methodological roadblocks in getting reliable and accurate values. The basic information needed to estimate NTFP values begins with some sort of accounting of the flow or stock of the resource. Typically, values are estimated based on prices received by harvesters, although the contributions that NTFPs make to harvesters' income, diet, and health also represent values to households and communities. Non-market valuation based on these types of contributions, while not easy, has been used in the absence of market prices.

Ecosystem service valuation studies should use past research as a starting point. While a comprehensive literature review is beyond the scope of this chapter, appendix 5.1 summarizes select valuation studies of NTFPs in the United States and around the world. Appendix 5.1 presents studies that may be relevant for an analyst attempting to value NTFP provisioning services.

Definitions

NTFPs come from plants (e.g., herbs, lichen, moss, shrubs, trees, vines) and fungi (e.g., mushrooms). They include food, medicine, decorations, and materials used in fine arts and crafts. Table 5.1 lists common NTFPs from the U.S. South. These products often are collected and consumed for personal and cultural uses (Cordell and others 2012, Robbins and others 2008) and provide significant economic contributions to users in the United States (Alexander and others 2001, Alexander and others 2011).

As the term NTFP specifies, these products are not timber and come from forests. This leads to questions about the definitions of "timber" and "forest." This publication considers industrial wood chips and poles to be timber products, while wood extracted for traditional firewood and artisanal crafts are considered NTFPs. Definitions and quantification methods focus on goods produced from natural forests (e.g., Adepoju and Salau 2007, Famuyide and others 2013, Godoy and Lubowski 1992, Sullivan 2002), but they could be used for products grown in plantations solely for their non-timber value. Often, products grown in tree plantations or cultivated on an industrial scale, such as fruits, nuts, or Christmas trees, are not considered NTFPs, yet the valuation methods presented are applicable to these products.

Non-biotic products that may come from the forest, such as rocks and minerals, are not classified as NTFPs. In some parts of the world, animal products such as game meat are considered NTFPs, but in the United States, wildlife is generally treated as a separate category. We do not deal with animals or animal products here, restricting NTFPs to plants and fungi, although many of the same principles would apply. For more information on the valuation of wildlife for recreation such as hunting, see chapter 2.

Many past studies on NTFPs report "total market value" or "economic value." Total market value is the total quantity harvested or traded in a locality, State, region, or country, multiplied by its market price. Economic value refers to the sum of the consumer and producer surplus for a good or service. While such estimates may provide information about the overall importance of NTFPs in a particular economy or policy changes that affect the entire source of a product, they are not described

Table 5.1—Major non-timber forest products of the Southern United States

Product	Part of plant	Market segment
Pine straw	Needles	Landscaping
Pine cones	Cones	Decorative
Conifer boughs	Boughs	Decorative
Sweet grass	Stem	Art
Sphagnum moss	Whole Plant	Art
Mistletoe	Whole Plant	Art
Vines	Stem	Decorative
Maple syrup	Sap	Culinary
Ramps	Whole Plant	Culinary
Fox grapes	Fruit	Culinary
Galax	Leaves	Decorative
Moss	Whole Plant	Decorative
Grape vine	Vine	Art
Dutchman's pipe	Vine	Art
Mountain laurel	Whole Plant	Landscaping
Winterberry holly	Leaves and Berries	Decorative
Pitcher plants	Whole Plant	Decorative
Aletris	Root	Medicinal
Bethroot	Root	Medicinal
Black cohosh	Root	Medicinal
Bloodroot	Root	Medicinal
Blue cohosh	Root	Medicinal
False unicorn	Root	Medicinal
American ginseng	Root	Medicinal
Goldenseal	Leaves & Root	Medicinal
Lady's slipper orchid	Root & Whole Plant	Medicinal
Saw palmetto	Fruit	Medicinal
Slippery elm	Bark	Medicinal
Virginia snakeroot	Root	Medicinal
Wild yam	Root	Medicinal
Black cherry	Bark	Medicinal
Trillium	Whole Plant	Medicinal
Autumn olive	Fruit	Culinary
Pawpaw	Fruit	Culinary
Black walnut	Fruit	Culinary
Tulip poplar	Bark	Decorative[a]
Persimmon	Fruit	Culinary
Butternut	Bark	Medicinal
Eastern red cedar	Leaves	Medicinal
Witch hazel	Bark & Leaves	Medicinal
White oak	Bark	Medicinal
Sassafras	Leaves	Culinary
Morels	Fruiting Body	Culinary
Other mushrooms	Fruiting Body	Culinary
Princess pine	Whole Plant	Decorative
Spanish moss	Whole Plant	Decorative
Staggerbush/ Crooked-wood	Branch & Stems	Decorative
Blueberries/ huckleberries	Fruit	Culinary
Blackberries	Fruit	Culinary
Fraser fir transplants	Whole Plant	Landscaping, Decorative[b]
Rhododendron/ azalea transplants	Whole Plant	Landscaping
Cypress knees	Stems	Art
Wood for carvings	Wood	Art
Wood for baskets	Wood	Art

[a]Tulip poplar bark is used for siding for houses.
[b]Fraser fir is used extensively for Christmas trees.

in this chapter. Rather than total values over a geographic region, this chapter explains how to find the best estimate of *per-acre* values resulting from small changes in forest area, or marginal value. This type of information is the most relevant for policy decisions that affect a limited forested area, as well as for tracking changes in the value of provisioning services over time.

Market participants who move NTFPs from forest to the first point of sale are generally called "harvesters" (alternatively, "collectors," "pickers," "gatherers"). They are analogous to "loggers" in the timber industry. Harvesters can be an important source of information about NTFP activities. They represent the primary knowledge base to locate the resource, provide extraction rates, and identify what the market wants and what prices can be obtained for different qualities of products. They observe changes in the forests that they know are critical to sustaining their livelihoods as well as the continued existence of the NTFP resource. Harvesters are the foundational players that initially define the market structure. They gather the products and consume, share, or sell the products as raw materials.

"Dealers" can play a key role in setting the prices and value received by harvesters of NTFPs. Dealers can be sub-classified into "primary buyers" who purchase directly from harvesters, consolidate transactions, and sell to regional or national buyers. "Secondary buyers" may consolidate transactions and sell to national or international buyers, or they may produce a final product for retail consumers. "Third buyers" in the market would then produce a final product for the retail consumer. The "final buyer" in the market chain typically is the retail consumer.

Greenfield and Davis (2003) found dealers of medicinal forest products (e.g., American ginseng), floral products (e.g., galax) and edible forest products (e.g., ramps) to operate full time, seasonally, and part time depending on the product. Some prices are reported daily by the dealers (ginseng) while others are set seasonally by buyers (e.g., galax and bloodroot). Blatner and Alexander (1998) and Schlosser and Blatner (1995) found that data on industries engaged in the marketing, processing, and distribution of NTFPs in the Pacific Northwest were limited due to the small, informal characteristics of NTFP markets and high price variability.

NTFPs can be produced by a continuum of forest management intensities. Those for which little or no management occurs are "wild-harvested" from natural populations. "Managing wild populations" does not mean establishing a species in a forest, but it does mean undertaking activities that favor a species or individuals over others to increase yield or quality of product. Intentionally establishing and maintaining NTFP species within a forest is called "forest farming." Forest farming can take numerous approaches, including "wild-simulated," a low-input method of establishing NTFPs with only minimal alterations and management, and "woods-cultivated" or "woods-grown," which refers to more intensively established and managed systems.

Conceptual Model

The value of a provisioning ecosystem service is not the same as the value of a product. To see this, consider that all NTFPs are the result of a combination of production inputs that include at least ecosystem functions and human effort. The value of the provisioning ecosystem service is most clearly understood to be that portion of the products value that is due to ecosystem function, that is, the "residual value" after factoring out human and other production inputs. We remind the reader that the measure of value we demonstrate here is the *marginal* value. Where competitive markets exist, market price is the best starting point for determining marginal values.

Smith and others (2010) describe an appraisal system for estimating the residual value of NTFPs, based on wholesale prices and total harvest cost, which is used by some National Forests. An NTFP cost analysis program was initiated by Region 6 (Pacific Northwest) of the National Forest System in 2000 in response to national legislation that required the National Forests to charge "fair market value" for harvest permits (Smith and others 2010). The tool provides an Excel spreadsheet model that uses a residual-value appraisal of permitted products (Smith and others 2010, USDA Forest Service 2016). The residual value appraisal uses data from interviews with harvesters on delivered wholesale market prices for products and all associated harvest costs to achieve fair and unbiased base rates or a minimum fee for permits. While this tool only includes information related to products common in the Pacific Northwest, a similar approach, as described in this and following sections, could be used to find residual values in other parts of the country.

Timber stumpage—the price per acre of standing trees before harvest—roughly corresponds to a provisioning ecosystem service marginal value (Alexander and others 2002a). Sometimes, harvesters may pay landowners per acre to harvest an NTFP on their property, in the same way loggers pay stumpage fees, or hunters pay per-acre lease fees, to landowners. If the landowner has not invested any time or resources into the production of that NTFP, then this per-acre price is the same as the ecosystem service marginal value: it is stated on a per-acre basis and already has other production inputs factored out. Cases where rights to harvest NTFPs are paid on a per-acre basis are relatively rare, but this system is used occasionally for a few products such as pine straw and saw palmetto. Forest managers of public and private lands have many options in deciding how to allocate harvest rights for non-timber products (Alexander and Fight 2003).

Cases where no such per-acre transaction occurs and the observed price is per unit of harvested product are more common. In such cases, the analyst must factor out of the price all human inputs including harvest, establishment, and management costs (Godoy and others 1993) to obtain an estimate of value for the ecosystem function portion of the production inputs. This approach is similar to what economists define as net present value (NPV). Equation (1) presents the basic NPV formula (see Alexander and others 2002a):

$$NPV = \sum_{i=1}^{t} \frac{P_i \cdot MQ_i - (EC_i + MC_i + HC_i)}{(1+\rho)^i} \qquad (1)$$

where:

NPV = the per-acre net present value over the "rotation" period t, on forest land of a given forest type and ownership class

t = the time period of the NTFP production "rotation" (time from establishment to final harvest)

ρ = the discount rate

MQ_i = the quantity of NTFP produced in year i on a marginal acre of forest land of a given forest type and ownership class (see "Valuation of Marginal Changes in NTFP Provisioning Services" later in this chapter)

P_i = the market price or other estimated shadow price per unit of NTFP at the first point of sale in year i (see "Estimation of Production Costs" later in this chapter)

EC_i, MC_i, and HC_i are the establishment, management, and harvest costs per unit in year i (see Scaling Up/ Aggregating" later in this chapter).

Typically having an annualized value ($ per acre per year) would be preferable. Indeed, much of the present guidance is based on the idea of an annual flow of goods and services. In the (relatively unusual) case that an NTFP is established, managed, and finally harvested at one time (e.g., forest-farmed American ginseng), the NPV from equation 1 is first converted to an infinite-horizon soil expectation value (SEV) as shown in equation 2, then annualized into equivalent annual income (EAI) by multiplying by the discount rate (c.f. Alexander and others 2002a) (eq. 3):

$$SEV = \frac{NPV}{(1+\rho)^t - 1} \tag{2}$$

$$EAI = SEV \cdot \rho \tag{3}$$

In other cases, NTFPs are harvested from the same plot annually. Such might be the case for fruits, or if only a small quantity of product (approximately equal to the annual growth of the product) is harvested. Perhaps the most common case is wild-harvesting, where there are no establishment or management costs, so equation 1 simplifies to (c.f. Godoy and others 1993):

$$EAI = (P - HC) \cdot MQ_{An} \tag{4}$$

where MQ_{An} is the marginal annual quantity harvested per acre on a sustainable basis.

If current harvest were so high as to be unsustainable, current estimates of value would overstate annual contributions to NPV, so estimated NPV should be adjusted down if current harvest levels are considered unsustainable. Godoy and others (1993) suggest adding a depletion premium to the harvest costs in the case of unsustainable harvest. Alternatively, one could adjust the marginal annual quantity harvested by the amount of the overharvest (O*h*):

$$EAI = (P - HC) \cdot (MQ_{An} - Oh) \tag{5}$$

NTFPs are most commonly priced as delivered (to primary buyer) or as roadside prices. Since delivered or roadside prices are marginal values for a product that has had value added through harvest and transport, they are an overestimation of the forest's provisioning service value. In many cases, harvest costs are primarily comprised of the opportunity cost of labor. If the analyst can reasonably assume that other harvest costs are minimal, and if it would be costly to collect the data required to adequately estimate those harvest costs, the analyst could defensibly argue that harvest costs are virtually zero, simplifying equation 1 further to:

$$EAI = P \cdot MQ_{An} \tag{6}$$

Unfortunately, since this last equation unambiguously overestimates the ecosystem service value (harvest cost must be non-zero), it does not meet the principle of finding a conservative estimate when uncertainty exists. For this reason, it is a best practice to find a reasonable estimate of harvest costs. These can be assessed through methods such as interviewing harvesters or utilization studies, as described in the "Estimation of Production Costs" section.

Challenges

NTFPs are found in most forests but are often neglected and not recognized in forest policies or management. One reason for this is that very little is known about the production, markets, industry, trade, and contributions to society of NTFPs. Realizing the actual contribution and value of NTFPs would likely enhance their status and generate greater attention in forest policy and management decisions. This section discusses the shortcomings of available data on the quantities and values of NTFPs in the U.S. South.

Valuing the ecosystem service of provisioning NTFPs presents numerous challenges compared to valuing the service of provisioning timber. First, NTFPs may be traded in formal or informal markets or used for personal benefits with no markets (McLain and others 2008). For products that are traded in formal markets, a convenient starting point for valuation is the market price, based on available transaction records and data on price and quantity. For NTFPs traded through informal markets, prices and quantities may not be tracked or recorded. Informal markets are less transparent, and the trade of many NTFPs occurs in the transitional region between formal and informal markets. Many NTFPs are consumed by harvesters or their family and friends with high cultural or recreational values placed on the act of collection or consumption. Finding the correct way to estimate and add together these values is not easy.

Second, NTFPs may be poached from natural forests or stolen from forest farms. Valuable products, such as ginseng, are reportedly poached frequently and extensively. Other products may be harvested without permits or permission, or out of season.

This illegal harvest production is not documented, but it certainly has value that affects States' economies. Law enforcement agencies may keep records that could help document the amount of NTFPs illegally harvested, yet this represents an unknown portion of the total illegal harvest. We do not provide guidance here about how to estimate value of poached products, but it is clear that when poached NTFPs are excluded from valuation, the resulting total values are certainly underestimates.

Third, scalability of research is a challenge. Results of many local level studies are not scalable to State, regional, or national levels. Findings and recommendations from studies that focus on local ecological or sociological systems are difficult, if not impossible, to apply to larger geographic areas. This may be because the locations chosen for NTFP valuation are not representative of the broader region. Survey respondents may be drawn from sampling frames that are particular to case study locations and markets, making survey results difficult to extrapolate to a State or region. Inadequate sampling of plant populations may not provide full representation from all forest types. Attaining an accurate sample of an entire forest or region may be difficult due to funding or accessibility issues.

Geographic variability in the presence and frequency of specific NTFPs, even within the same forest type, makes it very difficult to impute NTFP values on specific acres. Any particular acre might have more or less NTFP quantity than the average. Further, even if product is available, its value may be diminished by factors that make it less accessible or more costly to harvest. These factors are difficult to estimate with existing data.

Fourth, most studies have been one-time efforts and therefore do not provide the information required for trend analysis. Most NTFP valuations could be considered one-time spot reports that become outdated with changing economic conditions. Only a few NTFPs, such as American ginseng, are regulated and monitored, resulting in time series data. The importance of temporal data is that NTFP markets and trade fluctuate with changes in demand for "natural" products, as does the biological production cycle given external vagaries such as weather. Many NTFPs have only had one, if any, formal valuation study and more often than not the valuation is many years old (Blatner and Alexander 1998). Survey data and value estimates from one point in time do not account for variation in supply and demand.

There are numerous challenges with measuring quantities and prices received for NTFPs in the forest. Problems with quantification relate to both biological and social conditions. Many NTFPs are seasonal, so there may be a very short amount of time to adequately quantify, interview harvesters, and assess product value. Ramps (*Allium tricoccum;* wild onions) are a good example, as they are available for harvest for only a few weeks during the year. When interviewing people about how much they harvest or what prices they receive, the timing and location of interviews are important. During the season, when recollection is best, harvesters may not want to be bothered or may be too busy to respond to requests for information. If outside the season, recollection may be more challenging. NTFP harvesting is a part-time seasonal occupation for many people who combine it with other more formal employment. The diversity of NTFP harvesters makes it challenging to sort out who is doing what.

The NTFP industry depends a lot on trust, and market participants are wary of outside surveys and interviews (Greenfield and Davis 2003). Harvesters, buyers, and other market players are reluctant to provide information especially when they are unsure of how it will be used. Harvesters may be reluctant to share information if they do not trust the interviewer to protect their knowledge. People involved with NTFP markets may be reluctant to provide reliable information if they are concerned about the product becoming regulated or losing competitive advantage. In addition to these factors, survey response rates may be low due to the nature of the business.

A partial accounting of harvest volumes can be obtained from the permitted harvests on public lands such as National or State forests. However, these data often have limitations. The product categories of the USDA Forest Service (National Forests) "cut-and-sold" reports often are too general to identify species. For example, the product code "foliage" is used across all National Forests. This code is applied to products sold to the floral industry, but there is no way to identify the species harvested.

IDENTIFICATION AND SELECTION OF NTFPS FOR VALUATION

Almost any plant or fungi gathered by the occasional forest visitor could be classified as a non-timber forest product for personal use. NTFPs gathered for personal use may be associated with specific market segments (food, medicine, decorations) or not (spiritual gain, luxury, subsistence, or recreation) (Emery and Pierce 2005). Southern forests also are the source of a plethora of medicinal herbs for a multi-billion dollar international market that has contributed to the region's economy since trade began with Europe, Asia, and other parts of the United States. Sassafras roots, harvested from what is now Martha's Vineyard, were formally traded in the global herbal market as early as the 1600s. Other NTFPs also have a long history of trade; for example, the longleaf pine forests of the Southern United States were a global source of pine resin and associated products from colonial times until the early 20th century.

Today, non-timber products are harvested from the forests of every Southern State. Table 5.1 provides examples of common non-timber forest products found in the region.

Some forest types, because of their biological diversity, have more NTFPs than other forest types. For example, the Appalachian hardwood forests are high in diversity and have many different medicinal forest products. However, we recommend focusing valuation efforts on the NTFPs that are most significant to each State. As knowledge and expertise about NTFPs increase, and the infrastructure and resources to value NTFPs improve, then additional products can be evaluated.

In this section, we discuss key information required to identify and select NTFPs for valuation, including commercially and non-commercially harvested NTFPs. Major market segments are identified to allow for categorizing products by their purpose. States also may find it useful to classify and prioritize NTFPs for valuation by forest type. Forest ownership is discussed to allow for further segmentation of analysis. Finally, we present criteria for selection of NTFPs for valuation.

The decision tree in figure 5.1 provides a framework for selecting priority NTFPs for valuation.

Without actually knowing the values of NTFPs in the State a priori, decisionmakers may need to rely on expert knowledge to select priority products for valuation. This can be accomplished by convening a diverse group of practitioners, researchers, and managers who can provide insights and recommendations. These experts may also provide valuable advice toward identifying data sources, and, if necessary, sampling and survey methodologies. Their knowledge of harvest routines and market structure will facilitate the selection of an efficient sampling strategy. Discussions should cover non-commercial values, as these may tend to be overlooked in comparison with commercial values.

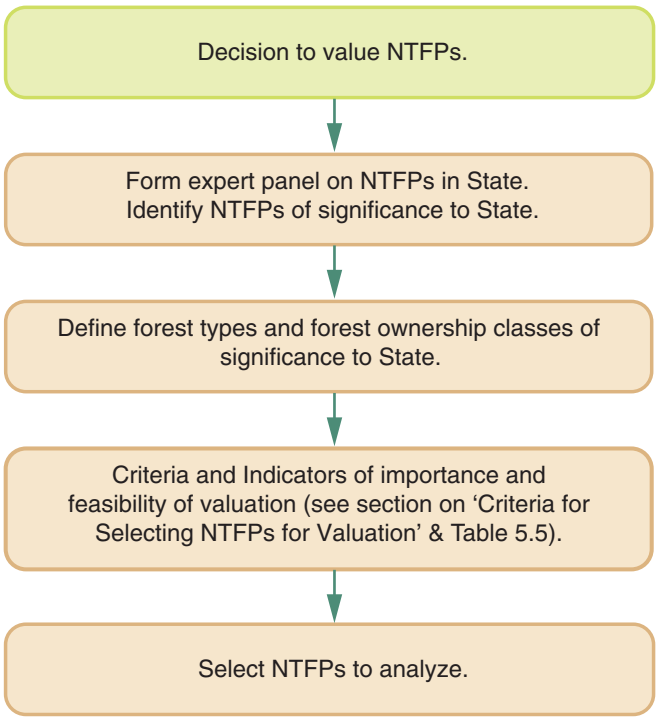

Figure 5.1—Decision tree that provides a framework for selecting priority NTFPs for valuation.

Market Segments of NTFPs

There are many ways to classify non-timber forest products. In general, NTFPs can be classified into five broad market segments (based on Chamberlain and others 1998): (1) culinary; (2) medicinal; (3) decorative; (4) nursery stock and landscaping; and 5) fine arts and crafts. Additional categories may evolve as knowledge about this industry develops. A brief summary of each segments is provided below.

Culinary forest products—Edible forest products include berries, nuts, saps, ferns, tubers, and bulbs. In the South, ramps are one of the most popular edible forest products found in the mountains. Edible fungi, particularly mushrooms, also are well-documented edible forest products. The geographic distribution of edible forest products is dependent on ecological conditions. Maple syrup is primarily produced in the Northeastern United States, from Ohio to Maine, but production extends south into Virginia. Many edible forest products are collected for personal consumption, although there are markets also for most products, such as the nuts of black walnut (*Juglans nigra*), which are harvested throughout the tree's natural range (Chamberlain and others 1998).

Medicinal forest products—The use and trade of herbal medicines derived from forest plants has a long history and may constitute the highest valued segment of the NTFP industry. The American Herbal Products Association (Dentali and Zimmermann 2012) tracks 21 plant species that are used in commerce. Table 5.2 summarizes information on 13 that are native to eastern hardwood forests. As previously noted, the markets for these products vary with changes in demand. Some products have increased in volume harvested (black cohosh [*Actaea racemosa*], slippery elm [*Ulmus rubra*], trillium [*Trillium erectum*]), while others have decreased (saw palmetto [*Serenoa repens*], bloodroot [*Sanguinaria canadensis*]). The roots of American ginseng (*Panax quinquefolius*) have been harvested from eastern hardwood forests for over 250 years. Nineteen States are certified by the U.S. Fish and Wildlife Service to export wild-harvested ginseng. Of those, seven are located in the South (table 5.3). Saw palmetto, which is used to treat benign prostatic hyperplasia, is sourced primarily from the pine forests of Florida (table 5.4).

Table 5.2—Average annual harvest of medicinal forests products tracked by American Herbal Products Association and found in southern forests

Latin name	Common name	Plant part	Average annual harvest[a] 2001–2005	Average annual harvest[a] 2006–2010	Percent change
Actaea racemosa	Black cohosh	Root	224,072	284,162	26.8%
Aletris farinosa	White colicroot	Root	1,012	690	-31.9%
Aristolochia serpentaria	Virginia snakeroot	Root	121	43	-64.2%
Caulophyllum thalictroides	Blue cohosh	Root	6,651	5,169	-22.3%
Chamaelirium luteum	Fairywand	Root	4,688	4,541	-3.1%
Cypripedium spp.	Lady's slipper	Whole plant	51	48	-4.3%
Dioscorea villosa	Wild yam	Tuber	33,422	37,692	12.8%
Hydrastis canadensis	Goldenseal	Root & Leaf	73,619	74,708	1.5%
Panax quinquefolius	American ginseng	Root	62,294	63,461	2.0%
Sanguinaria canadensis	Bloodroot	Root	24,823	5,056	-79.6%
Serenoa repens	Saw palmetto	Fruit	3,293,377	2,432,841	-26.1%
Trillium erectum	Red trillium	Whole plant	1,099	1,445	31.5%
Ulmus rubra	Slippery elm	Bark	182,435	304,207	66.7%

[a]Average annual wild harvest (pounds dry weight) for 5-year periods.

Sources: AHPA (2012) and Chamberlain and others (2013b).

Table 5.3—Volume by weight in pounds of dry wild American ginseng harvested by States

State	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Total
Alabama	457	1,025	749	221	761	318	717	1,345	474	454	476	626	7,623
Arkansas	2,073	2,632	1,770	504	927	989	1,190	1,796	1,195	487	238	1407	15,208
Georgia	266	426	263	402	167	280	406	293	212	158	361	346	3,580
Kentucky	15,085	22,583	16,717	9,392	13,713	11,345	11,839	19,246	15,041	13,176	15,276	20,025	183,439
North Carolina	8,790	6,548	4,271	5,602	7,060	12,378	11,402	10,531	8,041	9,716	8,765	7,849	100,953
Tennessee	5,815	10,826	8,690	5,280	8,153	8,695	8,435	14,642	11,464	9,322	10,145	13,867	115,334
Virginia	3,801	4,675	3,435	1,571	2,878	3,050	2,918	4,081	3,610	3,856	4751	4370	42,996
Total	36,287	48,715	35,895	22,973	33,659	37,055	36,908	51,934	40,037	37,169	40,012	48,490	469,133

Table 5.4—Volume by weight in pounds of dry saw palmetto berries

	Wild harvested dried (pounds)	Conversion factors	
		Times 2 for under-reporting[a]	Times 3.3 for fresh fruit (pounds)[b]
1997	1,253,280	2,506,560	8,271,648
1998	1,966,685	3,933,370	12,980,121
1999	1,082,594	2,165,188	7,145,120
2000	4,663,613	9,327,226	30,779,846
2001	2,206,157	4,412,314	14,560,636
2002	2,877,519	5,755,038	18,991,625
2003	3,397,465	6,794,930	22,423,269
2004	2,918,940	5,837,880	19,265,004
2005	5,786,806	11,573,612	38,192,920
2006	2,277,504	4,555,008	15,031,526
2007	4,199,685	8,399,370	27,717,921
2008	2,644,813	5,289,626	17,455,766
2009	1,581,106	3,162,212	10,435,300
2010	1,461,125	2,922,250	9,643,425
Total	38,317,292	76,634,584	252,894,127
Average	2,736,949	5,473,899	18,063,866

[a] Industry representative estimates that reported harvest volumes are one-half what is actually harvested.

[b] A factor of 3.3 is the standard for converting from dried to fresh product.

Source: Dentali and Zimmermann (2012).

Decorative forest products—Many forest plants and their parts are used in decorative arrangements, to complement and furnish the backdrop for flowers, and as the main component of fresh and dried ornaments. The end uses for forest-harvested floral decoratives include fresh/dried flowers, greenery, basket filler, wreaths, and roping. Galax (*Galax urceolata*) from western North Carolina is an iconic floral product from the hardwood forests. The city of Galax, Virginia, is named after the plant, reflecting its historical importance to the local economy. Spanish moss from southern forests also are in this market segment. Conifer boughs may be the most widely sold decorative forest product in the United States (Chamberlain 2000). The products in this category contribute significantly to regional economies. For example, in 1995, the United States exported more than $14 million in forest-harvested moss and lichens, most of which originated from Appalachia and the Pacific Northwest (Goldberg 1996).

Nursery and landscaping forest products—Live forest plants are collected for the nursery and landscaping industry. These may be marketed as bare root stock or balled live plants for direct planting. Common examples include rhododendron (*Rhododendron* spp.), azaleas (*Azalea* spp.), mountain laurel (*Kalmia latifolia*), and the endemic Fraser fir (*Abies fraseri*). The Christmas tree industry has realized tremendous growth over the last decades, due in part to the germplasm from Fraser fir, growing in a very limited distribution in western North Carolina and southern Virginia. Its value to these States could be significant. Pine straw, harvested throughout the South, is used extensively in landscaping. The National forests report the permitted harvests of plant materials used for nurseries and landscaping. In 2013, more than 43 percent of the total recorded harvest in all National forests came from North Carolina. Collection of forest understory wildflowers for horticultural sales is a cottage industry in the southern Appalachian region, and many wildflowers are readily available through internet sales and brick-and-mortar stores (Botanical Wonders Nursery 2015, Cullina 2000, Mainely Crafts 2015).

Fine art and craft forest products—Artisans using non-timber products to craft luxury items find the ingredients for their creations in forest plants. The use of NTFPs for fine arts and crafts is limited only by the artisans' imagination. Wood collected from forests may be formed into carvings, turnings, walking sticks, utensils, and containers. Moss, lichens, and seeds may be formed into jewelry. Vines are crafted into wreaths, sculptures, and statues. Fine baskets are crafted from splints of wood or grass stems. The outlets for these fine arts are varied as well. For some artisans, the preferred venue is local and regional craft fairs. Others may market their products through specialty retail stores or internet based shops. NTFPs used for fine arts and crafts contribute to a multi-million dollar handicraft industry. Determining the proportional value of the provisioning ecosystem service to this industry is problematic because of the challenge of differentiating the value of the forest input from the value of human artistry.

Forest Type Classifications

Each forest type supplies distinct NTFPs. Appendix B of the Forest Inventory and Analysis (FIA) manual for southern forest inventories identifies nine forest types of the South, along with their associated species (USDA Forest Service 2010). These forest types and associated tree species are provided in appendix 5.2 of this chapter. The FIA manual provides information on the tree species found in each forest type, but information on the associated plants and fungi is lacking.

Forest Ownership Classifications

The ownership of southern forests reflects historical and contemporary trends in economic sectors, stakeholder preferences, and technological developments. While the ownership class (public, corporate, family) of forests may affect the quantity of NTFP harvest, harvesting opportunities do exist across these ownership classes (Alexander and others 2011, Butler 2008, Salwasser 2006). Attempts to value NTFPs must consider the resource base and the interactions and impacts of its changing ownership and management. As competition for land continues in the South, changing forest land uses and management practices could impact forest ecosystems in ways

that affect the availability and values of NTFPs. If products become more/less available on private lands, their value from public lands will decrease/increase, as well.

Criteria for Selecting NTFPs for Valuation

Deciding which NTFP or suite of NTFPs to value in each State is the first step in estimating the value of NTFPs in the U.S. South. Harvest activity, demand, and a State's position as a producer of a particular NTFP will help determine whether to value a particular NTFP in that State. The perceived importance to a State's cultural heritage, economy, and ecological diversity should also be criteria for targeting valuation efforts. The criteria and indicators presented in table 5.5 and discussed below provide guidance on deciding which product, or suite of products, to prioritize.

Criterion 1—Amount of harvest by volume. There is little incentive to devote limited resources for valuation of products that have insignificant demand. There needs to be an indication that large quantities, relative to the product's abundance, are being harvested. One good source of the amount being harvested are the National Forest "cut-and-sold" reports (USDA Forest Service 2015a). For example, the National Forests of North Carolina reported that more than 10,000 pounds of forest herbs were harvested in 2014. In the same year, the National Forests in Florida reported 48,000 pounds of "foliage" as being harvested. These harvest quantities suggest that it would be worthwhile estimating the value of these products, starting with determining which species are categorized under these product codes. Other sources of data that might help estimate harvest volumes and identify priority NTFPs are export databases such as the Interactive Tariff and Trade DataWeb (U.S. International Trade Commission 2016).

Criterion 2—Availability of data. The basic data requirements to value a non-timber forest product are the harvested or standing stock volumes, measured in an appropriate unit (e.g., pounds), the prices paid to a clearly identified market player (e.g., harvester, primary buyer, secondary buyer), and the associated costs (labor, capital, transport, processing). Lack of volume, price, or costs data could thwart valuation efforts. However, just because data are not available does not mean that a particular NTFP should be disregarded. If there is evidence of large harvest volumes or values, lack of data may suggest that funding should be allocated to data collection. Potential data sources are listed in appendix 5.3. Further development of sources of data is necessary to value many NTFPs. Perhaps the most valuable type of data would be the amounts of per-acre payments to landowners for the rights to harvest a product, where relevant.

Criterion 3—Amount of potential product stock in State's forests. The forest types, and the amount, found in a State are indicators of the resource base and should be a factor in selecting which NTFP to value. A State with large amounts of pine forests that could be the source of pine straw may want to direct resources to estimating the value of provisioning that product. Upland hardwood forests, mixed mesophytic forests, and Appalachian hardwood forest types (classified as *oak/hickory* group and *maple/beech/birch* group by FIA) have tremendous

Table 5.5—Criteria and indicators for selection of NTFPs to estimate value

Criteria	Indicator(s)
C1. Amount of harvest by volume	I.1 Permit volume reported by National Forests I.2 Permit volume reported by State I.3 Harvest volume reported by industry I.4 Harvest volume reported by regulatory agencies
C2. Availability of data	I.1 Harvest volume reported by regulatory agencies I.2 Number of dealers I.3 Permit volumes reported by National Forests
C3. Amount of potential product stock in State's forests	I.1 Acres of potential habitat, as determined by forest type and other parameters
C.4. State's relative standing as producer or potential producer	I.1 Acres of potential habitat compared to other States I.2 Relative harvest volumes
C.5. Economic importance to specific communities	I.1 Expert social knowledge
C.6. Ecological vulnerability to over-harvest	I.1 Expert ecological knowledge I.2 State's threatened and endangered listings I.3 State's natural heritage listings I.4 Plant's conservation status

plant diversity that provision medicinal and edible plants. In States with large areas of forest types that produce American ginseng (as shown in table 5.6), valuation efforts should include that product. Information about the extent of different forest types in different States is readily available through FIA databases.

Criterion 4—State's relative standing as producer or potential producer. An important criterion for selecting NTFPs to value is the market share that a State realizes from a particular product. A State that is the sole producer, or a major producer, should consider directing more resources to estimating the value or provisioning that product. For example, Florida is the sole, or major, producer of saw palmetto. North Carolina is the sole producer of galax leaves for the floral industry. Efforts by these States to value the respective products would contribute much to a comprehensive valuation of NTFPs in the South. Estimates of the marginal value of forest for production of NTFPs common in other States may be available in reports from those States, assuming that each State directs valuation efforts based on local harvest activities and the local resource base.

Criterion 5—Economic importance to specific communities. The perceived importance of NTFPs to a State's rural economy should be considered in selecting NTFPs to value. How important are these products to rural people of each State? For example, sweet grass baskets from South Carolina are important to the cultural and economic well-being of African-American communities, who can trace this activity to their ancestors. Valuing this product would be important to South Carolina. Communities in western North Carolina and eastern Tennessee depend on annual ramp festivals to generate revenues for fire departments and other civic groups. There are at least 10 ramp festivals in western North Carolina and eastern Tennessee, and people travel for many hours to attend them. Large volumes of ramps are harvested during the spring and sold through the festivals and through farmers' markets, roadside stands, and restaurants. These edible forest products are critical to the rural economy of these States.

Criterion 6—Ecological vulnerability to over-harvest. Priority consideration may be given to forest species that are vulnerable or at risk of over-harvesting or some other stressor that can endanger the product. Common species that are widespread may be less of an immediate concern in valuation. For example, it may be more important to estimate the value of orchids rather than Joe-Pye weed (*Eupatorium purpureum*), both of which are used for their medicinal properties. Orchids are much less common than Joe-Pye weed, and the marginal value of forest for provisioning a relatively scarce product is likely to be higher. Species of ecological concern may be identified from State threatened or endangered lists.

QUANTIFICATION OF NTFP PROVISIONING SERVICES

While the challenges of accurately valuing ecosystem services are numerous, the results depend heavily on quantifying the amounts of NTFPs harvested per acre of productive habitat. Quantification can take the form of an estimate of the total physical standing inventory, or "stock," of each NTFP present; or the rate of harvest, or "flow," from those areas. Most researchers prefer flow measures (Godoy and others 1993, Tewari 2000). The flow approach relies on measuring the amount of NTFPs harvested from a region (e.g., forest, watershed, State) often through reporting of volumes sold to market entities. This provides insight of the volumes of products that enter the market. To estimate values, data are needed on both annual harvest volumes and prices paid to a clearly defined market player (preferably the harvester). In this section, we discuss quantification of harvest volumes and the challenges of estimating the marginal quantity harvested per hectare, following the decision tree in figure 5.2.

There are a few sources (appendix 5.3) of data on the volumes of NTFP harvest in a State, and each has limitations. One major challenge with existing data sources is that none measure or report marginal *per-acre* NTFP flows. They report at the forest, county, State, or national level. Estimating even average per-acre harvest volumes would require knowing how many acres of product are in the forest. This requires inventorying the respective NTFPs. We know of no inventories of standing stocks of NTFPs. Trees within the forest are regularly inventoried, and growth and yield models are developed for many tree species. Trees that provide NTFPs, such as tulip poplar (bark) and slippery elm (bark), can be assessed for their per-acre stock volumes, using FIA database. In general, this information does not exist for forest plants and fungi that are harvested as non-timber products. To

Table 5.6—Area of potential oak/hickory and maple/beech/birch habitat for ginseng by ownership group and State

Ownership group	State							
	AL	AR	GA	KY	NC	TN	VA	Total
National Forest	215,248	1,280,534	541,963	789,820	889,384	572,202	1,486,968	5,776,121
Other Federal	83,871	191,850	104,814	290,252	271,419	486,375	314,118	1,742,698
State and local	200,468	131,427	264,390	208,062	284,177	671,329	381,969	2,141,823
Private	6,604,943	6,281,779	5,543,069	9,300,586	5,926,558	8,659,048	7,886,110	50,202,092
Total	7,104,530	7,885,590	6,454,236	10,588,720	7,371,538	10,388,954	10,069,165	59,862,734

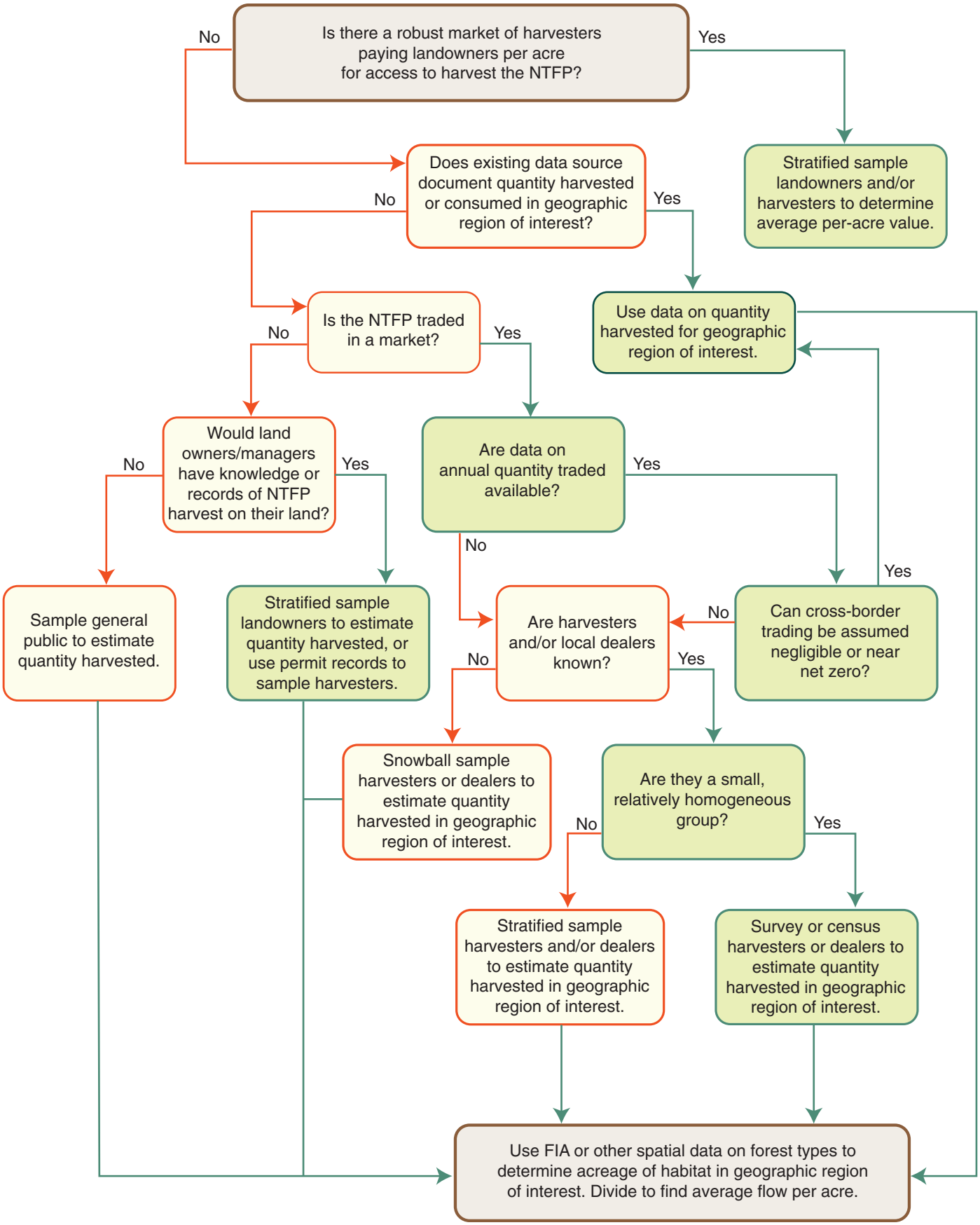

Figure 5.2—Decision tree showing the quantification of NTFP provisioning services.

obtain this information, forest agencies would need to develop methods and protocols to inventory these products. Efforts are underway to develop inventory protocols for some medicinal plants harvested for their roots (Chamberlain and others 2013a, Small and others 2011).

Given this lack of data, and the probable uneven distribution of individual NTFP populations and NTFP harvest within particular forest types, estimating the quantity of NTFP supplied by a "marginal" acre may not be possible at this time. An impact or land-use change on one "marginal" acre may not have any impact on NTFP flows at all, whereas a different acre might greatly impact flows. Thus, the best available estimate of the impact of a marginal change in acreage of forest of a given type on NTFP flows is the per-acre *average* flow for that forest type in a particular geographic region. However, it is important to keep in mind the fact that average and marginal are different measures and to identify conditions under which marginal values are likely to be substantially different than average ones. For example, there might be great geographic diversity where NTFPs are found and also where they are harvested. The areas that provide the highest net value of NTFP flows per acre may be those that are near access points (e.g., roads and trails), relatively closer to towns, and with productive sites, since costs would be lower. Also, the presence (or lack thereof) of sufficient substitute NTFP harvest sites may decrease (or increase) the marginal value of a specific site.

Another issue of particular concern for an ecosystem service valuation is variation in harvest (flow) over time. As table 5.2 demonstrates, aggregate NTFP harvests are quite variable. Variables explaining change in aggregate NTFP harvest levels over time have not been widely researched, but they likely include macroeconomic conditions, weather, and policy (Bailey 1999[16]). The challenge is that most ecosystem service studies estimate values only at a single point in time. That single point in time could be substantially higher or lower than the average, leading to erroneous estimates of the ecosystem service value. At its worst, the ecosystem service value might be based on a level of harvest that is unsustainable, and thus impossible over the long term. If conducting a single point in time estimate, the analyst should consult with individuals within the NTFP sector of interest to determine if the studied year is likely to be an over- or underestimate of the average, and if so, how to adjust it. If current harvest levels are unsustainable, they should be adjusted with a depletion premium (Godoy and others 1993) or by subtracting the amount of the overharvest. The overharvest adjustment would be equal to the difference between the annual amount harvested and the amount of new product that is generated every year.

The main sources of harvest volumes are the National Forests and the U.S. Fish and Wildlife Service. "Cut-and-sold" reports are available from the National Forests since fiscal year 1977 and are based on harvest permits issued by National Forests (USDA Forest Service 2015a). Data on NTFP harvest in the "cut-and-sold" reports for 13 National Forests in 12 Southern States (USFS Region 8) include Christmas trees, limbs and boughs, foliage, mosses, needles, cones (dry or green), transplants, roots, herbs, grass, vines, mushrooms, and other plants among non-convertible removals from National Forests for which a permit is required. Data from "cut-and-sold" reports reflect the permitted harvests amounts on National Forests only. Thus, they may not accurately represent the actual harvest amounts, and they may underestimate harvests for an entire State.

"Cut-and-sold" reports provide information on the volume and value of permitted harvests but not the number of permits. Also, the value of permitted harvests is based on the amount charged for the permit and does not reflect prices paid to harvesters for the product. With few exceptions, the "product" description and species codes do not provide enough information to identify specific species. American ginseng is the exception, though the use of the "species" code that identifies this NTFP is questionable. For example, the National Forests in Florida use the species code for ginseng in reporting "other plant" material harvested in 2014, even though the species is not found in the State. Other National Forests use the species code for ginseng in reporting permitted harvests of "transplants," which is an unlikely use of the product. The National Forest System is aware of these challenges and is making efforts to improve the reporting system. However, even an improved system will provide data on harvests only from National Forests and no other public or private land ownership categories.

State forests may also be a potential source of information about NTFP harvests. Of the 13 Southern States, 7 (Alabama, Florida, Georgia, Kentucky, North Carolina, South Carolina, Tennessee) indicated that NTFP harvest on State forests is allowed, at least in some cases, while 5 (Arkansas, Louisiana, Mississippi, Texas, Virginia) indicated that no NTFP harvest is allowed on any State forest, and one State (Oklahoma) has no lands officially designated as State forests (Frey and Chamberlain 2016). State agency representatives indicated that NTFPs commonly harvested from State lands include pine straw, saw palmetto, pine cones, berries, medicinal plants, and transplants. In the States that allow harvest, activity is controlled by methods such as permits (both free and for a fee), leases, and other contracts (Frey and Chamberlain 2016). Unfortunately, in most cases the fees charged for harvest access are not set by the market, so most likely they bear little relation to marginal values. The quality and accessibility of harvest data from these State forests varies from State to State.

[16] Also see: Frey, G.E.; Chamberlain, J.L.; Prestemon, J.P. 2017. Supply, demand, and regulation of wild American ginseng. Unpublished manuscript. On file with: Gregory Frey, Research Forester, USDA Forest Service, Southern Research Station, P.O. Box 12254, 3041 E. Cornwallis Rd., Research Triangle Park, NC 27709-2254.

Data are available for American ginseng in States that are certified, by the U.S. Fish and Wildlife Service, to export the roots. Ginseng buyers are required to register with the appropriate State agency, keep records of each transaction (volume and harvest location by county), and have ginseng roots inspected and certified by the State agency before the roots can leave the State. The records are sent to State agencies who report annually to the U.S. Fish and Wildlife Service. Web addresses are provided in table 5.7 for appropriate State agencies. Buyers of American ginseng regularly buy other medicinal forest products, but they are not required to report volumes of these other products.

Market Harvest Volumes

Many NTFPs are sold in markets and used, gifted, or bartered by harvesters (McLain and others 2008). When a particular NTFP is primarily harvested for sale, the analyst must decide if the market harvest volume in a State is a reasonable approximation of the total volume. Using only market harvest volumes may leave out some quantities that are never traded and used for personal use by the harvester, but for some products, this might be a negligible amount.

NTFP ecosystem values are produced at the location of harvest. If data on volumes traded are based on the location of sale rather than the location of harvest, the analyst must determine if cross-border (e.g., interstate) trading of NTFPs can be considered negligible or, alternatively, if the trade is roughly equivalent in both directions (net zero). If one of these two assumptions can be made reasonably, then data at location of sale are appropriate for estimating NTFPs harvested in the State. On the other hand, if trade goes mostly one direction (either mostly into or mostly out of a State), then a further survey will be needed to determine the location of harvest.

Using existing data sources—The Southern United States has a dynamic and significant commercial NTFP industry, with active and substantial trade within and across State borders. The States of the South are in many cases the global source of particular non-timber forest products. Yet complete data are not available to fully assess the values of these products. Data are primarily available for medicinal forest products, gathered regularly by the American Herbal Products Association (AHPA). The AHPA surveys its members every 2 years and publishes the findings. To illustrate the significance of the medicinal plant industry in the South, we provide examples based on these findings. In addition to ginseng (described below), the average annual harvest (2006-2010) of another 21 medicinal forest products are tracked by the AHPA (Dentali and Zimmermann 2012). Quantities range from 43 dry pounds of Virginia snakeroot (*Aristolochia serpentari*) to 2.4 million pounds berries of saw palmetto (*Serenoa repens*). Over 14 years (1997-2010), more than 19,730 dried tons of dried saw palmetto berries were harvested, primarily from the forests of Florida (table 5.4). Average annual harvest declined for about half of the products from the 5-year period 2001-2005 to the period 2006-2010.

We provide two examples of the flow (harvest) approach to quantifying NTFPs. First, American ginseng is harvested from forests in seven Southern States, and harvests are well documented. In this example, we start by estimating the total volume of ginseng harvest in each State. Once total volume is estimated, we calculate average volume per acre based on the number of acres of habitat (table 5.6). The wide range across States illustrates the importance of examining market share of a product to determine the urgency of valuing any given NTFP in a particular State. The second example, saw palmetto, is harvested almost exclusively from forests in Florida. Reporting of harvest volumes of saw palmetto is voluntary and facilitated through a biennial (every 2 years) industry survey.

Example: American ginseng—Data on ginseng harvest is available from the U.S. Fish and Wildlife Service, and to a lesser extent the National Forest "cut-and-sold" reports. States first need to determine if this product is worth valuing. An examination of the States that are certified to export ginseng reveals seven Southern States (i.e., Alabama, Arkansas, Georgia, Kentucky, North Carolina, Tennessee, Virginia) that produce significant

Table 5.7—Southern States certified to export American ginseng

State	Ginseng program
Alabama	http://www.agi.alabama.gov/divisions/plant-health/
Arkansas[a]	http://www.aad.arkansas.gov/ginseng-program
Georgia	http://www.georgiawildlife.com/GinsengProgram
Kentucky	http://www.kyagr.com/marketing/ginseng.html
North Carolina	http://www.ncagr.gov/plantindustry/plant/plantconserve/ginseng.htm
Tennessee	http://www.tennessee.gov/environment/article/na-ginseng-program
Virginia	http://www.vdacs.virginia.gov/plant-industry-services-ginseng.shtml

Note: this table provides links to State program Web sites showing the regulations enacted to manage the harvest of American ginseng [Date accessed: October 4, 2017].

[a] On last date of access, the URL listed for Arkansas did not contain information, but it is the official website for the Arkansas ginseng program.

quantities of American ginseng (table 5.2). From 2002 through 2013, more than 469,000 pounds of American ginseng were harvested from the forests of these States (table 5.3). Of these Southern States, western North Carolina, eastern Tennessee, and eastern Kentucky accounted for approximately 85 percent of the southern harvest from 2002 through 2013 (fig. 5.3). Virginia accounted for about 9 percent of the South's total, while Arkansas accounted for about 3 percent.

The importance of ginseng to a State can be further assessed by examining permitted harvests on National Forests. Only four National Forests reported the permitted harvest of American ginseng (table 5.8) and then only for 2009 through 2013. During this period, the total amount of American ginseng harvested from National Forests in the southern United States was approximately 4,450 pounds. The National Forests of North Carolina generated more than 60 percent of this volume. The Cherokee National Forest generated 13 percent of the total volume of American ginseng from National Forests.

The next step in quantifying ginseng flow is to determine the volumes harvested in each State. These data are available through the U.S. Fish and Wildlife Service and can be complemented by National Forest data from the "cut-and-sold" reports. Table 5.3 summarizes volume of ginseng harvest by State and year (2002-2013). State level data can be disaggregated to the county level, while national forest data are for the specific forest.

The challenge now is to determine the per-acre marginal flow of American ginseng. To approximate this with the average production per acre, we need to know how many acres of appropriate habitat are producing ginseng in each State. American ginseng prefers mixed mesophytic forests (e.g., north-facing cove forests) but may be found in similar forest types. FIA classifies this forest type as *oak/hickory group* and *maple/beech/birch group*. Trees found in these groups under which ginseng grows include yellow-poplar, northern red oak, black walnut, black cherry, ash, yellow birch, and red maple. However, because it has been harvested extensively, American ginseng may not appear in forests that should support the plant.

Using FIA databases, we can estimate the area of appropriate forest habitat in each State (table 5.6). To estimate the volume per acre, the best available approximation may be to assume that harvest occurs evenly over the entire area of potential habitat. This assumption will likely lead to an underestimate of the volume per marginal acre where ginseng is actually being harvested.

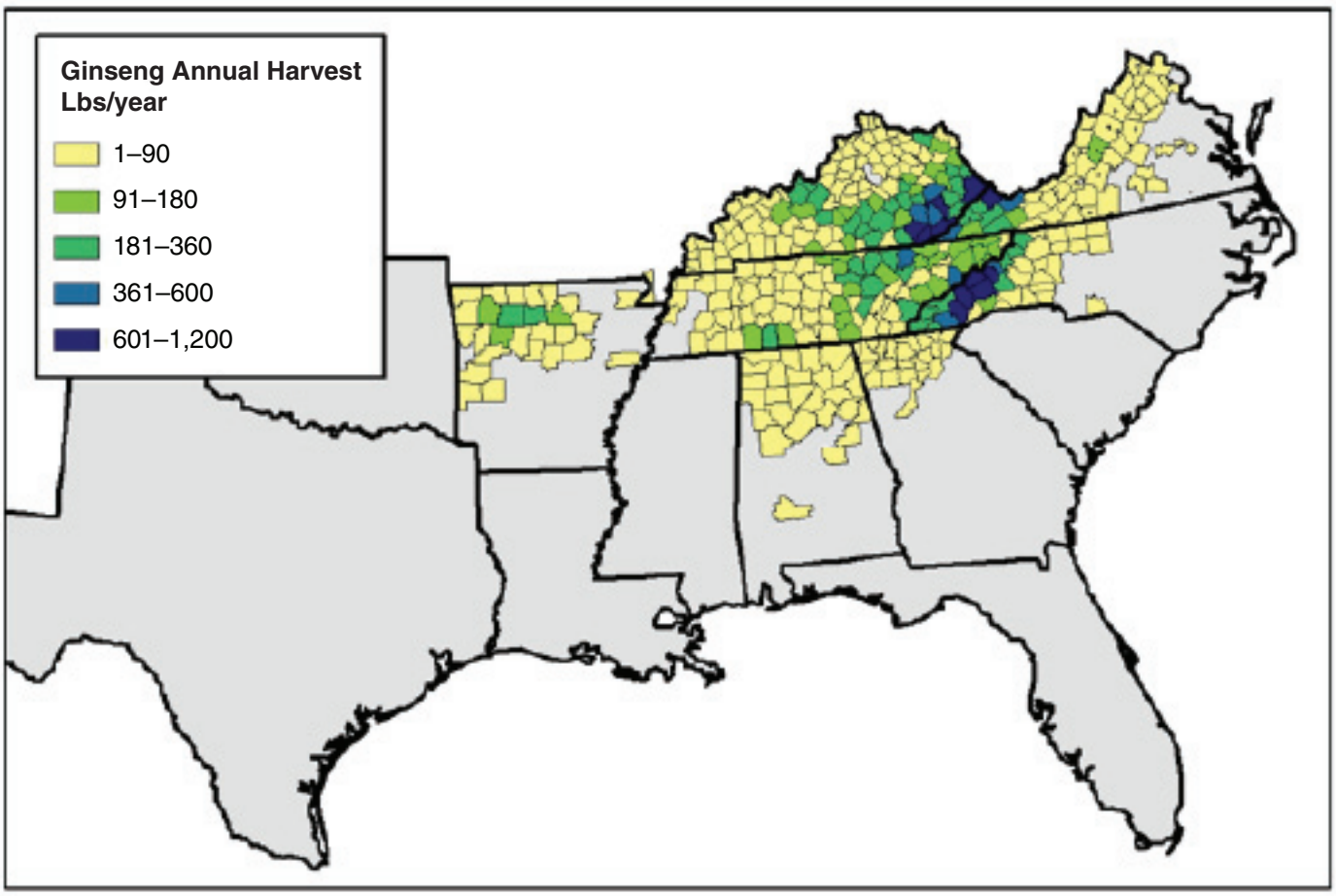

Figure 5.3—Concentration of American ginseng harvest for 2001-2007. Source: Chamberlain and others (2013).

Table 5.8—Pounds of permitted wild-harvested ginseng from National Forests, 2009–2013

State	National Forest	Pounds of permitted wild-harvesting ginseng					
		2009	2010	2011	2012	2013	Total
Georgia	Chattahoochee/Oconee	38	70	29	50	123	310
Kentucky	Daniel Boone	95	74	197	178	132	676
North Carolina	Pisgah/Nantahala	637	417	458	626	728	2,866
Tennessee	Cherokee	55	36	46	58	406	601
Total		825	597	730	912	1,389	4,453

Source: National Forest cut-and-sold reports.

Example: saw palmetto—Saw palmetto is endemic to coastal plains from South Carolina to southeastern Louisiana, including the Florida panhandle. It is found in every county in Florida (Smithsonian Marine Station at Fort Pierce 2015) and is considered a keystone species (Carrington and others 2000). Figure 5.4 shows saw palmetto growing in east Texas and north into Arkansas (Seiler and others 2015). Saw palmetto is a characteristic understory shrub in pine flatwoods, prairies, scrub, and live oak-sea oats communities (Duever 2011, Smithsonian Marine Station at Fort Pierce 2015). It is an indicator of poorly drained soils in pine flatwoods (Tanner and others 1996). The major center of harvesting is southwest Florida (Collier County), although harvesting also occurs in central Florida (Polk and Indian River Counties) and in southeast Georgia (Carrington and others 2000).

The berries of saw palmetto are harvested for their medicinal properties. The American Herbal Products Association includes saw palmetto in its biennial survey of the herbal industry and is the primary source of data regarding harvest volumes. Table 5.4 presents estimated quantity of harvest volumes (HVs) of saw palmetto for 1997 through 2010 as reported by Dentali and Zimmermann (2012). They argue that "under-reporting of saw palmetto berry harvests is a certainty" (Dentali and Zimmermann 2012) and a "reasonable estimate" is that harvest data capture only half of total dry weight. Estimates of harvest volume data are transformed to account for under-reporting (table 5.4). As harvesters are paid for fresh fruit, estimates of dried weight are multiplied by 3.3 (a standard industry conversion rate) to reflect fresh fruit HVs.

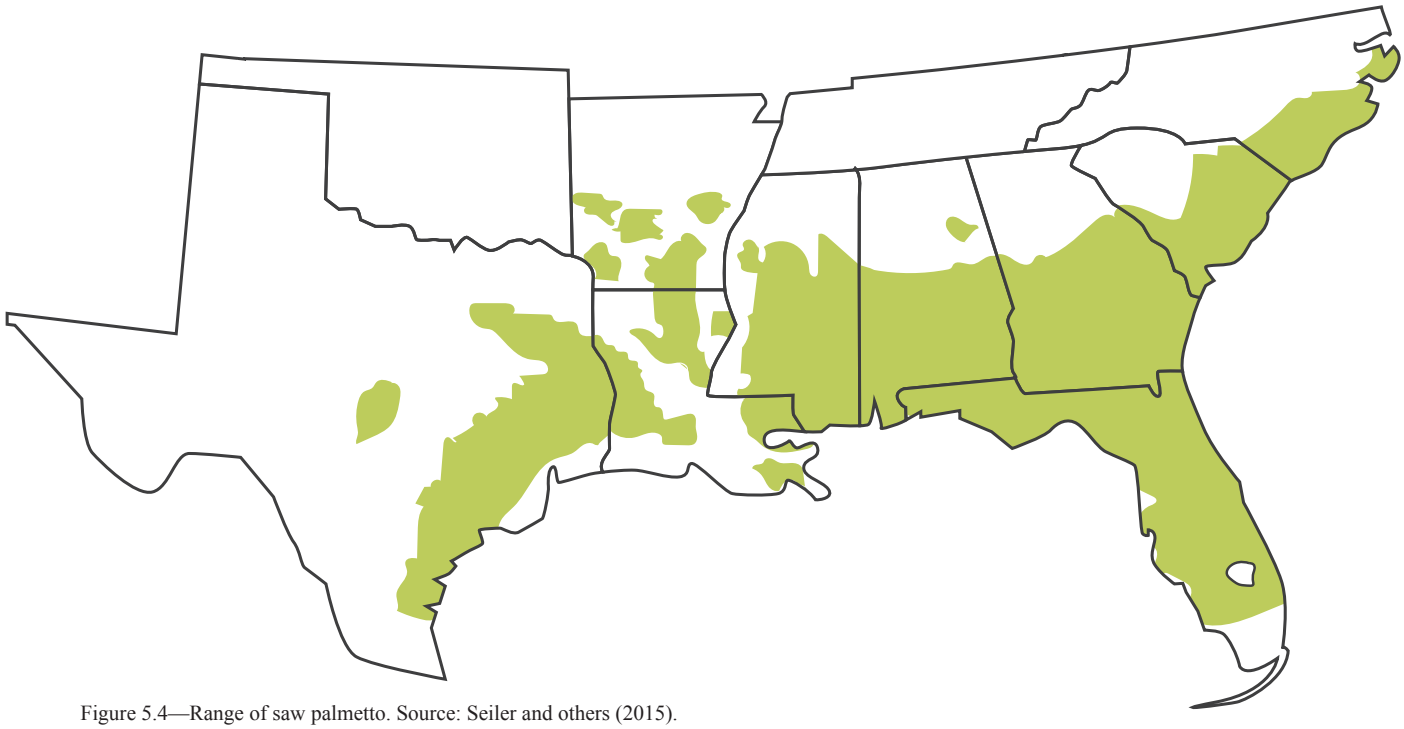

Figure 5.4—Range of saw palmetto. Source: Seiler and others (2015).

Determining per-acre marginal flow of saw palmetto depends on accurate estimates of acreage of the plant and yield per acre. Mitchell (2014) estimated the suitable habitat for saw palmetto in Florida at approximately 9,266,265 acres. We could use this estimate to calculate average harvest per acre if we assume that all available habitats are harvested. An inventory of actual harvest area is needed.

Estimating harvest volumes with no data sources— Determining commercial HVs when there are no data available will require States to survey the industry. Surveying harvesters and primary buyers is probably the best way to get volume estimate at or near "farm gate." Neither harvesters nor primary buyers are easy to identify as there are few if any directories of these market players. Unlike timber processors, there are no sampling frames available for non-timber product enterprises.

Significant thought and care should be put into determining the (human) population of interest and designing a sample frame and sampling technique based on the product(s) of interest. The sampling frame might then be stratified to account for variability in scale of operation, market participant type, sub-regions, and forest type. We present some guidance here on survey design and implementation, but an analyst considering a survey method should review the broader literature on surveys, including Dillman and others (2009).

***Step 1: Identify sources of business information*—**Segmenting the NTFP industry by markets can help to focus development of sample frames. The segments discussed in "Quantification of NTFP Provisioning Services" provide a convenient and consistent framework. For medicinal forest products, the list of ginseng buyers provides a good starting place to craft a sample frame. Ongoing research with the USDA Forest Service and Virginia Tech substantiate that most ginseng buyers also buy other medicinal herbs. Dealers from around the State could be recruited to seek more information and could ask one or two simple questions to harvesters. Other sources of business information include trade associations (e.g., Christmas tree growers, florists and floral decorative, nurseries), U.S. Census Bureau (companies over a certain value are listed), State Chamber of Commerce, and the Internet. Also, some universities may have lists of businesses that have been included in previous studies.

***Step 2: Determine what information is desired*—**Keep the requested information at a minimum and in an easy format to encourage maximum response rates. Surveys that are long and tedious typically do not get good response rates. Simple and straightforward surveys are much more productive.

Step 3: Create a sample frame—This can be a simple list of the market players (i.e., firms, enterprises, companies), with contact information, that you want to survey. This group of buyers can help identify harvesters who bring products from the forest to them. Once the sample frame is completed, maintaining it is less costly.

Step 4: Determine the level of sampling needed to achieve representation of the population—In some cases, where the human population of interest is limited, it may be possible to undertake a census of all market players. In other cases, sampling the population will be necessary. For example, in 2002 there were 11 galax dealers in North Carolina and taking a census of these would be possible. Conversely, there are hundreds of ginseng primary buyers, and sampling the population may be more appropriate. Deciding on which approach to use will be easier once a sample frame has been created.

In some cases, the human population of interest is uncommon among the general population, and population members are unknown to the researchers. In these cases, one of a few methods for sampling rare populations may be used (see: Kalton and Anderson 1986, Wagner and Lee 2014). An example of these sampling methodologies includes "snowball sampling," in which a few members of the population are identified by the researchers and asked to identify associates that are also within the population, a process which is continued until a relatively complete list of individuals is developed (Kalton and Anderson 1986, Wagner and Lee 2014). As an example, ginseng buyers may know other dealers who trade in non-ginseng botanicals, forming the basis for a snowball sample of botanical dealers. An indication that the process has "snowballed" sufficiently to cover the population of interest is when the same people are identified over and over again.

***Step 5: Contact and evaluate non-respondents*—**Once the survey is implemented and responses have been received, efforts should be made to get data from non-respondents. Non-respondents could impact survey results if they represent a large portion of NTFP production. Examining this portion of the sample is critical to ensuring credible reporting. It allows the analyst to determine if the survey represents the population.

Example: pine straw—Pine straw markets operate at various levels of formality and scale. There may be a few large scale producers that collect needles from many properties in a year, as well as numerous smaller scale operations that collect pine straw on weekends or seasonally. Furthermore, there may be many private landowners who collect their own straw and sell to wholesalers or even retail the product directly. With pine straw, stratifying the sample of pine straw collectors into large scale, small scale, and landowners may make sense. Other stratification schemes may be more appropriate for another State. In the subset of large scale collectors, it likely makes sense to interview all the producers or as many as possible, since there are relatively few and each has a disproportionate impact on the market. Small scale producers and landowners might be identified by an expert panel

and using snowball sampling. Subsets of the population may be further stratified by other characteristics and a sample of each subset surveyed.

Some subsets of market participants may be extremely difficult to identify; for instance, landowners who collect straw themselves and retail directly. That portion of the market that is informal is difficult to quantify and track. State analysts may have to rely on an expert estimate of the informal market size or undertake a few select interviews with sellers that can be identified. Another option is to acknowledge that this segment of the market is insignificant and missed in the analysis.

Non-Market Harvest Volumes

Non-commercial NTFP uses include subsistence, recreation, cultural and spiritual uses, and education. While these uses are the most difficult to identify, quantify, and value, they may provide significant economic value to a State. Unfortunately, we know of very few data collected on non-commercial NTFP harvesting, and what is collected does not ask about quantities harvested and is limited in its reach to a single land ownership class. While this information alone is insufficient to estimate the quantity of NTFPs harvested, it could form the basis for a secondary survey.

One database that includes information on NTFP harvest is the National Visitor Use Monitoring (NVUM) Program, which collects data on recreational visitors to National Forests (English and others 2002). In summarizing the NVUM methodology, which is described in detail in English and others (2002), the USDA Forest Service (2013) states, "In essence, visitation is estimated through a combination of traffic counts and surveys of exiting visitors. Both are obtained from a random sample of locations and days distributed over an entire forest for a year." These surveys ask whether part of the trip involved gathering of NTFPs, or "special forest products," and whether this was the primary reason for the visit (Bowker and others 2009, USDA Forest Service 2013). It does not specify which NTFP was harvested.

Another source of NTFP harvest information is the National Woodland Owners' Survey (NWOS), which collects data on the attitudes, perceptions, and management of family forests in the United States (Butler and others 2005, USDA Forest Service 2015b). The most recent iterations of NWOS include questions about whether NTFPs have been collected on these forests during the time they have been owned by the current landowners. It asks about market segment (edible, medicinal, etc.) and if the product was for sale or personal use. However, it does not ask about the quantity of product collected, so it would be impossible to use these data alone to estimate quantity of NTFP harvested on private lands.

Given the lack of publicly available data, if quantification of NTFP harvest for non-commercial purposes is desired, it is necessary to create and implement a survey. One approach would be to survey the general public in each State to determine how many people collect NTFPs, how much, and for what purpose it is used. For example, Maher and others (2013) used a survey of the general population in a region of Alaska to determine NTFP harvest quantities for 20 different NTFPs. Robbins and others (2008) undertook a phone-based random sample survey of residents of New England to examine personal use of NTFPs. An alternative approach would be to survey landowners, stratified by land ownership type and scale, forest type, and other characteristics.

If personal use, or "recreational" NTFP harvest is allowed via permits on public lands (National forest, State forest, etc.) in the State, it may be possible to access those permit records to contact harvesters. This approach was taken by Starbuck and others (2004) in Washington State. This would give a narrow sample and avoid the expense of surveying the general public, the majority of whom may collect no NTFPs at all.

VALUATION OF MARGINAL CHANGES IN NTFP PROVISIONING SERVICE

The value of anything is first identified as it fulfills the demands of humans. The majority of NTFPs fall within the three important categories of needs: physiological (food), safety (medicinal), and social (crafts, greenery, flowers) (Blatner and Alexander 1998, Greenfield and Davis 2003). When available, market prices are the most accurate measure of value at the margin—the value society places on one additional unit of a product or service. Unfortunately, NTFP markets may be informal with no data recorded, or NTFPs may not be traded at all. In this section, we discuss estimating the marginal value of products that are harvested for commercial and non-commercial uses.

Market Harvest Values

Assigning a price may be the most challenging part of valuation and it is best to use market price, if possible. It is usually necessary to have a basic understanding of the way the market for that product works, as the product changes hands from the harvester to the first point of sale, to various intermediaries and value-added processors, to the final consumer. To understand the intricacies of small, informal markets, studies frequently utilize interviews, written surveys, diaries, and face-to-face interactions with harvesters and other participants in NTFP activities (e.g., Alexander and others 2002b, Blatner and Alexander 1998, Carroll and others 2003, Davis and Persons 2014, Emery and others 2003, Greene and others 2000, Greenfield and Davis 2003, Jones and others 2004, Schlosser and Blatner 1995, Wolfe and others 2005). It is important to keep in mind that the results from these studies may be relevant only to the specific locations, products,

and time period, such that decisionmakers are cautioned not to apply valuations from one study to other areas or use them to aggregate values to a larger scale.

Prices (and harvest quantities) can vary greatly over time (Blatner and Alexander 1998, Schlosser and Blatner 1995) due to factors such as weather patterns, land use policies, supplies of competing food sources, and overall economic conditions in the region, creating uncertainty in what price to use. With an understanding of the market, sometimes one can track reasons for price and quantity variations. For example, in the Pacific Northwest, early and heavy snow decreases supply and increases price in floral greens. If prices are available there are a number of issues that need to be addressed. Prices will vary depending on a number of factors such as season, harvest volume, product quality, distance to processor or consumer, and locality. Many NTFPs are sold in small quantities, so it is hard to quantify and collect data across perhaps thousands of individual sellers. Therefore, prices for the same product in the same region can vary dramatically based on market conditions.

When possible, the ecosystem service value should use the price at the first point of sale after harvest; however, without a basic understanding of the market, this first point may not be clear. Many NTFP harvesters who sell their products have a point of sale near the forest and in the local area (Godoy and Lubowski 1992, Gram 2001). That first point of sale for the harvester is the primary buyer who may consolidate transactions and sell to secondary buyers, or may be a retailer (from a small roadside stand to a local brick-and-mortar store).

NTFPs such as ginseng and other medicinals, and florals for landscaping and nurseries, are part of formal markets, with dealers and distributors that move the products, with or without further value-added processing, along the supply chain. Gatherers of pine straw, bark, and other landscaping and nursery materials also work in formal markets. Local and regional landscaping and gardening nurseries and depots drive demand for much of the floral and greenery NTFPs. In addition to local and community gardening retail shops and self-employed landscaping businesses, harvesters sell generally to small dealers who, in turn, may transport wholesale quantities to regional businesses. Harvesters of these NTFPs likely realize a larger share of the overall value of the delivered product given that much of the intrinsic values of these products are reflected in the near natural state and form of the raw material itself.

The characteristics and behavior of market agents reflect the degree of structure in the market for the particular category of NTFP and the spatial scale of the market. In more formal markets, established agencies or organizations may track prices of particular NTFPs. A few data sources for NTFP prices are reported in appendix 5.2. For example, medicinal and herbal NTFPs such as black cohosh, bethroot, goldenseal, and bloodroot are tracked by the American Herbal Products Association (AHPA 2007, Dentali and Zimmermann 2012). Past literature may also be useful; however, reported prices may not be up-to-date, or may not reflect local conditions.

If price data are not available, or are not adequate, from an existing data source, prices can be obtained through direct surveys of harvesters or buyers. Obtaining price data from harvesters or buyers could be costly in time and money across a broad swath of producers. Producers may be sensitive about revealing actual price information for competition and confidentiality reasons. Depending on the type of NTFP, having local dealers as a focal point to collect data may work to address the decentralized nature of the business. The section on "Estimating Harvest Volumes with No Data Sources" discusses some approaches for determining basic sampling and stratification approaches in the context of NTFPs. The same basic decisions apply here, as outlined in the decision tree in figure 5.5. These include snowball sampling; stratified sampling of harvesters, dealers, and/or landowners; or a survey or census of harvesters or dealers without stratification.

Example: American ginseng—In the American ginseng market, harvesters sell roots to primary buyers who sort, grade, consolidate, and market larger volumes to national and international buyers. Davis and Persons (2014) reported historical price ranges for American ginseng for 31 years (1982-2012). During the years 2000 through 2007, primary buyers paid, on average, wild-harvesters $430 for a pound of dried American ginseng root (Chamberlain and others 2013b). Table 5.9 summarizes prices paid to harvesters for a pound of dried ginseng. There are other sources, including the State agencies with responsibilities for administering the ginseng program. These may provide only historical prices; current prices are best obtained directly by surveying dealers.

Example: saw palmetto—Estimating the value of saw palmetto requires having estimates of prices paid to harvesters. Carrington and others (2000) reported prices paid to "freelance" harvesters of $0.10-$0.11 (1997-98) per pound of fresh fruit. Mitchell (2014) recorded prices paid to harvesters ranging from $0.10 to $1.00, and notes that a price of $0.50 per pound is average. Landowners, who hired crews to harvest, received $0.20-$0.21 per pound and paid harvesters about $0.07 per pound of fresh fruit (Carrington and others 2000). To get up-to-date prices, State analysts need to visit saw palmetto buying stations during the harvest seasons and ask harvesters what they are being paid. Several visits are needed throughout the season to record variations.

Carrington and others (2000) also reported one value of particular note: the price *per acre* received by landowners from contractors who harvest the saw palmetto. In industries structured this way (pine straw may be another example where this type of per-acre contracting occurs), this per-acre value in a competitive market

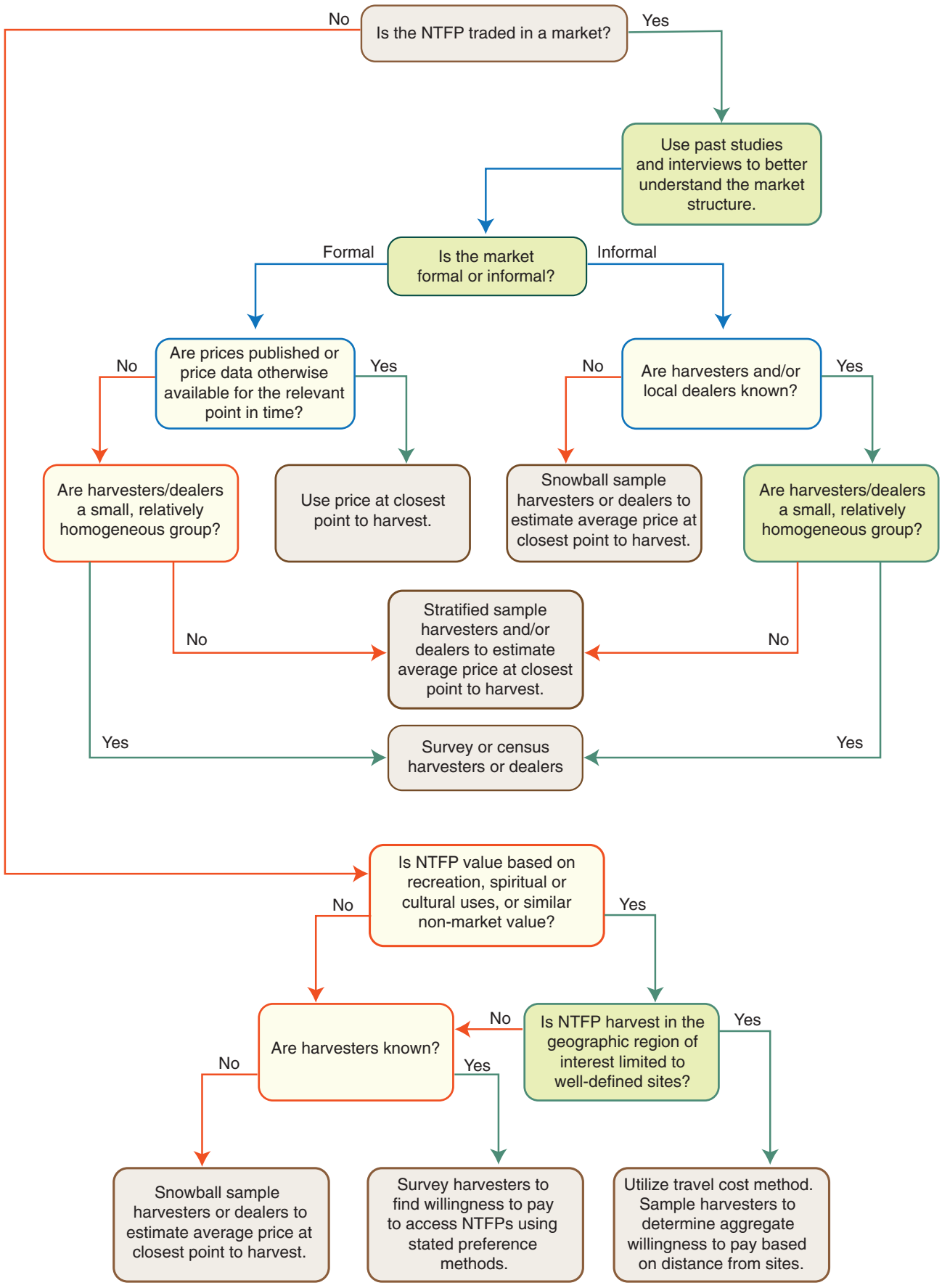

Figure 5.5—Decision tree for valuation of marginal changes in NTFP provisioning service.

Table 5.9—Wild American ginseng high and low yearly prices paid to harvesters

Price range	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
						$/dry pound						
Low	250	300	250	250	300	400	250	350	350	320	400	800
High	500	400	500	550	600	1,150	1,000	600	1,100	750	1,250	850

Source: Davis and Persons (2014).

is essentially the ecosystem value as we have defined it, and may even obviate the need for collecting information on harvest quantity (see section on Conceptual Model). However, such per-acre contracting is not typical among NTFPs. Landowners who contracted for the harvesting of saw palmetto received about $15.42-$31.25/acre at 151-303 pounds per acre.

Non-Market Harvest Values

When traditional markets do not exist, valuing the provisioning services of non-commercial NTFPs poses difficulties. Non-market valuation techniques, as described in chapter 2, can be applied to NTFP harvesting opportunities. In many cases, NTFP harvest may be considered recreational in nature, and recreation valuation techniques can be applied (chapter 2). Even if the NTFP harvest is not considered "recreational" to the harvester (e.g., for subsistence, cultural, spiritual, educational, or other purpose), from a methodological standpoint, similar valuation techniques can be used. Contingent valuation and contingent behavior methods are the most popular examples of stated preference methods. Revealed preference methods for non-market valuation are based on actual behavior rather than stated intentions. Hedonic pricing uses data on real attributes to estimate how those attributes affect market prices. The travel cost method is the most commonly used revealed preference technique when valuing access to public lands for recreation activities.

Imputed values method—When the NTFP of interest has no market value, an alternative approach would be to use imputed values based on the market value of a good that is commonly bartered for the NTFP, or the market value of a close substitute for the NTFP (Godoy and others 1993). These would be good approaches if the analyst was confident that the estimated imputed or substitute prices were consistent enough across a broad human population that they could be relied upon. However, in most parts of the United States, bartering for lack of a market is not widespread enough to be consistently applied. Likewise, finding a true market substitute for a non-market product is unlikely. For example, one might propose that the value of store-bought (field cultivated) berries could be used as a substitute for non-commercial wild-harvested berries. However, if one were to ask the consumer, he or she likely places high value either on the harvesting itself (for cultural or recreational reasons) or on the fact that the berries are natural.

Hedonic pricing method—Similarly, hedonic pricing may have applicability for NTFP valuation in some rare cases, but the method does not seem promising. We are unaware of any studies that have used hedonic pricing for NTFP valuation. We do not want to dismiss the concept entirely, however. Hedonic pricing with NTFPs would rely on estimating the difference that people are willing to pay to access or purchase land that has NTFPs, compared to similar land that has equivalent characteristics but no NTFPs. Unfortunately, data on real estate sales do not include availability of NTFPs on the property, and the use of any proxy (e.g., forest type) for NTFP availability is just as likely to also be a proxy for many other characteristics other than NTFPs, all of which might impact price just as much or more than presence of NTFPs. One might consider a "market" for campsites or some similar access points, which have NTFPs or not, but it is hard to see how this could form the basis for a study or how the data could even be collected. Most campgrounds charge a flat rate regardless of the site; if sites with NTFPs are filled before other sites, this might be an indicator of some value, but trying to estimate that value in dollar terms is challenging in the least.

Stated preference methods—Stated preference methods could be used to value non-market NTFPs, although we are not aware of any studies in the United States that have done so. The analyst would use one of various approaches, described in more detail in chapter 2, to elicit people's willingness to pay for a particular product, through a survey. In this case, a best metric would be to elicit a willingness to pay to access the product, assuming that the survey respondent would hypothetically have to harvest and process the product themselves. In this way, the respondent implicitly factors out harvest costs. Stated preference methods may be the most applicable for NTFPs when the population of harvesters can be identified. This would serve as the population for the survey.

Travel cost method (TCM)—If the harvest or collection of NTFPs is not traded commercially, and is mostly valued for recreational, spiritual, or cultural purposes, then the total quantity of product harvested may be less important to value than access to the resource. TCM can be used to estimate a value per trip or per visitor-day. Because the TCM is used to derive a demand curve for recreation, and if quantity of NTFP was calculated on a per trip basis, a dollar value per unit of NTFP or per acre can be calculated (Starbuck and others 2006).

To estimate demand for NTFP harvesting on southern forests using the TCM, a crucial assumption is made that the cost of travel to the site (including associated fees) is a proxy, or shadow price, for the harvesting activity. In the United States, TCM has been rarely used to value NTFP provisioning services, with two examples being Markstrom and Donnelly (1988) and Starbuck and others (2004). However, the methodology is not substantially different from how TCM would be used to value any recreational resource, and more guidance can be found in chapter 2. A comprehensive review of the development of recreation demand models and TCM can be found in Phaneuf and Smith (2005).

TCM involves surveying or observing recreational participants at one or more sites, with the goal of determining the cost of traveling to the site and the time spent at the site for each participant. These data are used to generate a demand curve, usually expressed in terms of numbers of visits at various levels of cost. For TCM to be effective, the analyst must be able to determine a distance from origin to destination to calculate travel costs. One approach to valuing NTFPs would be to use the ZIP code of origin to the forest centroid as the distance calculation upon which the travel cost is based. This allows TCM to be used to define a value per unit of harvest for a regional area (such as a forest area with a high density of NTFP harvesting). The inaccuracy introduced by using a forest centroid instead of a specific coordinate is well within the error of the estimate (Bowker and others 2009, English and others 2002).

While imperfect, TCM can yield important economic and demographic information about NTFP harvesting and provide a proxy for the value of the NTFPs associated with recreation. If a State has a number of forests that provide the NTFP in question, the analyst would want to survey visitors about which forest they visited and then aggregate across all the forests of similar type to estimate a total State value. For any non-market valuation, one must survey visitors and obtain information on behavior to estimate demand and hence monetary value. TCM can be applied to any spatial scale so long as the origin-destination information is obtained and there is sufficient information to calculate a cost per trip or per day value.

The sampling frame and visitor characteristics need to be carefully considered. When a survey is designed, map information that shows trail and parking access points must be used to identify where to "trap" the most representative sample. Questions regarding demographics and activities can then be compared to other sampling or population information to generate an estimate of the sample characteristics relative to the population. Numerous estimation methods exist to account for endogenous stratification and other sampling issues known to be exist in recreation data. With a well-designed sampling frame and survey protocol issues related to the reliability of the estimate resulting from sampling issues can be minimized and does not significantly increase the cost of generating a non-market value for an NTFP. For TCM to be effective the survey must ask information about the purpose of the trip and what portion of trip time and expenditures are related to each listed activity. This is easily done by a well-designed survey instrument and does not pose a significant issue in the application of TCM.

The analyst must consider the number and distribution of harvest sites of the particular NTFP throughout the State, and whether only one site or multiple sites are of interest. In general, single-site analysis would be relevant for a narrow policy question involving only that site (for example, a change in a National Forest management plan) or in the rare case where only one harvest site exists. Multiple-site analysis would be appropriate for a statewide valuation if the NTFP is restricted to a relatively few, relatively well-known sites, such as National or State forests. Bowker and others (2009) constructed a multiple-site TCM using NVUM data from 120 National Forests, which included NTFP gathering, although it did not estimate a value for NTFPs independently. The complexity of harvesting location and site definition for a multi-site TCM are not insurmountable, and again relate to the development of the sampling frame and survey implementation. Bowker and others (2009) developed a rigorous sampling framing and survey method, and the NVUM results could have easily been extended to NTFP if a question on NTFP harvesting had appeared as a list of recreational activities.

In summary, for TCM to be effective, one must collect origin-destination information and demographic information. In a well-executed TCM, it is important to ask about the primary purpose of the trips and the types of activities and/or percentage of trip for each purpose in order to handle issues of substitution that can affect valuation (Freeman 2003, p. 424-425). These considerations provide initial insight and guidance about using the travel cost method to value NTFP provisioning. While it is has been infrequently used for NTFPs, the TCM may offer a way to value NTFPs that are harvested recreationally.

ESTIMATION OF PRODUCTION COSTS

Provisioning ecosystem service can be interpreted to mean the portion of value of a product that is generated by the ecosystem. In this case, the portion of value that is generated by humans, that is the human-incurred production costs, should be factored out (equation 1), leaving a "residual value" that can be attributed to ecosystem function. Human-incurred production costs include costs of establishment, management, and harvest. In the case of wild-harvested NTFPs, there are no costs of establishing or managing these populations. Ginseng harvesters are supposed to plant seeds that are found on plants that they harvest. In this case, the "establishment cost" would be the time it takes for the harvester to plant seed, which likely would be negligible in this case, and could be simply considered part of the harvest cost. Harvesters of other products have fewer restrictions. This section focuses on measuring costs incurred in production of NTFPs.

To estimate the cost of harvesting an NTFP, an analyst would need to interview or survey the harvesters. The costs of harvesting include fuel, any equipment needed to harvest, any food or lodging required (most harvesters in Southern United States probably do not overnight anywhere during harvest trips), and the harvesters' labor.

In many cases, labor is the principal cost of NTFP production and is not paid in terms of a wage. The value of this labor can be estimated as the "opportunity cost" of some alternative economic activity. In general, if the harvest activity is relatively low-skill, the average hourly wage for low-skill labor may be an appropriate value to put on this opportunity cost. This is usually somewhat higher than minimum wage (but could be lower than minimum wage if there is a larger informal labor market in the area). Certain specific types of NTFP harvest activities might correspond more closely with higher-skilled employment. The U.S. Bureau of Labor Statistics provides data on average wages by occupation and area, which can be used to find an appropriate opportunity cost of time for the typical NTFP harvesters in your area (U.S. Bureau of Labor Statistics 2016).

For certain products, there might be numerous harvest methods with varying levels of mechanization. For example, pine straw can be harvested with a rake and a wooden manual baler, or with a tractor and mechanical baler. For the former, equipment costs are minimal and labor might be the most important input, so using an appropriate opportunity cost of time is important. For the latter, harvest would also include such expenses as equipment depreciation, fuel, etc.

Determining production costs of NTFPs harvested from "managed" populations of NTFPs will require "utilization" studies, similar to what the USDA Forest Service FIA program does for timber. In these types of studies, the analysts actually spend time monitoring all aspects of establishment and management of the product. Care must be taken not to double count costs when estimating production costs for NTFPs that might be produced with other products (e.g., pine straw with timber and cattle). Also, the amount of labor required should be recorded and stratified by different tasks (e.g., site preparation, maintenance, harvesting, transport) along with equipment and materials costs. To make these studies relevant, they need to be replicated over time and locations so that generalizations can be made.

Some NTFPs are being grown in a "forest farming" system that have associated establishment and management costs. These costs include labor to undertake site preparation, planting, and maintenance. The costs of seed, equipment, pesticides, and other inputs can be estimated directly by monitoring forest farming activities. A few studies have created "forest farming budgets" for selected NTFPs (e.g., Burkhart and Jacobson 2009, Davis and Persons 2014); however, unlike typical crop budgets published by State Cooperative Extension services, these sources are not updated periodically or replicated in different geographic areas.

Initially, efforts to estimate the value of natural forest ecosystems to provide NTFPs can disregard production costs. There is little evidence that most NTFP harvesting from natural populations is being managed, nor are there associated establishment costs. As forest management agencies begin to actually manage for these products, then associated costs will occur and can be estimated.

SCALING UP/AGGREGATING

The guidance here has been written with a State-level valuation in mind. We assume that the desire is in valuing NTFPs across the entire State by forest type and landowners. Many of the recommendations may be valuable for other spatial scales. To be sure, local (e.g., National Forest or district) level valuations provide valuable information for managers of those areas, but they often cannot be scaled up because of differences within the population of harvesters. For example, if a small number of individuals have an extra-large impact on the market, a simple random sample at low sampling intensity may not capture the value accurately. A small number of large harvesters can skew results of a valuation exercise. It is, therefore, critical that surveys of harvesters get a representative sample of all harvesters.

A State-level valuation should strive to account for variations in harvester populations by appropriately sampling from different operational scales, forest types, ownership classes, and/or management/regulation regimes. This is called stratified sampling, which strives to sample across the variety of players. After an initial survey of the populations, efforts should be made to make sure that each strata is represented. Also, efforts should be made to get responses from "non-respondents."

Results of small studies can be "scaled up" or aggregated to represent State-level spatial dynamics with effort, thought, and consideration. Small scale "pilot" studies allow the researcher or analyst to better understand factors that may inform larger studies of challenges that need to be addressed. Undertaking small studies across landscapes can provide valuable information on per-acre production, growth, and yields and operational costs. To scale these to State-level analyses requires that they capture variations across forest types and landowner classification. To aggregate small studies to the State level, they must represent all spatial and temporal variations.

CONCLUSIONS

Non-timber forest products contribute to the economies of every State in the South. They are important provisioning services of all forest ecosystems of the region. Yet, they have not been included in efforts to value forests. People collect these products for personal consumption and to generate income to support families. Different approaches are used to estimate market and non-market values of these products. Estimating market values is simply the product of quantity harvested (or standing stock) and market price (farm gate) as a proportion of habitat. Non-market estimation is more complicated and requires interviewing and surveying harvesters and translating results into comparable units of measure.

The major challenge with estimating the provision service of ecosystems for NTFPs is the lack of data. In general, there are insufficient data to estimate the provisioning of NTFPs from forest ecosystems. There are volume data for a few NTFPs, such as American ginseng, although this is the only NTFP for which county-level data is available. Price data exists for ginseng as well, but not for most other products. Determining standing stock of NTFPs will require inventorying plants within the forests, similar to what is done with trees. Determining the flow, or annual harvest rate, will require utilization surveys of market players.

Designing and implementing surveys requires thought and consideration for the designed end-use. The first task will be to develop a sample frame that represents various market segments (for market valued NTFPs) and personal use harvesters. These will take significant time and resources, but once these are completed, maintaining them is less costly. There are standard and well-accepted methods for designing and undertaking surveys (Dillman and others 2009).

The initial investment to estimate the provisioning of NTFPs by forest ecosystems may be significant for any one State. By collaborating on valuing specific priority (high valued) products, States can reduce their investment requirements. Further, after the initial investment has been made, replicating and refining the estimating efforts will be significantly reduced. All evidence indicates that NTFPs are economically and ecologically significant and worthy of valuing. The total ecosystem provisioning value of forests will remain elusive until NTFPs are included.

LITERATURE CITED

Adepoju, A.A.; Salau, A.S. 2007. Economic valuation of non-timber forest products (NTFPs). Munich Personal RePEc Archive. No. 2689. 17 p.

Adger, W.N.; Brown, K.; Cervigni, R.; Moran, D. 1995. Total economic value of forests in Mexico. Ambio. 286-296.

AHPA. 2007. Tonnage survey of select North American wild-harvested plants, 2004-2005. Silver Springs, MD: American Herbal Products Association. 25 p.

Alcorn, J.B. 1989. An economic analysis of Huastec Mayan forest management. In: Browder, J.O. Fragile lands of Latin America: strategies for sustainable development. Boulder, CO: Westview Press, Inc.: 182-206.

Alexander, S.J.; McLain, R.J.; Blatner, K.A. 2001. Socio-economic research on non-timber forest products in the Pacific Northwest. Journal of Sustainable Forestry. 13(3-4): 95-103.

Alexander, S.J.; Pilz, D.; Weber, N.S. [and others]. 2002a. Mushrooms, trees, and money: value estimates of commercial mushrooms and timber in the Pacific Northwest. Environmental Management. 30(1): 129-141.

Alexander, S.J.; Weigand, J.; Blatner, K.A. [and others]. 2002b. Nontimber forest product commerce. In: Jones, E.T.; McLain, R.J.; Weigand, J. eds. Nontimber forest products in the United States: uses and issues. Lawrence, KS: The University Press of Kansas: 115-150.

Alexander, S.J.; Fight, R.D. 2003. Managing access to nontimber forest products. In: Monserud, R.A.; Haynes, R.W.; Johnson, A.C. eds. Compatible forest management. Dordrecht, The Netherlands: Kluwer Academic Publishers: 383-400.

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

Bailey, B. 1999. Social and economic impacts of wild harvested products. Morgantown, WV: West Virginia University. 153 p. Ph.D. dissertation.

Blatner, K.A.; Alexander, S.J. 1998. Recent price trends for non-timber forest products in the Pacific Northwest. Forest Products Journal. 48(10): 28-34.

Botanical Wonders Nursery. 2015. Botanical wonders: wildflowers and hardy ferns. http://botanical-wonders.com/. [Date accessed: January 28, 2015].

Bowker, J.M.; Starbuck, C.M.; English, D. [and others]. 2009. Estimating the net economic value of National Forest recreation: an application of the National Visitor Use Monitoring database. Athens, GA: University of Georgia, Department of Agricultural and Applied Economics.

Burkhart, E.P.; Jacobson, M.G. 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): 437-453.

Butler, B.J.; Leatherberry, E.C.; Williams, M.S. 2005. Design, implementation, and analysis methods for the National Woodland Owner Survey. Gen. Tech. Rep. NE-336. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station. 48 p.

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

Carrington, M.E.; Mullahey, J.J.; Krewer, G. [and others]. 2000. Saw palmetto (*Serenoa repens*): an emerging forest resource in the southeastern United States. Southern Journal of Applied Forestry. 24(3): 129-134.

Carroll, M.S.; Blatner, K.A.; Cohn, P.J. 2003. Somewhere between: social embeddedness and the spectrum of wild edible huckleberry harvest and use. Rural Sociology. 68(3): 319-342.

Chamberlain, J.L.; Bush, R.; Hammett, A. 1998. Non-timber forest products: the other forest products. Forest Products Journal. 48(10): 10-19.

Chamberlain, J.L. 2000. The management of National Forests of Eastern United States for non-timber forest products. Blacksburg, VA: Virginia Polytechnic Institute and State University. 253 p. Ph.D. dissertation.

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

Chamberlain, J.L.; Prisley, S.; McGuffin, M. 2013b. Understanding the 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.; Betz, C.J.; Mou, S.H.; Gormanson, D.D. 2012. Outdoor recreation in the northern United States. Gen. Tech. Rep. NRS-100. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northern Research Station. 74 p.

Cullina, W. 2000. The New England Wild Flower Society guide to growing and propagating wildflowers of the United States and Canada. New York: Houghton Mifflin Harcourt.

Davis, J.; Persons, W.S. 2014. Growing and marketing ginseng, goldenseal and other woodland medicinals. 2nd ed. British Columbia, Canada: New Society Publishers. 466 p.

De Groot, R.S.; Wilson, M. A.; Boumans, R.M. 2002. A typology for the classification, description, and valuation of ecosystem functions, goods, and services. Ecological Economics. 41(3): 393-408.

Dentali, S.; Zimmermann, M. 2012. Tonnage surveys of select North American wild-harvested plants, 2006-2010. Silver Springs, MD: American Herbal Products Association.

Dillman, D.A.; Smyth, J.D.; Christian, L.M. 2009. Internet, mail and mixed-mode surveys: the Tailored Design Method. 3rd ed. Hoboken, NJ: John Wiley and Sons. 499 p.

Duever, L.C. 2011. Ecology and management of saw palmetto. Gainesville, FL: Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Unit: 81.

Emery, M.R.; Ginger, C.; Newman, S.; Giammusso, M. 2003. Special forest products in context: gatherers and gathering in the eastern United States. Gen. Tech. Rep. NE-306. Newtown Square, PA: U.S. Department of Agriculture, Forest Service, Northeastern Research Station. 59 p.

Emery, M.R.; Pierce, A.R. 2005. Interrupting the telos: locating subsistence in contemporary U.S. forests. Environment and Planning A. 37(6): 981-993.

English, D.: Kocis, K.; Zarnoch, S. [and others]. 2002. Forest Service national visitor use monitoring process. Gen. Tech. Rep. SRS-57. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station. 14 p.

Famuyide, O.; Adebayo, O.; Bolaji-Olutunji, K. [and others]. 2013. Assessment and sustainable management of non-timber forest products used as food and medicine among urban dwellers in Oyo State, Nigeria. Journal of Horticulture and Forestry. 5(11): 186-193.

Freeman, A.M., III. 2003. The measurement of environmental and resource values: theory and methods. 2nd ed. Washington: RFF Press. 491 p.

Frey, G.E.; Chamberlain, J.L. 2016. Collection of nontimber forest products from State forests in the U.S. South. Journal of Forestry. 114(2): 85-88.

Godoy, R.A.; Feaw, T.C. 1989. The profitability of smallholder rattan cultivation in Southern Borneo, Indonesia. Human Ecology. 17(3): 347-363.

Godoy, R.A.; Lubowski, R. 1992. Guidelines for the economic valuation of nontimber tropical-forest products. Current Anthropology. 33: 423-433.

Godoy, R.A.; Lubowski, R.; Markandya, A. 1993. A method for the economic valuation of non-timber tropical forest products. Economic Botany. 47(3): 220-233.

Goldberg, C. 1996. From necessity, new forest industry rises. The New York Times. 24 March.

Gram, S. 2001. Economic valuation of special forest products: an assessment of methodological shortcomings. Ecological Economics. 36(1): 109-117.

Greene, S.M.; Hammett, A.; Kant, S. 2000. Non-timber 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.

Greenfield, J.; Davis, J.M. 2003. Collection to commerce: western North Carolina non-timber forest products and their markets. Raleigh, NC: North Carolina State University Department of Horticultural Science. 106 p. https://www.ces.ncsu.edu/fletcher/programs/herbs/pdf/ntfpfinal17.pdf. [Date accessed: unknown].

Grimes, A.; Loomis, S.; Jahnige, P. [and others]. 1994. Valuing the rain forest: the economic value of nontimber forest products in Ecuador. Ambio. 405-410.

Jones, E.T.; McLain, R.J.; Lynch, K.A. 2004. The relationship between nontimber forest product management and biodiversity in the United States. Washington, DC: National Commission on Science for Sustainable Forestry. 60 p. http://www.ntfpinfo.us/docs/academicdocs/JonesMcLainLynch2005-USNTFPBiodiversity.pdf. [Date accessed: unknown].

Kalton, G.; Anderson, D.W. 1986. Sampling rare populations. Journal of the Royal Statistical Society. Series A (general). 65-82.

Maher, K.; Little, J.; Champ, P.A. 2013. Insights from a harvest trip model for non-timber forest products in the interior of Alaska. Res. Note RMRS-RN-60. Fort Collins, CO: U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station. 11 p.

Mainely Crafts. 2015. Mainely Crafts Booth at Bonanza Marketplace. http://www.bonanza.com/booths/mainelycrafts. [Date accessed: unknown].

Markstrom, D.C.; Donnelly, D.M. 1988. Christmas tree cutting: demand and value as determined by the travel cost method. Western Journal of Applied Forestry. 3(3): 83-86.

McLain, R.J.; Alexander, S.J.; Jones, E.T. 2008. Incorporating understanding of informal economic activity in natural resource and economic development policy. Gen. Tech. Rep. PNW-GTR-755. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 56 p.

MEA. 2005. Ecosystems and human well-being: synthesis. Washington, DC: Island Press. 245 p.

Mitchell, C. 2014. Contested spaces: NTFPs, livelihoods, and conservation planning. Boca Raton, FL: Florida Atlantic University. 380 p. Ph.D. dissertation.

Paoli, G.D.; Peart, D.R.; Leighton, M.; Samsoedin, I. 2001. An ecological and economic assessment of the nontimber forest product gaharu wood in Gunung Palung National Park, West Kalimantan, Indonesia. Conservation Biology. 15(6): 1721-1732.

Peters, C.M.; Gentry, A.H.; Mendelsohn, R.O. 1989. Valuation of an Amazonian rainforest. Nature. 339: 655-656.

Phaneuf, D.J.; Smith, V.K. 2005. Recreation demand models. Handbook of environmental economics. 2: 671-761.

Robbins, P.; Emery, M.R.; Rice, J.L. 2008. Gathering in Thoreau's backyard: nontimber forest product harvesting as practice. Area. 40(2): 265-277.

Robles-Diaz-de-Leon, L.; Kangas, P. 1998. Evaluation of potential gross income from non-timber products in a model riparian forest for the Chesapeake Bay watershed. Agroforestry Systems. 44(2-3): 215-225.

Salwasser, H. 2006. Meeting the challenges of sustainability. Corvallis, OR: Oregon State University.

Schlosser, W.E.; Blatner, K.A. 1995. The wild edible mushroom industry of Washington, Oregon and Idaho: a 1992 survey. Journal of Forestry. 93(3): 31-36.

Seiler, J.; Jensen, E.; Niemiera, A.; Peterson, J. 2015. Saw palmetto. Blacksburg, VA: Department of Forest Resources and Environmental Conservation, College of Natural Resources and Environment, Virginia Tech. http://dendro.cnre.vt.edu/dendrology/syllabus/factsheet.cfm?ID=355. [Date accessed unknown].

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

Smith, J.; Crone, L.K.; Alexander, S.J. 2010. A U.S. Forest Service special forest products appraisal system: background, methods, and assessment. Gen. Tech. Rep. PNW-GTR-822. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 22 p.

Smithsonian Marine Station at Fort Pierce. 2015. *Serenoa repens.* http://www.smsi.si.edu/irLspec/Sereno_repens.htm. [Date accessed: February 26, 2015].

Starbuck, C.M.; Alexander, S.J.; Berrens, R.P.; Bohara, A.K. 2004. Valuing special forest products harvesting: a two-step travel cost recreation demand analysis. Journal of Forest Economics. 10(1): 37-53.

Sullivan, C.A. 2002. Using an income accounting framework to value non-timber forest products. In: Pearce, D., ed. Valuation methodologies. Cheltenham, United Kingdom: Edward Elgar. 27 p.

Tanner, G.W.; Mullahey, J.J.; Maehr, D. 1996. Saw-palmetto: an ecologically and economically important native palm. Circular WEC-109. Gainesville, FL: Wildlife Ecology and Conservation Department, Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences, University of Florida. http://www.plantapalm.com/vpe/misc/saw-palmetto.pdf. [Date accessed: unknown].

Tewari, D. 2000. Valuation of non-timber forest products (NTFPs): models, problems, and issues. Journal of Sustainable Forestry. 11(4): 47-68.

U.S. Bureau of Labor Statistics. 2016. Overview of BLS wage data by area and occupation. http://www.bls.gov/bls/blswage.htm. [Date accessed: February 4, 2016].

USDA Forest Service. 2010. Forest inventory and analysis national core field guide, vers. 4.01. Volume 1: Field data collection procedures for phase 2 plots. Washington, DC: U.S. Department of Agriculture, Forest Service, Forest Inventory and Analysis.

USDA Forest Service. 2013. National visitor use monitoring results, USDA Forest Service national summary report: data collected FY 2008 through FY 2012. Washington, DC: https://www.fs.fed.us/recreation/programs/nvum/. [Date accessed: unknown].

USDA Forest Service. 2015a. Cut and sold reports. http://www.fs.fed.us/forestmanagement/products/sold-harvest/cut-sold.shtml. [Date accessed: February 27, 2015].

USDA Forest Service. 2015b. National woodland owners' survey. http://www.fia.fs.fed.us/nwos/. [Date accessed: December 14, 2015].

USDA Forest Service. 2016. Special forest products. http://www.fs.usda.gov/detail/r6/landmanagement/resourcemanagement/?cid=fsbdev2_027051. [Date accessed: March 24, 2016].

U.S. International Trade Commission. 2016. Interactive tariff and trade dataweb. https://dataweb.usitc.gov/. [Date accessed: March 24, 2016].

Wagner, J.; Lee, S. 2014. Sampling rare populations. In: Johnson, T.P., ed. Health survey methods. Hoboken, NJ: John Wiley and Sons: 77-104.

Wolfe, K.L.; Best, M.J.; Price, T. 2005. Pine straw market analysis for southwest Georgia. Market Analysis 05-01. Athens, GA: The University of Georgia. 10 p.

Appendix 5.1

Summary of select valuation studies of NTFPs in the U.S. South and around the world

Citation	Geographic location	Stock or flow quanti-fication	Market or non-market valuation	Marginal value estimates	Other methodological notes
Adger and others (1995)	Mexico			Multiple NTFPs $330 per hectare per year Coffee and other NTFPs $1,540 per hectare per year	
Alcorn (1989)	Mexico				
Alexander and others (2002a)	Pacific Northwest	flow	market	Matsutake, chanterelle, and morel mushrooms $0.4-99 per hectare per year	Describes soil expectation value approach similar to that in section 1.2 here. Describes assumption and methodological choices. Variation in values due to differences in species, location, and methodological assumptions.
Chamberlain, Prisley, and others (2013)	U.S. South	flow	market	Not applicable	Calculates average annual harvest and revenue (2000-2007) for ginseng in the United States.
De Groot, Wilson, and Boumans (2002)	Worldwide	flow	market and non-market	Not applicable	Synthesis of meta-analysis which summarizes the relationships between ecosystem functions and monetary valuation techniques
Godoy and Feaw (1989)	Indonesia			Rattan $495 per hectare per year	
Gram (2001)	Peru	flow	market and non-market	Fishing, hunting, gathering $9 - $17 per hectare per year	Analysis of strengths and weaknesses of valuation methods for economic importance of local extraction activities
Grimes and others (1994)	Ecuador	flow	market	Fruit, medicinal and handicrafts NPV $1,257 - $2,939 per hectare per year	Estimates sustainable harvest levels and net present value of fruit, medicinal and handicraft products on three plots
Greenfield and Davis (2003)	North Carolina	flow	market	Not applicable	Looks at 46 forest botanical products (medicinal, edible plants, floral plants, ornamentals) in 25 western counties, using an exploratory, inductive approach estimate volumes, sales, economic and socio-economic information and prices of NTFPs.

(continued to next page)

Appendix 5.1 continued

Summary of select valuation studies of NTFPs in the U.S. South and around the world, cont.

Citation	Geographic location	Stock or flow quantification	Market or non-market valuation	Marginal value estimates	Other methodological notes
Godoy and Lubowski (1992)	Sri Lanka Brazil Peru	flow	market and non-market	Florals $50-$420 per hectare per year Babassu palm products $59 per hectare per year Wild camu $167 per hectare per year	Summarizes net economic valuation studies in multiple countries
Paoli and others (2001)	Indonesia	stock and flow	market	Gaharu wood $3.80 - $18.56 per hectare Average of $10.83 per hectare	Estimates net present value per hectare for five major forest types
Peters, Gentry, and Mendelsohn (1989)	Ecuador			Fruit and latex $6,820 per hectare per year	
Robles-Diaz-de-Leon and Kangas (1998)	Chesapeake Bay Watershed, Maryland	stock and flow	non-market	Ornamentals, edible fruits, edible nuts $60,694 per hectare per year	Calculates total gross income obtained from a riparian forest buffer
Starbuck and others (2004)	Gifford Pinchot National Forest, Washington	flow	non-market	Not applicable	Estimates recreation demand (consumer surplus) for NTFP gathering
Tewari (2000)		stock and flow	market and non-market		Explains the variation dynamic and static, income and wealth valuation models of NTFPs

Appendix 5.2

FIA Forest Groups and Associated Tree Species

Forest Type Group/Species
White / red / jack pine group
Jack pine
Red pine
Eastern white pine
Eastern white pine / eastern hemlock
Eastern hemlock
Spruce / fir group
Balsam fir
White spruce
Red spruce
Red spruce / balsam fir
Black spruce
Tamarack
Northern white-cedar
Fraser fir
Red spruce / fraser fir
Longleaf / slash pine group
Longleaf pine
Slash pine
Tropical softwoods group
Tropical pines
Loblolly / shortleaf pine group
Loblolly pine
Shortleaf pine
Virginia pine
Sand pine
Table Mountain pine
Pond pine
Pitch pine
Spruce pine
Other eastern softwoods group
Eastern redcedar
Florida softwoods
Exotic softwoods group
Scotch pine
Other exotic softwoods
Norway spruce
Introduced larch

Forest Type Group/Species
Oak / pine group
Eastern white pine / northern red oak / white ash
Eastern redcedar / hardwood
Longleaf pine / oak
Shortleaf pine / oak
Virginia pine / southern red oak
Loblolly pine / hardwood
Slash pine / hardwood
Other pine / hardwood
Oak / hickory group
Post oak / blackjack oak
Chestnut oak
White oak / red oak / hickory
White oak
Northern red oak
Yellow-poplar / white oak / northern red oak
Sassafras / persimmon
Sweetgum / yellow-poplar
Bur oak
Scarlet oak
Yellow-poplar
Black walnut
Black locust
Southern scrub oak
Chestnut oak / black oak / scarlet oak
Cherry / white ash / yellow-poplar
Elm / ash / black locust
Red maple / oak
Mixed upland hardwoods
Oak / gum / cypress group
Swamp chestnut oak / cherrybark oak
Sweetgum / Nuttall oak / willow oak
Overcup oak / water hickory
Atlantic white-cedar
Baldcypress / water tupelo
Sweetbay / swamp tupelo / red maple
Baldcypress / pondcypress

Forest Type Group/Species
Elm / ash / cottonwood group
Black ash / American elm / red maple
River birch / sycamore
Cottonwood
Willow
Sycamore / pecan / American elm
Sugarberry / hackberry / elm / green ash
Silver maple / American elm
Red maple / lowland
Cottonwood / willow
Oregon ash
Maple / beech / birch group
Sugar maple / beech / yellow birch
Black cherry
Hard maple / basswood
Red maple / upland
Aspen / birch group
Aspen
Paper birch
Gray birch
Balsam poplar
Pin cherry
Tropical hardwoods group
Sable palm
Mangrove
Other tropical
Exotic hardwoods group
Paulownia
Melaleuca
Eucalyptus
Other exotic

Appendix 5.3

SUMMARY OF DATA SOURCES

Data sources for non-timber forest products in the U.S. South are varied and disparate

Source	Data type	Notes
Interviews/surveys of harvesters and dealers	price, volume, acreage	
USDA Forest Service cut and sold reports	volume	includes value of permit fees
USDI Geological Survey models	acreage, geographic distribution	species habitat
Interactive Tariff and Trade DataWeb (U.S. International Trade Commission 2016)	volume	export data
Greenfield and Davis (2003)	price	North Carolina ginseng, goldenseal, galax, ramps
Davis and Persons (2014)	price	historic ginseng prices
U.S. Fish and Wildlife Service	volume, geographic distribution	ginseng, county and State
American Herbal Products Association	volume	17 Appalachian medicinal products
National Woodland Owners survey	acreage	By number of owners, type of sale, type of product
USDA Forest Inventory and Analysis	acreage, geographic distribution	forest type, bark
State Natural Heritage databases	geographic distribution	—
Wholesalers	price, volume	various NTFPs
Ginseng dealers	price, volume	by State
National Christmas Tree Association	price, volume, acreage	by total U.S., State
State agriculture departments	price, volume	pine straw
Farmers markets	price, volume	edibles
USFS and State forestry agencies	volume	also permit fees
Maple Syrup Association	price, volume, acreage	and other saps
National Agriculture Statistics Service	price, volume	maple syrup, blueberries
Green nursery/landscaping industries/ associations	price, volume	forest florals, cones
Georgia Farm Gate Value Reports	price, volume	includes pine straw
Mitchell (2014)	price, volume, acreage	saw palmetto
Chamberlain and others (2013a)	price, acreage	black cohosh
Chamberlain and others (2013b)	price, volume	ginseng

For the purposes of this report, and for future analysis by State foresters, the above list provides a starting point of some specific research studies and general resources with regular collection and compilation of data on NTFPs.