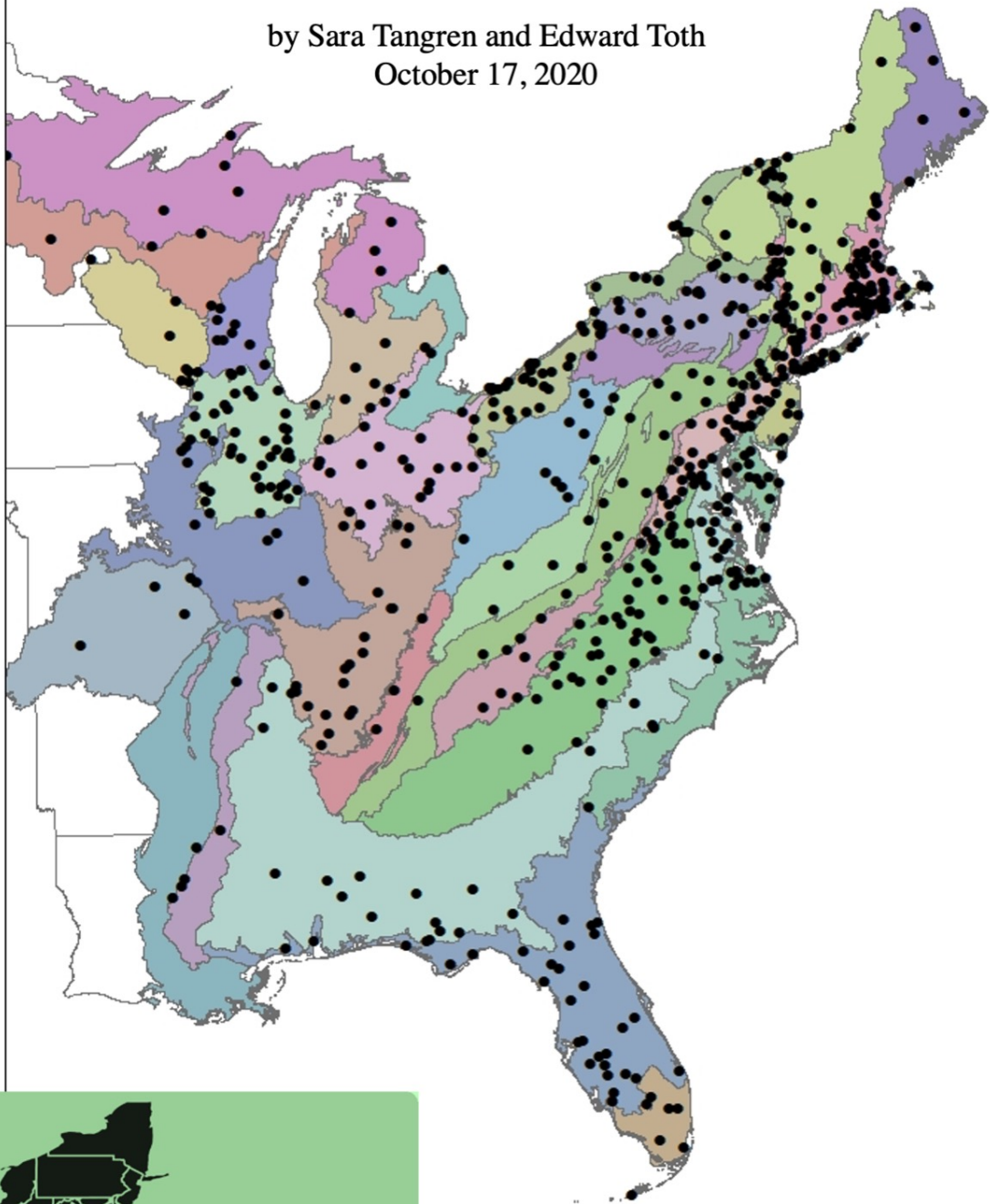


# Native Plant Materials Use and Commercial Availability in the Eastern United States

by Sara Tangren and Edward Toth  
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## About the Authors



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## Executive Summary

In 2018, the Mid-Atlantic Regional Seed Bank (MARSB) and the University of Maryland Extension conducted an internet survey of the native plant and seed user community throughout the Eastern United States. The authors developed an extensive list of native plant users. The survey was sent to names on that list, and those receiving the survey were encouraged to send it on to other users for their input. We asked questions about the commercial availability of native plants and seeds (referred to as native plant materials or NPMs). We also asked about definitions, preferences, uses, and respondents' professional needs for technical information and continuing education. We received 760 responses. All states (Fig. 1) and all EPA Level III ecoregions (Fig. 2) in the survey area were represented. This survey is preceded by nine others. This is the first to cover the entirety of the Eastern U.S. (Table 2).

The majority of respondent organizations use NPMs for habitat restoration, creation, and pollinator support. Many other types of environmental and landscape uses are also popular (Fig. 6). Respondents express an overwhelming preference for local ecotypes (74%), and almost no interest in cultivars (0.3%, Fig. 4).

Respondents identify commercial availability as the greatest barrier to their use of the local ecotypes they prefer (Fig. 7). This is the tenth consecutive survey to document a commercial shortage of NPMs (Table 2), suggesting that the shortage is both chronic and nationwide. Respondents rated the commercial availability for ecotype seeds at 2.1 on a scale of 0=never to 5=always, and ecotype plants at 2.8 (Fig. 9). Lead times are insufficient for contract growing (Fig. 7, 8). Eighty-three percent would be willing to pay a premium to obtain the local ecotype NPMs they want.

Ninety-two percent of respondents use native seeds. Respondents who prefer local ecotype seeds have to buy outside what they consider to be the "local" area (Fig. 3). Those who use a 50-mile definition, on average use vendors 415 miles away. Those who prefer a 100-mile definition use vendors 375 miles away. Those who think of local as being in the same state buy out-of-state 85% of the time. The average distance between respondents and their native seed vendors is 418 miles. The second-most popular native seed vendor has an average customer distance of 805 miles (Table 4).

Potential solutions to the commercial shortage of NPMs include creating an online marketplace, increasing project lead times, improving procurement policies, charging premiums for local ecotypes, conducting needed research, providing technical support, supporting the ongoing production efforts, and a rapid, dramatic increase in available georeferenced seed for NPM production by developing a network of active seed banks. Seventy-five percent of respondents expect their organization's demand for NPMs to increase over the next 10 years (Fig. 12), highlighting the importance of addressing these issues now.

# 1. Introduction

This report presents the results of a survey of native plant material (NPM) users in the Eastern United States. Our objectives were to better understand the challenges NPM users face, and to collect their insights on potential solutions. In forming the questions (Table 1), we were inspired by the development of the National Seed Strategy (Plant Conservation Alliance, 2015), and some of our questions were based on the goals, objectives and action items listed therein. We were also inspired by the works of previous survey authors, whose works are cited throughout this report (Table 2).

The target audience for this survey was anyone who uses NPMs to conduct their work. To reach our audience, an extensive list of NPM users was developed by staff at the Mid-Atlantic Regional Seed Bank. Those receiving the survey were encouraged to send it on to others. The resulting 760 respondents range from individual volunteers to executives from multinational organizations. What they all have in common is that they perform essential work that improves or restores natural systems and fortifies ecosystem functions resulting in benefits to society such as clean air, clean water, and pollination services. To perform their work, they need a reliable supply of NPMs.

One challenge of surveying respondents' opinions about native plants is that they have so many different interpretations of what constitutes “native” and “locally” native. The four prior surveys that addressed this issue took different approaches: telling respondents what was meant by native for the purpose of the survey, asking respondents how they interpret “native”, or both. In this survey, we asked respondents about their own definitions and then used that information to better understand their responses to other questions.

All four prior surveys concluded that there was confusion about what constitutes “native” or “local” (Table 2). Tamimi (1999) for example, was working in Hawaii, a context that involves a state with no shared boundaries but separate islands, and extremely high rates of botanical endemism. A particularly confusing etymology exists in which the First Peoples of Hawaii are referred to as native, but the plants they brought with them are not. The confusion in Hawaii, therefore, was around the word “native”, not around the word “local”. Hooper (2003) on the other hand, working in Utah, was grounded in the context that “native” referred to local and genetically appropriate<sup>1</sup> materials. The

*“The material isn't available. The price is very high if it is available. Available volumes aren't sufficient. Material described as locally native, turns out to be a cultivar after we use it.”*

- Survey Respondent

According to the Plant Conservation Alliance (2015), “*Native species are those that occur naturally in a particular region, state, ecosystem, and/or habitat, without the direct or indirect actions of modern humans.*” The term “locality-specific” refers to NPMs that are “matched in terms of their genetic composition to the particular region or location in which they are used, reflecting patterns of local adaption” and are carefully increased “to maintain the original genetic composition of the wild population”. The phrase “local ecotype” is commonly used among practitioners to represent this concept, and we follow that convention in this report. Among ecologists, “local ecotype” is used to denote a plant which has measurable adaptations to the location in which it co-evolved.

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<sup>1</sup> The Plant Conservation Alliance (2015) uses *genetically appropriate* to mean “native plant materials that are environmentally adapted to a restoration site that are likely to establish, persist, and promote community and ecological relationships. Such plants would be: sufficiently genetically diverse to respond and adapt to changing climates and environmental conditions; unlikely to cause genetic contamination and undermine local adaptations,

source of confusion in Utah was around what constituted local, how NPMs were labeled, and how often native plants were exchanged between their point of genetic origin and their point of use. In her analysis, she found that 86% of Utah landscape architects agreed with, "Consumers are generally confused about what constitutes a "native plant". She explains the confusion this way, "The fundamental contradiction inherent in native plant products is that political, ecological, and commercial regions do not match". Her interviewees noted that the confusion over accepted native plant definitions creates dilemmas for suppliers trying to decide which plants to grow and how to market their products. Similarly, in his analysis Peppin et al. (2010) found that 65% of native seed suppliers and users found defining the term "local genotype" difficult. Both Hooper and Peppin et al. concluded that confusion around the term "local ecotype" impedes progress in improving the commercial availability of local ecotype materials. Kauth and Pérez (2011) were the first authors to ask their respondents for quantitative definitions of "native" as well as asking about any confusion surrounding the term, and 64% said that their customers were confused about what constitutes "native".

In the current survey, we dig a little deeper than our predecessors to better understand how respondents see this important terminology. We use the terms "cultivar", "native", and "local ecotype". We ask our readers to share their organizational definitions and policies surrounding these terms.

The current survey builds on the work of its predecessors in continuing to document the chronic, commercial shortage of NPMs that exists throughout the United States. The current survey also corroborates the work of three prior surveys that asked about preferences (Table 2). Across a span of 15 years and across the nation, respondents have repeatedly and consistently expressed a preference for locally sourced native plants and seeds. Respondent preferences for local NPMs are supported by a large body of science indicating benefits of using locally genetic material and disadvantages of using NPMs from sources that are too dissimilar or too distant. Peppin et al. (2010) summarized it this way, "projects continually incorporate non-local genetic materials which may be more susceptible to the negative effects of changing environments (Huenneke 1991; Schmid 1994; Rogers & Montalvo 2004) and threaten the long-term sustainability of restored sites (Lynch 1991; Hufford & Mazer 2003), as well as other local populations (Linhart 1995; Montalvo & Ellstrand 2001) with which they may inter-breed." Baughman et al. (2019) reviewed the relevant literature and conducted a meta-analysis of 75 prior research projects, and concluded that "Locally sourced plants likely harbor adaptations at rates and magnitudes that are immediately relevant to restoration success".

The current survey is the first to ask about preference for cultivars as well as straight species and local ecotypes; the first to analyze responses about commercial availability in the context of these preferences; and the first to show how far respondents who prefer local ecotypes must go to secure native seed. This was made possible by the high response rate, which permits us to split respondents into groups for cross tabulation. Although this work is the largest in terms of geographical coverage, it very much supports the findings of previous authors. The cumulative body of evidence created by these surveys, both in terms of the shortage and in terms of the preference for local plant sources, supports the National Seed Strategy's call to address the nation's chronic shortage of NPMs by building and supporting a network of seed banks, seed

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*community interactions, and function of resident native species within the ecosystem; not likely to become invasive and displace other native species; not likely to be a source of nonnative invasive pathogens; and likely to maintain critical connections with pollinators".*

storage facilities, and seed producers and native plant nurseries capable of meeting our nation's demand for genetically appropriate NPMs (Plant Conservation Alliance, 2015).

No prior survey authors asked about lead time. Lead time shortages are often driven by natural events, market forces, and/or government procurement policies beyond any one buyer's control (Plant Conservation Alliance, 2015). Hooper (2003) mentions lead time in the context of how long it takes to produce larger nursery stock and says that some growers or contractors are known to dig larger plants from wild populations rather than to invest the time needed to grow them. Peppin et al. (2010) discusses the unpredictable nature of wildfires in the Western United States and the resulting short lead times for native seed orders.

The current survey builds on the work of two predecessors in documenting respondents' willingness to pay a premium. Hooper found that 33% of Utah landscape architects were willing to pay a premium for source-identified products. Kauth and Pérez (2011) found that the majority of Florida native wildflower producers were willing to pay a premium of up to 50% for certified native seeds. Certified native seeds are those that have been inspected and approved as either "source-identified" or "natural track" in accordance with AOSCA guidelines (Young, Schrupf and Amberson, 2003).

This survey, like its predecessors (Table 2), documents the need for more research, education, and outreach. These are also important components of the National Seed Strategy (Goals 2 and 3). Some common themes expressed by prior survey authors were the need for research on propagation protocols, container production, and landscape uses. Professionals need to be educated about the differences in establishing and maintaining native landscapes versus conventional, horticultural landscapes. Outreach needs to be targeted at producers, users, and the public. Outreach products suggested included training sessions and workshops for practitioners and the public, signage, brochures, posters, pot tags, and demonstration gardens.

Our findings corroborate those of prior survey authors. Our collective works not only document phenomena such as a commercial shortage of native plants and seeds, but document that this shortage has persisted for two decades and spans our nation from the Pacific to the Atlantic. In many places throughout this report, we are able to explore topics more deeply, or add a new element, or present our results more quantitatively than has been done previously. It is our hope that these survey results will be a useful tool for our colleagues in all sectors of the native plant industry.

**Table 1.** Survey questions. Question numbers followed by letters indicate questions that, depending on the answer to the first part (a), had follow up parts (b, c). Multiple choice answers offered are shown in italics. Appendix B provides more detail on survey flow and Appendix C provides more detail on answer choices.

- Q1a This information is used to help us analyze the data. Under no circumstances would you or your organization be singled out in any summary of the survey results. Our findings will be aggregated so that individuals and their organizations remain anonymous. Organization name: \_\_\_\_\_
- Q1b Department, branch office, or other sub-unit name, if applicable: \_\_\_\_\_
- Q2 Please select from the list of states below to indicate where your office is located.
- Q3 Please select the option that best describes your organization's structure. *business/ non-profit/ federal/ state/ county/ municipal/ working group/ other*
- Q4 Please select the term that best describes the scale at which your organization operates. *local/ regional/ statewide/ multi-state/ nationwide*
- Q5 Please click on the map below to select the EPA Level III Ecoregion(s) served by your organization.
- Q6 Does your organization use native plants or seeds in its projects? *both/ native plants only/ native seeds only/ neither*
- Q7 Please select all that apply. For which purposes does your organization use native plant materials? *ecological restoration/ pollinator support/ wildlife habitat/ stewardship of lands we own/ mitigation or ecosystem restoration/ horticultural landscapes/ flood management or water resources/ green infrastructure/ land reclamation/ roadside vegetation/ post fire or storm rehabilitation/ production of plants for sale/ other*
- Q8a My agency would be open to changing project specifications to include the use of locally-adapted, native plants and seeds. *I agree/I disagree/I don't know*
- Q8b My office/department is allowed to change project specifications to include the use of locally-adapted, native plants and seeds. *I agree/I disagree/I don't know*
- Q8c Within my job duties, I am empowered to change project specifications to include the use of locally-adapted, native plants and seeds. *I agree/I disagree/I don't know*
- Q9a Does your organization have a definition of "native plant"? *yes/ no/ we refer to another organization's definition and that organization is \_\_\_\_\_/ don't know*
- Q9b Does the native plant definition used by your organization make any reference to ecoregion, seed zone, local provenance, or otherwise specify plants with a local genetic origin? *yes/ no/ don't know*
- Q9c Please select all that apply. Which concepts are included in your organization's interpretation of local provenance? *EPA Level III ecoregions/ EPA Level IV ecoregions/Plant Hardiness Zones/ empirical seed transfer zones/ 50-mile radius/ 100-mile radius/ within the county/ within a regional, multi-county area/ within the state/ other/ don't know*
- Q10a Is your organization subject to a policy that recommends or requires the use of native plants? *yes/no/don't know*



- Q10 Does the policy guiding your organization's native plant use specifically recommend  
b or require the use of locally-adapted (local ecotype, local provenance, etc.) plant materials? *yes/no/don't know*
- Q11 Please select all that apply. Typically, how does your organization choose the native plant species it uses? *commercial availability/lists of locally native plants/reference site information/outside contractors, designers, consultants/other/don't know*
- Q12 Typically, how far in advance is your organization able to forecast plant material needs? *less than 1 year/1-2 years/2-3 years/3 years or longer/don't know*
- Q13 How do you expect your organization's demand for native plant materials to change over the next 10 years? *increase/decrease/stay the same/don't know*
- Q14 Which statement best describes your organization's general preference when using native plants and/or seeds?  
*local ecotype/species/cultivars/no\_preference/other/don't know*
- Q15 How useful would your organization find an online listing of commercially-available, ecoregional native plant materials? *not useful/ slightly useful/ moderately useful/ quite useful/ extremely useful/ don't know*
- Q16 Would your organization be willing to share plant use/plant needs information if it could result in increased commercial availability of locally-adapted native plants and seeds? *yes/ no/ maybe/ don't know/ additional comments: \_\_\_\_\_*
- Q17 Can you estimate the total amount of plant materials your organization uses in a typical year? *yes/ after checking our records/ no we don't track this/ don't know*
- Q18a Which choice best describes your general experience with sourcing native plants? The species my organization wants to use are available as plants: *never/ rarely/ sometimes/ often/ mostly, with a few exceptions/ always/ don't know*
- Q18 b Which choice best describes your general experience with sourcing native plants? The species my organization wants to use are available as plants in our preferred ecotype: *never/ rarely/ sometimes/ often/ mostly, with a few exceptions/ always/ don't know*
- Q19a Which choice best describes your general experience with sourcing native seeds? The species my organization wants to use are available as seeds: *never/ rarely/ sometimes/ often/ mostly, with a few exceptions/ always/ don't know*
- Q19 b Which choice best describes your general experience with sourcing native seeds? The species my organization wants to use are available as seeds in our preferred ecotype: *never/ rarely/ sometimes/ often/ mostly, with a few exceptions/ always/ don't know*
- Q20 Please tell us about any recurring issues you have related to the availability of native plant materials and/or local ecotypes.
- Q21 In no particular order, please list your organization's top 5 commercial sources of native seeds.
- Q22 If there were a cost difference, how much more would your organization be willing to pay for genetically appropriate, local provenance plants and seeds? *no more/ up to 50% more/ up to 100% more/ greater than 100% more/ other: \_\_\_\_\_/ don't know*
- Q23a How limiting are these factors to your organization's use of local ecotype native plants? cost, lack of commercial availability, lack of seed transfer guidelines, lack of project lead time, lack of policy encouraging or requiring use, lack of organizational

- preference, lack of organizational awareness of benefits *not limiting/ somewhat limiting/ limiting/ very limiting*
- Q23 same as Q21a but with respect to seeds  
b
- Q24 How adequate are the conferences and/or other continuing education opportunities offered through your professional associations with respect to the use of local ecotype native plants and seeds? *slider bar ranging from 1 (unhappy) to 5 (happy)*
- Q25 Please select all that apply. What native plant protocols has your organization developed? *germination/ plant establishment/ plant production/ seed collection/ seed cleaning/ seed storage/ seed transfer/ other: \_\_\_\_\_/ none of the above/ don't know*
- Q26a Please select all that apply. Does your organization engage in any of the following production-related activities? *wild seed collection/ native plant production/ native seed production/ none of the above/ comments: \_\_\_\_\_*
- Q26 b Please select all that apply. Where does your organization collect wild seeds? *on our organization's lands/ on private lands not owned by our organization/ on public lands not owned by our organization/ other: \_\_\_\_\_/ don't know*
- Q26c Please select all that apply. Which of the following resources does your organization have? *propagation facilities/ greenhouses/ land for production/ irrigation/ seed collecting or harvesting machines/ seed cleaning equipment/ seed storage facilities/ other: \_\_\_\_\_/ none of the above/ don't know*
- Q27 Please select all that apply. *Which resources would be helpful to your organization? ecoregional species lists/ species fact sheets/ propagation protocols/ seeding rates/ planting densities/ plant establishment protocols/ seed transfer guidelines/ reference site information/ information on plant communities and associated species/ template garden designs/ landscape maintenance tips/ other: \_\_\_\_\_/ none of the above*
- Q28 Please select all that apply. *How would you describe your role, in relation to your organization's use of native plant materials? I select native plant species for projects./ I make purchasing decisions related to our procurement of native plants and/or native seeds./ other: \_\_\_\_\_/ none of the above*
- Q28 This survey is being disseminated to individuals who work with native plants across all sectors (public, private, non-profit) and at all scales. As such, the questions may not adequately capture your organization's experiences and concerns in regard to native plant availability and use. Please use this space to share anything else with us that we haven't asked you about: \_\_\_\_\_

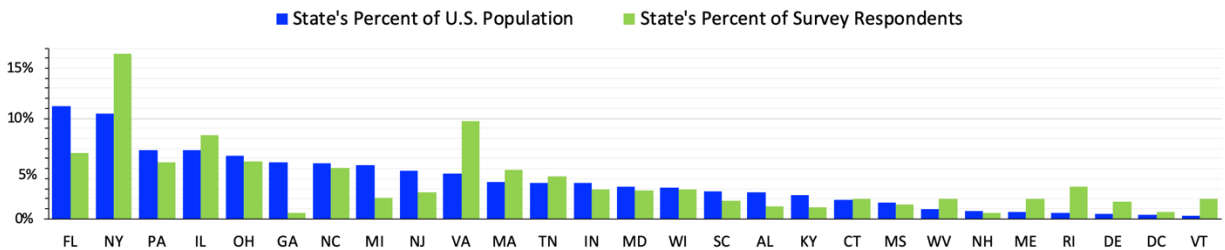
**Table 2.** Summary of prior surveys. Abbreviations: + = increasing, CE = customer education, LUM = landscape use and maintenance, PE = professional education, POP = better labels and/or point of purchase materials, PPP = plant production protocols, SE US = Southeastern US, SP = seed germination, storage, and/or production protocols, STZ = seed transfer zones

Year	Author(s)	Respondents	Region	n	Definition confusion	Local preference	Commercial availability	Premiums	Cost	Research, education	Demand
1998	Waterstrat, Deeds, Harkess	mostly nursery owners	SE US	196	not asked	not asked	poor for selection, quantity	not asked	not asked	not asked	+
1999	Tamimi	landscape architects	Hawaii	29	people vs. plants	not applicable	the greatest challenge	not asked	not limiting	LUM	+
2002	Potts, Roll, Wallner	landscape; retail; plant, seed growers	Colorado	33	not asked	not asked	poor for seeds (33%), larger plant stock	not asked	not limiting	LUM, PPP, PE, CE, POP	+
2003	Hooper	landscape architects	Utah	136, 15	86% about "native"	87% prefer in-state	79%	33% would pay more	serious factor 28%	LUM, POP	+
2007	Brzuszek, Harkess, Mulley	landscape architects	SE US	145	not asked	not asked	at least 63%	not asked	not limiting	POP	+
2009	Brzuszek, Harkess	wholesale, retail	SE US	129	not asked	not asked	at least 15%	not asked	not limiting	CE, POP	+
2010	Brzuszek	Master Gardeners	SE US	979	not asked	not asked	at least 68%	not asked	not limiting	POP	+
2010	Peppin	native seed suppliers, users	Arizona, New Mexico	37, 33	65% about "local"	93% concerned about genetic source	at least 27%	not asked	one of the greatest obstacles (22%)	SP, STZ	not asked
2011	Kauth, Pèrez	wildflower growers	Florida	51	64% about "native"	90% concerned to some degree	77% poor species, 54% poor seed	84% would pay more	lowest ranked concern	CE, PE, SP	+

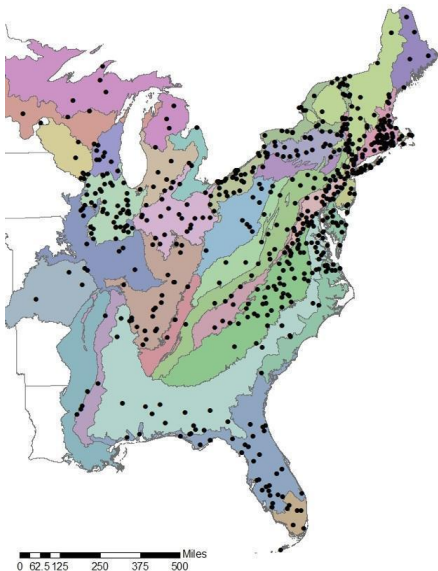
## 2. Results and Discussion

### 2.1 Who Are Our Respondents?

760 individuals responded to the survey, 676 of whom answered all questions. 709 respondents identified a state (or Washington, D.C.) as the location of their organization. Responses were received from all 26 states east of the Mississippi River, with no state having fewer than 4 respondents (Fig. 1). The general trend was that more populous states were the source of more respondents, as expected. Respondents conduct their work within all 32 US EPA Level III ecoregions (Woods, Omernik, & Brown, 1999) east of the Mississippi River (Fig. 2).



**Figure 1.** Geographic origin of respondent organizations. n=717. [Q1]



**Figure 2.** The 32 Level III ecoregions (colors) in the survey area and respondent organizations (dots), anonymized to protect their identities. No ecoregion had fewer than 16 respondents. Respondents were allowed to choose more than one ecoregion. 1700 responses, n=629. Ecoregion base map from US Environmental Protection Agency data set, 2013. [Q5]

Most of our respondents work at a local to regional scale. More than half of respondents indicated that their organization serves a single ecoregion, and 91% serve five or fewer ecoregions. Eighty-eight percent of respondent organizations operate at scales ranging from local to statewide, 10% at a multi-state scale, and 2% at a national scale. The general structure of their organizational affiliations is shown in Table 3. Organizations include parks (95), institutions of higher education (33), individuals (10), landscaping businesses, landscape restoration contractors, plant nurseries, conservation non-profits, watershed organizations, land trusts and conservancies, public forests, public gardens, highway departments, natural resource departments, neighborhood associations, schools, Master Gardeners, Master Naturalists, native plant societies, invasive plant control organizations, and one seed bank (n=709). Forty-eight percent of respondents are affiliated with a government organization.

**Table 3.** Please select the option that best describes your organization's structure. n=722 [Q2]

non-profit	30%
government: state	23%
government: federal	17%
private company/commercial business	15%
government: county	8%
government: municipal	3%
working group/collaborative	2%
individuals (write-in)	2%

We were concerned whether government agencies would have flexibility in terms of specifying the use of locally native plants for their projects. Government respondents indicated that they do, whether at the agency (97%, n=258), department (98%, n=281) or individual level (91%, n=278). The majority of all respondents are engaged in selecting species (78%) and/or making purchasing decisions (61%) for their organization, while 5% are not engaged in either.

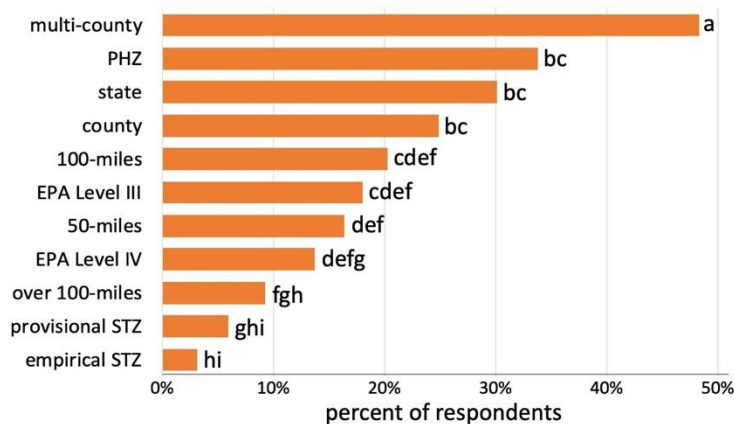
## 2.2 Definitions of Native Plant and Local Ecotype

Seventy-eight percent of respondent organizations have a definition of native plant (n=561). Sixty-four percent of organizations use an internal definition of native plant, 15% refer to another organization's definition, and 22% operate with no official definition,  $\chi^2(2, n=562) = 237, p < .0001$ . Among the 82 organizations using another organization's definition, government and non-profit definitions are equally popular (33 respondents each). The most frequently mentioned government source was the USDA PLANTS Database (8 respondents). The most popular non-profit sources are state native plant societies (11) and the Native Plant Trust (6). Technical references such as state flora and herbaria were also cited (9).

*“The average homeowner or facilities manager can't find native plants easily, has trouble telling what is native and what is not in nursery stock, and can't tell what the provenance of these plants is.”*

- Survey Respondent

Of the organizations with a definition, 81% include within it some concept of local genetic origin. Sourcing NPM's "locally" is key to avoiding maladaptation and maintaining appropriate adaptive genetic diversity in wild plant populations (Hufford and Mazer, 2003; McKay, Christian, Harrison and Rice, 2005). However, these organizations have diverse interpretations of what constitutes "local" (Fig. 3).



**Figure 3.** Please select all that apply. Which concepts are included in your organization's interpretation of local provenance?  $\chi^2(10, n=537 \text{ respondents}) = 467.8, p < .0001$ . 1,202 responses. Proportions followed by the same letter are not significantly different using a Bonferroni corrected alpha = .0028. Abbreviations: PHZ = Plant Hardiness Zone (USDA Plant Hardiness Zone Map, 2012), EPA Level III = EPA Level III ecoregion, STZ = seed transfer zone. [Q7]

*“There is also an issue with misinformation, suppliers claiming species are native - 'nativars' or using native to North America as the definition of native - and simply not knowing where the material comes from.”*

- Survey Respondent

Political boundaries play a prominent role in defining “local” for most organizations. 55% of respondents said their organizations perceive “local” in terms of political (state 30% and/or county 25%) boundaries. This is almost certainly a practical matter. Just over half of the respondents represent government agencies which have jurisdiction over political boundaries. However, the lead author has had many students who were surprised to learn that state boundaries have no biological meaning, that plants are not actually, for example, “native to Maryland”, so that common misperception probably plays a role here, too. Hooper (2003) mentioned similar confusion around the use of the term “Utah native plant”.

Of the 247 organizations using radius (37%), 36% use 50-miles, 44% use 100-miles, and 20% use over 100-miles. In comments, respondents wrote in ranges from 15 to 250 miles. Of the 126 organizations using ecoregions (23%), 77% use Level III and 59% use Level IV ecoregions. In comments 12 respondents indicated use of other types of biogeographic regions. Very few respondents use seed transfer zones (STZs) to help them determine how far they can go off-site for plant material without genetically compromising on-site and nearby plant populations.

Empirical STZs are research-derived zones within which seed may be safely translocated. They are determined by comparing the adaptive traits of multiple plant populations using common garden and reciprocal transplant studies (Plant Conservation Alliance, 2015). Empirically determined STZs are “species-specific and are influenced by many factors, including mating system and patterns of gene flow, geographic distribution of the species, the heterogeneity of the landscape and climate where the species occurs, and other biotic and environmental factors” (Havens et al., 2015). No empirical STZ results are available east of the Appalachian Mountains. Provisional STZs are estimates based on climatic, edaphic and other indirect evidence. They are not species-specific, and are intended as a stop-gap measure in lieu of actual empirical data.

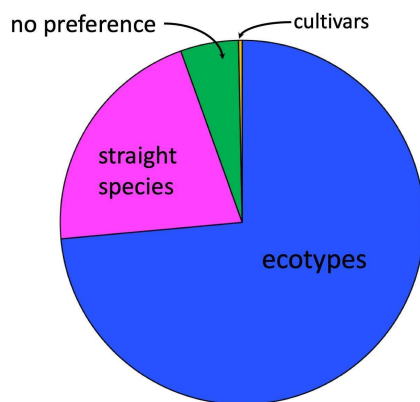
Among the 91 respondents who chose “other,” 20 said that for their organizations “local” means obtaining seeds from the site they will be used at. This is encouraging, provided that collection sampling methods are used to capture maximum population genetic diversity and protect parent populations, including collecting from large parent populations and using an appropriately stratified random search pattern (ENSCONET, 2009; Offord and Meagher, 2009; Haidet and Olwell, 2015; U.S. Bureau of Land Management, 2018). Respondents also made several good points in their comments, for example that natural range should be included in any concept of native; habitat is an important component of considering what is locally native; and climate change must be considered as we move forward. These thoughts are consistent with Havens et al. (2015), who instead of putting strict geographic limits on sourcing, such as political boundaries or radii, recommend a more complex approach that takes species biology, habitat, and climate change into consideration.

*“There are not enough options available for local ecotypes so myself and many of my volunteers and some colleagues have collected from lower quality remnants such as railroad corridors and roadside and we raise these plants ourselves in order to have local ecotype seed/plants for our own uses. This is very labor/time intensive and can't be used to meet all our needs and therefore we often need to go out of state/region to get the correct species and forgo ecotype preferences.”*

- Survey Respondent

## 2.3 Preferences and Policies

Seventy-four percent of respondent organizations prefer local ecotype NPMs (Fig. 4). The preference for local ecotypes is true regardless of the use for the plant material, including use for horticultural landscapes. Our results support the findings of all three prior surveys that have asked respondents about their preferences for local ecotypes. Hooper (2003) asked landscape architects about local preference by presenting them with a list of fifteen landscape objectives for native plants. For each objective, she asked if they would specify use of plants native to the site, the ecological region, or the Western United States. In all but one case, the majority of respondents chose either native to site or native to region, the sole exception being the specification of shade trees. 93% of Peppin et al.'s (2010) native seed producers and users expressed concern about the genetic source of their native seeds. Kauth and Pérez (2011) found that 90% of Florida native wildflower producers expressed some level of concern about the genetic origin of their stock, with 33% being very concerned.



*“Native plants and native seeds of local origin are rarely available. In order to complete restoration projects, my agency must disregard the recommendations of its own seed policy.”*

- Survey Respondent

*“It is often difficult, if not impossible, to find true species available for sale. Generally, commercial nurseries seem to prefer stocking cultivars. It's not always clear if the plant is a cultivar or not.”*

- Survey Respondent

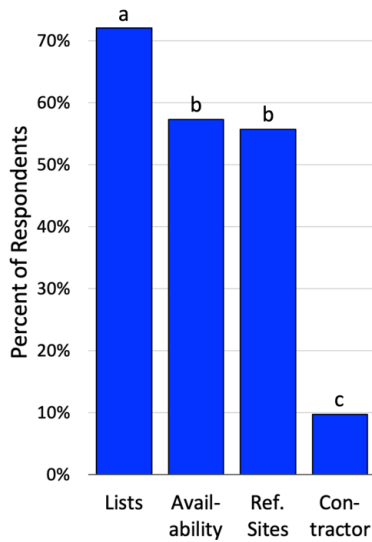
**Figure 4.** Overall, 74% of respondent organizations prefer to work with ecotypes, 21% with straight species, and 0.3% with cultivars. 5% have no preference,  $\chi^2 (1, n=640) = 813, p < .0001$ . [Q12]

The current survey is the first to ask respondents about their preference *for* cultivars. Our respondents exhibited a low preference rate for cultivars (.3% = 2 respondents). This was surprising to us because 39% of our respondent pool engages in horticultural landscaping. Our findings would seem to reflect decreased preference for cultivar use as NPMs, and presumably an understanding that horticultural uses of NPM's can affect nearby wild plant populations.

When we asked our respondents about organizational native plant policies, 59% of all respondents said that their organization has a standard operating procedure, agency manual, or other policy that recommends or requires the use of native plants<sup>2</sup>, and 67% of those (40% overall) have a policy that specifies the use of local ecotypes.

<sup>2</sup> Compared with 80% in a survey of Arizona organizations that use native seeds (Peppin et al., 2010)

## 2.4 Species Selection Methods



**Figure 5.** Please select all that apply. Typically, how does your organization choose the native plant species it uses?  $\chi^2 (1, n=660) = 297, p < .0001$ . Bonferroni corrected alpha = .0167. [Q9]

Respondents have preferred methods to determine what species they want (Fig. 5), such as lists (72%) and reference sites (56%), but many (57%) resort to purchasing whatever is available. Similarly, when Florida wildflower producers were asked about factors that influence their market, they said the lack of availability of desired species was their most serious limitation (Kauth and Pérez, 2011). Ten percent of our respondents have contractors that make species selection decisions for them. In the 131 comments, 20 respondents further emphasized the limitations of commercial availability. Others indicated that species are also selected based on growing conditions (9), pollinator/wildlife needs (9), vigor (3), and cost (1).

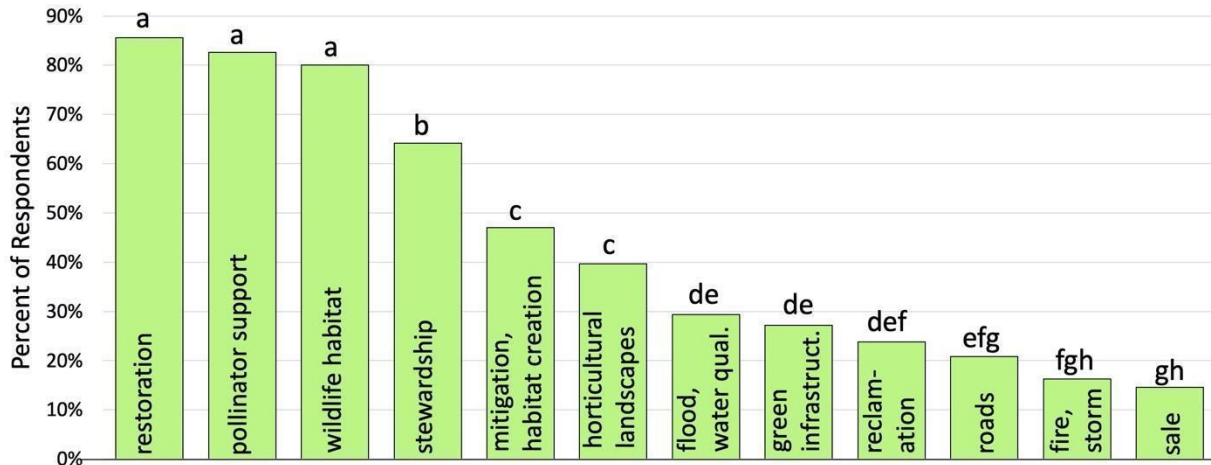
Do different types of organizations use different methods to select the plant species they work with? The answer is no, with one exception: Counties use reference sites much more often than other organizations do. Reference sites are generally considered an effective approach to species selection.

## 2.5 How Are Native Plant Materials Used?

Ninety-five percent of respondent organizations use native plants and 92% use native seeds.<sup>3</sup> The types of projects respondent organizations use NPMs for are indicated in Fig. 6. Respondents left comments about some additional native plant material uses that weren't included in the multiple choice options, or that were more specific than the options, including education (26), research (10), restoration after invasives (5), reforestation (5), shoreline stabilization (4), rare plant conservation (4), food production (2), and biofuels (1).

<sup>3</sup> In hindsight, some respondents may have answered native seed availability questions in reference to their use of, and access to, wild seed, either for subsequent plant production or for direct sowing in the landscape, rather than answering in reference to their use of bulk seed (seed as an end product of the seed increase process), as was our intent. However, we are able to see from write-in comments that most respondents interpreted our meaning correctly and answered with regards to bulk seed.

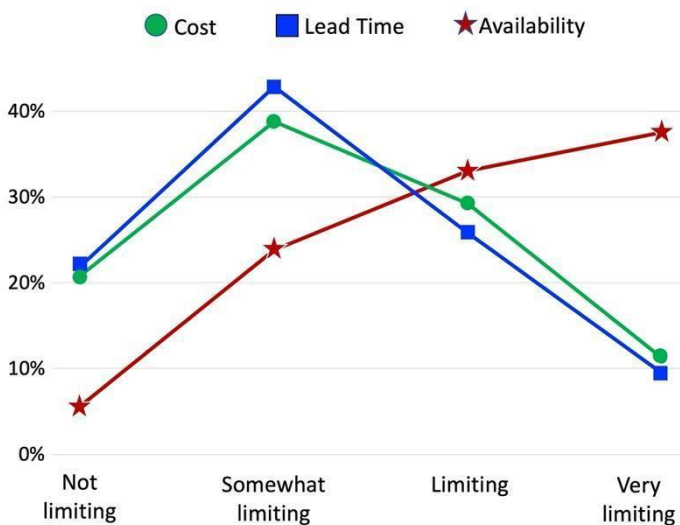




**Figure 6.** Please select all that apply. For which purposes does your organization use native plant materials? n=688. Values followed by the same letter are not significantly different, Bonferroni corrected alpha = .00333. [Q6]

## 2.6 Supply and Demand: What Limits the Use of Ecotypes?

Respondents want to use local ecotypes, but availability, cost, and lead time<sup>4</sup> are limiting their ability to do so. “Commercial availability” is the greatest challenge, with 94% of respondents describing commercial availability as limiting to at least some degree, and most often as “very limiting” (Fig. 7).



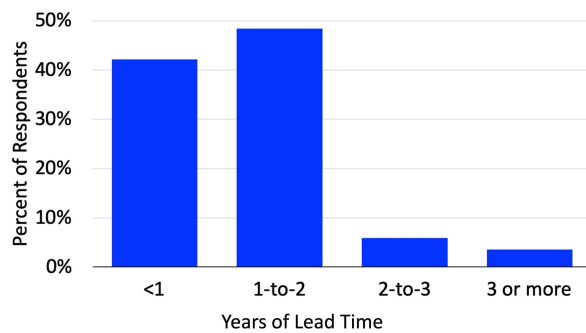
**Figure 7.** Please select all that apply. How limiting are these factors to your organization’s use of local ecotype native seeds? [Q21] The responses for native plants are nearly identical and not shown. Test of independence for availability  $\chi^2(3, n=442) = 94.29, p < .0001$ ; for cost  $\chi^2(3, n=436) = 94.59, p < .0001$ ; for lead time  $\chi^2(3, n=422) = 70.42, p < .0001$ . Other factors (policy encouraging use, awareness of benefits, seed transfer guidelines, organizational experience) were rated as “not limiting” by a majority of respondents.

“Cost” was most often perceived as “somewhat limiting”. Of nine prior surveys (Table 2), six found that costs were not limiting survey respondents’ use of NPMs, and two (Hooper, 2003; Peppin et al. 2010) found that costs were limiting for a substantial minority. We note that those

<sup>4</sup> The amount of time between when people become aware of a new project and when they have to put plants or seeds in the ground.

two surveys had a higher proportion of native seed users than other surveys did, and these findings may represent a higher gap between the cost of non-native and native seeds than between non-native and native plants.

“Project lead time” was also most often perceived as “somewhat limiting”. Our respondents have from 0 to 2 years of lead time when placing plant or seed orders. (Fig. 8) This is typically insufficient to order plants other than those that are already commercially available. In the junior author’s experience, fifteen months to 5 years are needed to custom grow plants (a growing season for wild seed collection, plus a winter season for cold stratification in temperate eastern North America, plus 3 to 12 months for herbaceous plugs; or plus 1 to 5 years for container trees). Lead times for horticultural production (“increase”) of bulk seed are even greater. Depending on factors such as need to collect wild seed, need to develop initial foundation seed, species, seed viability, and quantities needed, 5 to 10 years are needed to develop a new line of bulk seed.



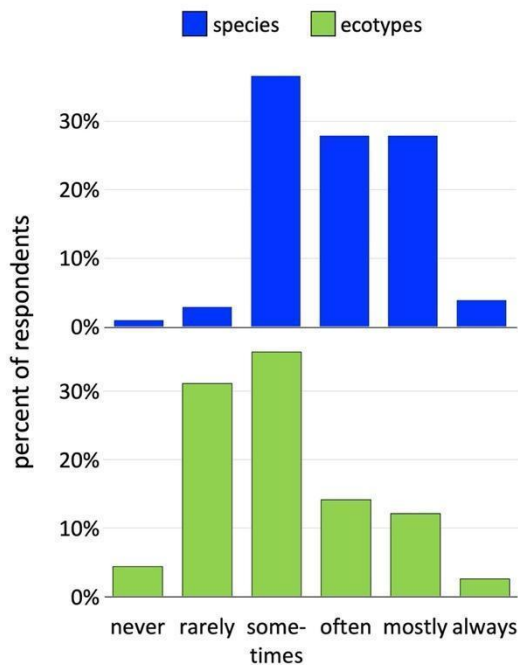
**Figure 8.** Typically, how far in advance is your organization able to forecast plant material needs? Respondents typically have 0 to 2 years lead time when placing plant or seed orders. n=610. [Q10]

For-profit businesses are the only type of organization with the majority of respondents reporting less than a year of lead time,  $\chi^2 (9, n=563) = 17.943, p < .05$ . This may be because activities with longer lead times are generally the purview of government agencies and non-profit organizations; or because for-profit businesses are generally hired to build projects, not necessarily to design and specify projects, and are often brought on board late in the process.

### Availability of Species and Ecotypes

Respondents were asked about commercial availability of the straight species and local ecotypes they need for their work. Respondents rated commercial availability on a 0 (never) to 5 (always) Likert-type scale. As mentioned previously, local ecotypes are preferred by 74% of respondents (Fig. 4), but that is where commercial shortages are the most severe. Only 15% of survey respondents described the ecotype seeds they need as always or mostly available (mean = 2.1, sd = 1.2, n=389, Fig. 9, 10). The commercial availability of straight species seeds isn’t good either, only 32% of respondents described them as always or mostly available (mean = 2.9, sd = 1.0, n=104). Similarly, in Kauth and Pérez’s survey (2011), 82% of Florida wildflower growers indicated that a reliable seed source was critical for their work, and 54% said that the seed supply was so low that it was limiting their production.

The results for commercial plant availability are similar. Only 12% of our survey respondents described the ecotype plants they need as always or mostly available (mean = 2.1, sd = 1.0, n=462). The commercial availability of straight species plants isn’t good either, only 27% described them as always (5) or mostly (4) available (mean = 2.8, sd = 1.0, n=609, Fig. 11).



**Figure 9.** Which choice best describes your general experience with sourcing native seeds? – A. The species my organization wants to use are \_\_\_\_\_ available as seeds. Organizations that prefer to work with straight-species seeds most often ranked them as “sometimes available” (mode=2, mean=2.9, sd=1.0, n=104). Organizations that prefer to work with local ecotype seeds most often ranked them as “sometimes available” (mode=2, mean=2.1, sd=1.2, n=389), too, but the distribution is skewed in the opposite direction, indicating lower availability; two-sampled, two-tailed t-test for unequal variances,  $t(184) = 7.37, p < .0001$ , Cohen’s  $D = .78$ ). Respondents were also asked about the availability of native plants, with nearly identical results. [Q17xQ12]

### Availability of NPMs: Geography

Respondents were asked to list their top commercial sources (up to 5) of native seed (Table 4). So many people wrote in “wild collection” that it ranked 3<sup>rd</sup> (15%) even though it would not really qualify as a “commercial” source.

On average, respondents purchase their native seeds from vendors who are 418 miles away. Even respondents who prefer “locally” native seeds go much farther afield than they would like. Respondents who conceive of local as a 50-mile radius are, on average, ordering seeds from vendors 415 miles away. Similarly, respondents who prefer a 100-mile radius are ordering seeds from vendors 375 miles away. Respondents who buy from the most popular vendor (Table 4) are on average 363 miles away; those who buy from the second-most popular vendor are on average 805 miles away. Respondents who think of local as being in the same state are buying out-of-state 85% of the time (n=138).

*“Besides, many of the native plant nurseries in Virginia purchase their seeds and plugs from out-of-state to grow in their greenhouses and then sell in-state as “Virginia” plants. I doubt that consumers realize this.”*  
- Survey Respondent

The measure of distance is further complicated by the fact that, in the experience of the authors, native seed vendors do not typically provide buyers with the provenance of the wild seed sources used for their production work, often offer seeds from multiple ecoregions, and/or sell seeds acquired from other vendors without knowing or revealing the provenance of those vendors’ seed sources. As a result, miles-to-seed-source could differ significantly from miles-to-vendor and further increase the chance that buyers are using seed maladapted to their site. When offered the opportunity to provide any additional comments about commercial availability issues [Q18], 39 respondents complained that vendor labeling makes it difficult to determine the genetic origin of NPMs.

We did not ask a similar question for distance to native plant vendors (nurseries). There are many more plant vendors than seed vendors. For example, the Maryland Native Plant Society

webpage, [www.mdflora.org](http://www.mdflora.org), lists 17 native plant vendors within state boundaries, but no native seed companies. So the distance between respondents and their plant vendors has the potential to be much less than the distance between respondents and their seed vendors. However, the distance to seed source could be greater, even considerably greater, than distances indicated by respondents (Table 4) and distance to seed source is the actual concern. For example, in her study of plants sold as native in Utah, Hooper (2003) found that they actually originated from a pool of nurseries in eleven states plus Utah.

**Table 4.** *In no particular order, please list your organization’s top 5 commercial sources of native seeds.* Vendors selected by more than 10 respondents are listed. [Q19]

Seed Vendor	No. Responses	Percent of Respondents	Average Customer Distance (miles)
A	201	47%	363
B	94	22%	805
wild collection	65	15%	NA
C	57	13%	399
D	44	10%	649
E	25	6%	110
F	23	5%	95
G	19	4%	195
H	18	4%	NA
I	16	4%	156
J	14	3%	121
K	13	3%	147
L	12	3%	441
Total	429		

*“Most plants are traveling far distances, and worse, many growers are not aware of the genetic source of material. In many cases, one collection spot may be responsible for restoration throughout an entire region.”*

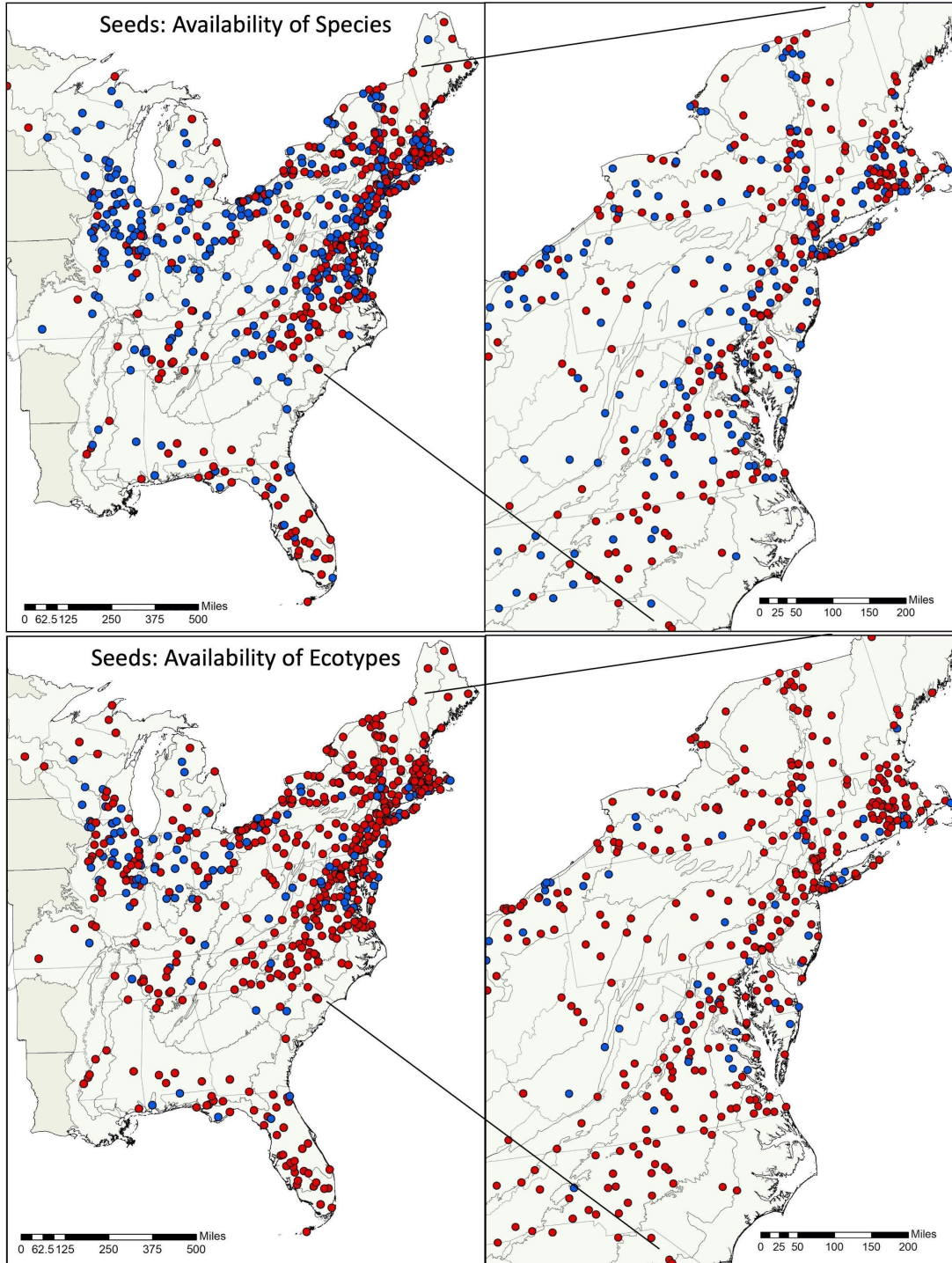
- Survey Respondent from a land conservancy in the Southeastern US

*“I find that many species were originally sourced from the Midwest, and that even producers in the east got their original material from places like...” vendor B in Table 4.*

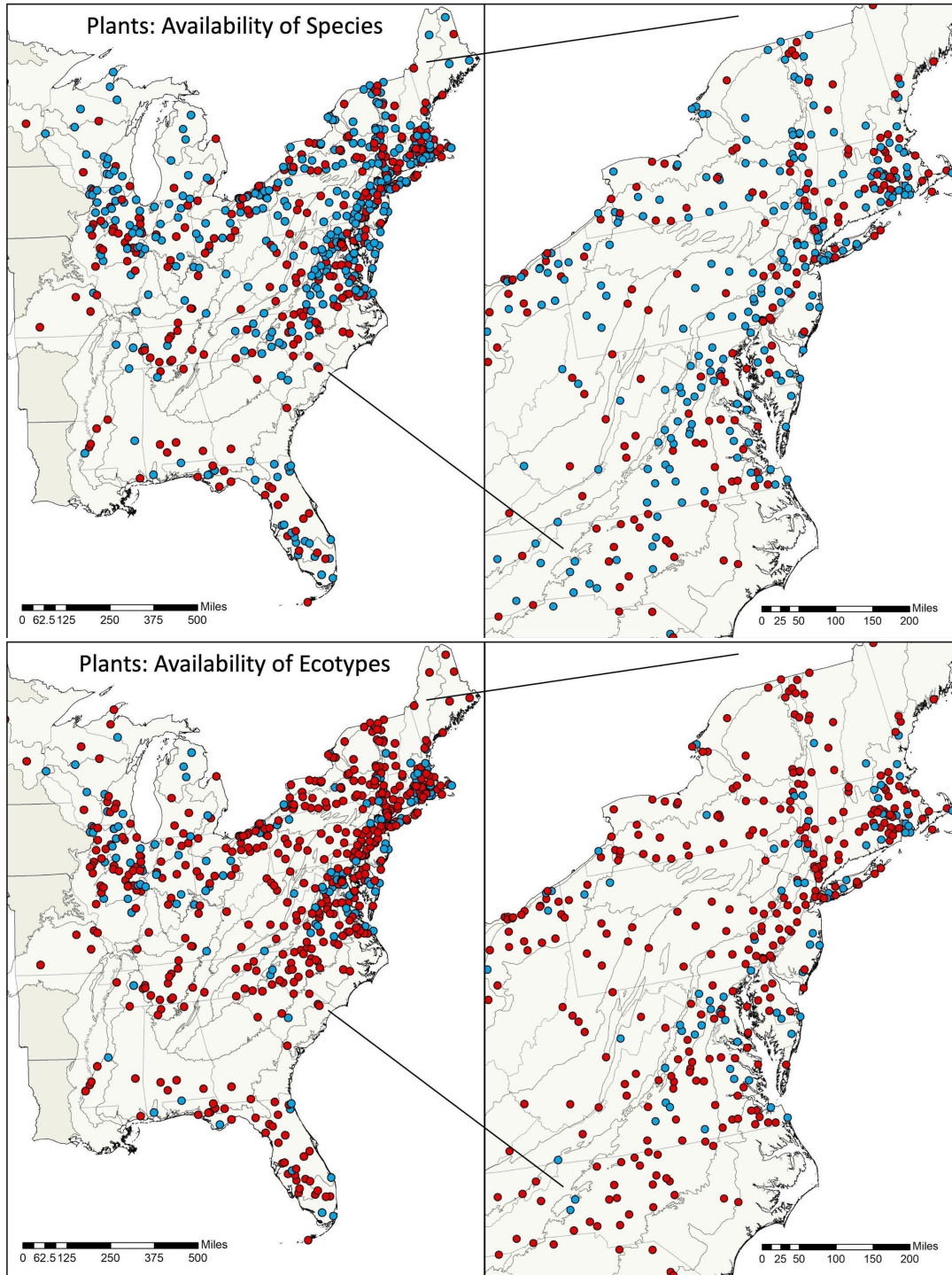
- Survey Respondent from East of the Appalachians

Proximity to a native seed vendor doesn’t impact respondents’ perceptions of native seed availability. For instance, 27 of our respondents who prefer Level III ecoregion seeds are lucky enough to work in the same Level III ecoregion as their native seed vendor, and as such we would expect these respondents to report high levels of local ecotype seed availability. However, these respondents experience the same low degree of availability ( $m=1.9$ ,  $sd=.92$ ) as others do ( $m=2.1$ ,  $sd=1.2$ ,  $n=389$ ).

As we have already seen (Fig. 9), native seed availability is worse at the ecotype level than at the species level. Commercial availability of ecotype seed peaks in a cluster of four states in the northwestern part of the survey area (Wisconsin, Illinois, Indiana, and Ohio;  $mean=2.6$ ,  $sd=1.1$ ,  $n=92$ ; Fig. 10), and is considerably worse elsewhere ( $mean=1.9$ ,  $sd=1.1$ ,  $n=288$ , Cohen’s  $D = .66$ ).



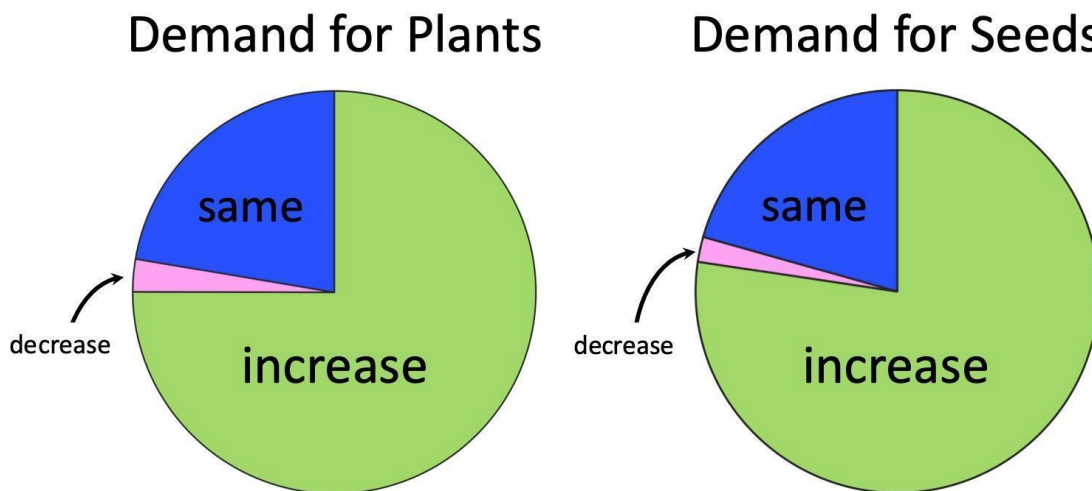
**Figure 10.** Upper maps: Respondents ranked the commercial availability of native seeds on a scale of 0 (never) to 5 (always). Respondents who ranked availability on the poorer half of the scale (0, 1, 2) are shown in red, those on the better half of the scale (3, 4, 5) in blue. Insets show detail in the most concentrated area of respondents. Respondent locations have been slightly altered-to protect their identity. [Q17]



**Figure 11.** Upper maps: Respondents ranked the commercial availability of native plants on a scale of 0 (never) to 5 (always). Respondents who ranked availability on the poorer half of the scale (0, 1, 2) are shown in red, those on the better half of the scale (3, 4, 5) in light blue. Lower maps: inset showing detail in the most concentrated area of respondents. Respondent locations have been slightly altered to protect their identity. [Q16]

## Increasing Demand

A large majority of respondents expect their organization to experience increased demand for NPMs over the next 10 years, which as we have established are already in short supply (Fig. 12). The expectation of increased demand was true in all of the 32 ecoregions surveyed. Expectations of increased demand were strongest in ecoregion 70 (94% of respondents).<sup>5</sup> Expectation of an increase was at 70% of respondents for all other ecoregions ( $p=.0140$ , Fisher's Exact Test). Our findings continue a pattern established by eight prior surveys, all of which reported expected increases (Table 2). This pattern was true even of surveys conducted during the Great Recession, suggesting that increasing demand for NPMs is a long-term and highly stable phenomenon.



**Figure 12.** 75% of respondents expect their organization's demand for native plants to increase over the next 10 years, 22% expect demand to remain the same, and 3% expect demand to decrease ( $n=573$ ). Responses were nearly identical for native seed demand (77%, 21%, 2%,  $n=548$ ). [Q11]

## An Open Question About Availability Issues

We provided respondents an opportunity to tell us anything they wanted to “about any recurring issues you have related to the availability of native plant materials and/or local ecotypes”. Respondents told us about poor commercial availability of local ecotype NPMs ( $n=122$ ) and/or poor selection of species (106). They mentioned a shortage of suppliers (72), and that where suppliers exist, plants/seeds are frequently out of stock (63). They complained about plant labels that omit or misrepresent genetic origin, or that misidentify species, or that indicate straight species or local ecotype even though the product itself is actually a cultivar (46). They shared concerns about cost (41), trouble finding nursery stock in larger sizes (20), and short lead times (18). Sixteen respondents complained that most of the plants or seeds available to them are cultivars, whereas one respondent writes that cultivars are sometimes useful in formal landscapes. They wrote about contracting and procurement issues (15), and the related problem of inappropriate substitutions (10). They told us they need more technical information (13), and

<sup>5</sup> Ecoregion 70, the Western Allegheny Plateau, stretches from Western Pennsylvania to northeastern Kentucky. It includes the cities of Pittsburgh, PA, and Wheeling WV.

that they have problems with seed mixes (10). Nine wrote about the difficulty of finding wild populations for collecting source seeds, some due to habitat destruction and fragmentation. Seven respondents wrote about the confusion surrounding what constitutes a native plant and how that relates to commercial availability. Many wrote about combinations of these issues. For example, one respondent described how the commercially available meadow mix, which comes from a distant region and therefore contains alien species, shapes public perceptions and expectations of what constitutes a native meadow where he works.

## 2.7 Users That Produce Their Own Plants and Seeds

We asked respondents if they were also producers of seeds and plants. A surprising number said they are<sup>6</sup>. Fifty-eight% of respondent organizations engage in wild seed collection (95% CI [55, 63]). These results are similar to the Florida survey, where 61% of native wildflower producers wild collect seeds to support plant production (Kauth and Pérez, 2011).

*“Rampant development is destroying many important plant habitats and we are racing to collect everything we can...”*  
- Survey Respondent

*“Difficult to find seeds and plants from coastal settings where development has destroyed most donor sites.”*  
- Survey Respondent

*“Sometimes, we can't get seed for a desired plant from our own watershed as the plant can no longer be found.”*  
- Survey Respondent

Our respondents also engage in native plant production (38%, 95% CI [36, 41]). This is well in excess of the percent who sell plants, too (14%, Fig. 6), suggesting that most of the plant production is for internal use. Fewer respondents engage in native seed production (23%, 95% CI [22, 25]). Sixty-five respondents wrote-in comments: 24 wrote that they don't engage in any of the listed activities, 19 said that the production they do is for internal use only, 15 said they hope to begin wild collecting seeds and/or producing plants in the future, 4 respondents said their organizations wild harvest live stakes (used in bank stabilization), and 2 respondents indicated that their organizations engage in plant rescue operations. The responses to this question suggest significant overlap between end-users and producers, perhaps driven by necessity, if nothing else.

We don't know the number of species or the quantities of their production, and it is not clear how significant this contribution is in terms of meeting overall demand. We did not ask more questions about production practices, quantities or species because the focus of this survey is native plant and seed *use*. Another survey that focuses on native plant and seed production should be conducted. However, it seems likely that if organizations were not meeting some of their own NPM demands, commercial availability problems would be even worse.

*“We have struggled to find local ecotype plant materials available to us. Limited funds and lack of availability has led us to collecting and growing our own.”*  
- Survey Respondent

<sup>6</sup> The Qualtrics software failed to report “none of the above” responses for question 25. This left us unable to tally the total number of falses as well as the total number of respondents, n, which is the denominator in the calculation of percentages. To obtain an estimate of n we averaged n-values for the two preceding and the two following questions. The mean is 596 with a standard deviation of 41.8. In the paragraphs that follow, these statistics are used to estimate percentages and provide the 95% confidence limits for those estimates.



## 2.8 An Open Question

*“Very difficult to find seed grown stock of shrubs or trees - everything is clonal.”*  
- Survey Respondent

Offered the opportunity to tell us about anything we hadn't asked, 197 respondents took time to write in closing comments. Thirty-six percent told us more about their work with native plant materials. Seventeen percent complained about poor commercial availability, and 14% complained about a lack of professional training opportunities and/or fact sheets. Ten percent discussed topics of research that would benefit their work. Eight percent either said they use NPMs to restore project sites degraded by invasive plants, or wrote about challenges presented by invasive species. Six respondents wrote that their budgets couldn't always accommodate the high cost of NPMs. Multiple respondents also wrote about policy issues, program funding problems, climate change, deer overpopulation, short lead times, a lack of qualified contractors, problems with the bidding process, and the need for an online marketplace, respectively.

## 2.9 Potential Solutions

### Support the Production Efforts of NPM Users and Regional Seed Banking Practices

Many respondent organizations are engaged in some level of native plant and seed production (Section 2.7). Empowering these users/producers to become part of the supply chain itself could help lessen NPM shortages. One potential way to bolster this sector would be to provide NPM users the type of technical support that would ordinarily be targeted at producers (see education and outreach discussion below). Organizing regional efforts into cooperatives or cost sharing arrangements is another potential and empowering tool, especially when structured to encourage academic, government, not-for-profit and commercial sector participation, and pooling resources to more effectively tackle the multi-faceted aspects of NPM development than would be possible if working alone. Such networks are becoming more common in the West but have yet to appear in the East. Two excellent examples include *the Great Basin Native Plant Initiative* [<http://www.greatbasinnpp.org>], and *the Colorado Plateau Native Plant Program* [<https://cpnpp-natureserve.hub.arcgis.com/>].

*“There's a marketing gap between the actual availability of flora and what people have access to. We produced a 5,000 plant surplus last year. We need help getting the word out and distributing plants.”*  
- Survey Respondent

Table 5 shows the degree to which respondent organizations have adequate internal infrastructure to support the entire process of obtaining, preparing, and deploying NPMs. In write-in comments, 16 respondents emphasize that although they have resources, they are very small scale. As we pointed out in Section 2.7, the scale of these users' current production and to what extent they have the monetary resources to increase their production capacity would determine to what extent, if any, their operations could alleviate shortages for others in their region. Twelve respondents emphasized the value of partnerships in their ability to leverage external resources.

The table indicates both the presence of some limited capacity in the Eastern United States, but also the degree to which most respondents are lacking basic production infrastructure. For example, among the 325 respondents who wild collect their own seed, only 31% have seed

storage facilities. While this may indicate that some wild collectors are putting the seed to immediate use, it also indicates that the majority of those collecting seed don't have the means to store seed properly to maintain anything but very short-term seed viability. Furthermore, only 24% of wild seed collectors and 44% of seed producers, for example, have even basic seed cleaning equipment.

Public sector seed banks provide short-term to long-term seed storage and some offer these services to outside groups to store their seed, allowing them to make withdrawals as needed, ensuring seed viability. Seed banks make a wider diversity of seed available to all users on short notice while managing and conserving wild source populations. Peppin et al. (2010) also proposed seed banking as a potential solution, recommending expanded seed storage facilities and providing growers with starter seed.

*“There are not enough options available for local ecotypes so myself and many of my volunteers and some colleagues have collected from lower quality remnants such as railroad corridors and roadside and we raise these plants ourselves in order to have local ecotype seed/plants for our own uses. This is very labor/time intensive and can't be used to meet all our needs and therefore we often need to go out of state/region to get the correct species and forgo ecotype preferences.”*

- Survey Respondent

users who:	n =	propagation facilities	greenhouses	land for production	irrigation	seed collecting/harvesting machines	seed cleaning equipment	seed drying facilities	seed storage facilities	none
wild collect seeds	325	38%	38%	46%	25%	18%	24%	23%	31%	26%
produce plants	214	62%	58%	62%	41%	20%	30%	28%	39%	11%
produce seeds	133	62%	62%	63%	39%	32%	44%	42%	52%	9%

**Table 5.** Users who also produce and their production resources (n=370). [Q25]

Havens and Kramer (2015) go a step further and call for the wild collection of as many species as possible, especially restoration species. All NPM development strategies would be strengthened by maintaining and making widely available collections of wild seed in a network of regional seed banks. The National Seed Strategy also calls for “field collections of seed that represent the genetic diversity of species populations” and their use in “seed zone development, seed production, restoration, research, breeding, and conservation” (Plant Conservation Alliance, 2015). It also calls for national seed banks to accommodate long-term, frozen storage of seeds for use in research, and the use of regional seed banks, like the Mid-Atlantic Regional Seed Bank, for short-term, temperature- and humidity- controlled storage of seeds that can be withdrawn for use in restoration projects.

*“We need to consider plant/seed availability when creating the designs. There are many species that I would love to specify, but can not be sure will be available in the quantities needed, and there is not time to contract grow. An online source for trying to find the various species would be extraordinarily helpful, as it could greatly expand the species diversity of our projects.”*

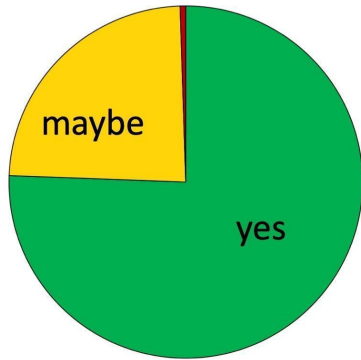
- Survey Respondent

Seventy-eight percent[1] of respondent organizations engaged in wild seed collection collect at least some seed on land owned by the organization, with 41% collecting *only* from their own land (n=332). Utilization of outside seed resources is also important to organizations that wild collect native seeds. Forty-four percent of organizations wild collect seed on public land they don't own, 48% do so on private land they don't own. When wild collection efforts are decentralized and use of the resource is not planned, coordinated and monitored, the threat of overcollection must be higher, especially as source populations decline due to habitat loss. Overcollection of wild seed is harmful to parent populations and the ecosystem in general. One possible tool suggested by the National Seed Strategy is a database for tracking seed collection on Federal sites.

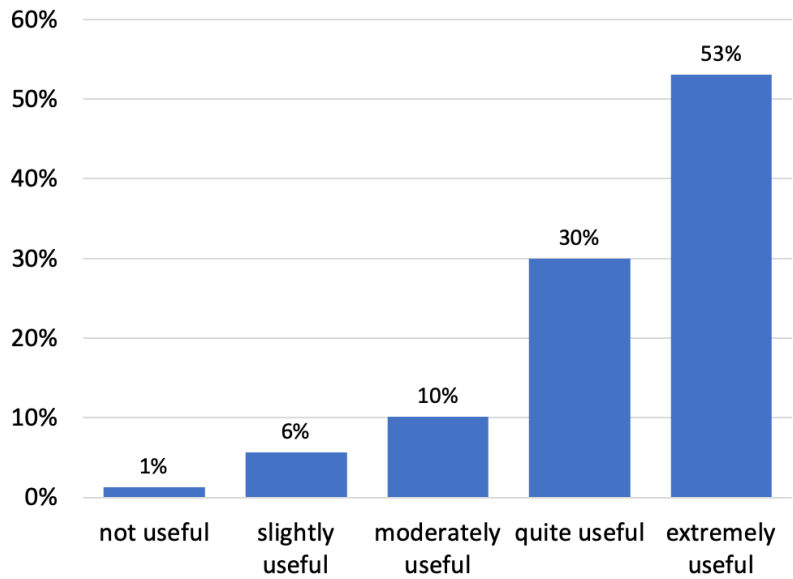
Most importantly, all of these issues of seed supply point to the utility of regional seed banks taking responsibility for managing, conserving, and sharing limited and shrinking wild seed resources

### **Create A Better Connection/Online Marketplace**

Survey results clearly indicate that NPM users are having difficulty sourcing the plants and seeds they need to successfully complete their organization's projects. Commercial availability might be improved if there were a better connection between those with needs and those with supply. Most organizations would be willing to share information regarding their native plant materials needs if it would improve commercial availability (Fig. 13). Respondents also thought their organizations would find information on market supply useful (Fig. 14). An online marketplace where vendors could post their inventory and buyers could post their needs could be very useful. The National Seed Strategy, as part of Goal 3, calls for just such a tool, “it will be necessary to develop national/ecoregional data, databases, and websites with seed needs and seed availability”.



**Figure 13.** *Would your organization be willing to share plant use/plant needs information if it could result in increased commercial availability of locally-adapted native plants and seeds? 75% said yes, 0.5% said no (n=594). [Q14]*

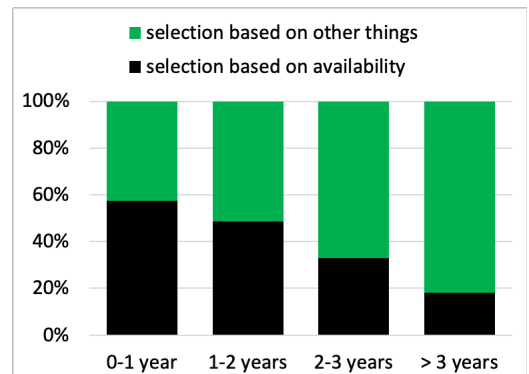


**Figure 14.** *How useful would your organization find an online listing of commercially-available, ecoregional native plant materials? n=641. [Q13]*

### Increase Lead Time; Improve Procurement Policies

Respondents with longer lead times are less likely to select species based on commercial availability than their counterparts are (Fig. 15). Anything that increases lead time would improve the quality of species selection. Given that contractors hired late in the project are the last professionals to know which plants are going to be needed for a project, one potential solution is to move the responsibility for NPM acquisition further up the chain. The University of Maryland Arboretum, for example, makes its own plant selections and purchases, which it then provides to planting contractors to install (Bill Monan, 2019, personal communication).

Government procurement policy is a little explored and poorly understood subject outside of a cadre of procurement professionals. Municipal, state and federal entities may each have their own policies regarding how and when NPM purchases are to be made. For instance, in New York City, where a dozen or more municipal, state, and federal agencies procure NPM's, significant impediments to timely sourcing exist in procurement policy. Almost without exception, plants cannot be procured during planning and project design stages, only after a contract has been



**Figure 15.** Respondents with short lead times are more likely to select species based on commercial availability (black),  $\chi^2 (3, n=577) = 19.422, p = .0002$ . Bonferroni-corrected alpha = .0125. By contrast, respondents' use of plant lists, reference sites, and contractors for selection of species was independent of lead time. [Q9xQ10]

awarded. Mostly this limits availability to the existing stock of NPM vendors and forces projects to seek NPM’s farther afield than they’ve specified.

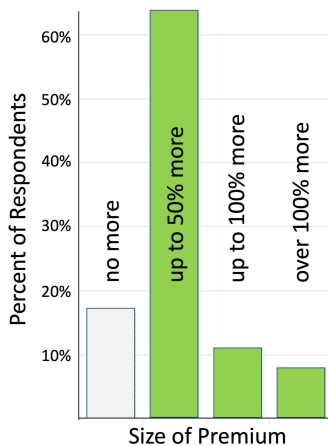
Hooper’s (2003) interviewees described problems with lead time, and stated that up to 3 years could be needed for the production of larger specimens or slow growing species. In western states, where wildfires cause "high demands for large quantities of native grass seed on short notice", Peppin et al. (2010) proposed the following measures to reduce lead time: expanded seed storage facilities, contract growing, and providing growers with starter seed and production protocols. Some federal agencies use a procurement method called “Indefinite Delivery, Indefinite Quantity” (IDIQ) in an attempt to warehouse contractor-produced seed in anticipation of post-wildfire needs. The National Seed Strategy also recognized the problems surrounding lead time and procurement, and calls for engaging, “federal procurement specialists to assess current contracting regulations and practices to identify strengths and take actions to correct deficiencies.”

Other relevant procurement issues include sole-sourcing, open-bidding, and funding allocations. Sharing of innovative procurement policies can expedite improved practices. For

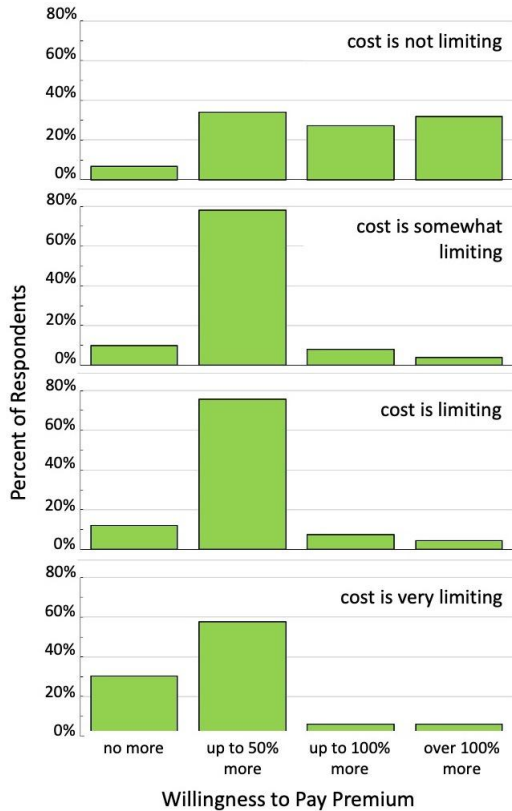
*“Planning to implementation may be as short as a few months so availability can drive the species lists we use.”*  
- Survey Respondent

*“Again, include growers in your design and development phase.”*  
- Survey Respondent

*“Buying materials from small local companies is difficult for us due to our state procurement policies.”*  
- Survey Respondent



**Figure 16.** *If there were a cost difference, approximately how much more would your organization be willing to pay for genetically appropriate, local provenance plants and seeds?* 83% of organizations would be willing to pay more for local ecotypes. n=286. [Q20]



**Figure 17.** Interaction between how limiting cost is (graph panel) and willingness to pay a premium for local ecotype plants. The responses for native seeds are nearly identical and not shown. Fisher’s Exact Test of Independence (n=244, p <.0005). [Q20xQ22]

instance, so-called Best Value Bidding under consideration in Los Angeles, can mitigate or improve the quality of returned bids and the performance of suppliers and ensure a better match to specified NPM’s (Jao, 2015).

### Charge Premiums

It is possible that commercial producers would be motivated to produce more ecotypes if they knew how many buyers would pay a premium for them. Of respondent organizations that prefer local ecotypes, 83% would pay a premium to obtain the ones they want (Fig. 16). Among the 17% who would not, a few provided their reasons: the public bid process (4), federal cost share programs and related plant lists (3), and budget constraints (3). Thirty-three respondents wrote that they would pay a premium when their budget, grant, or client permits it. Eleven wrote that they would pay a premium for some landscape uses but not others, and 10 respondents commented that they would pay a premium for some species but not others. The willingness to pay a premium is particularly important given that a well-structured NPM supply chain will probably increase the cost of NPMs, especially during the years it will take to develop the supply system.

If 78% of respondents find cost to be

limiting (Fig. 7), how is it that most are willing to pay a premium? It would seem that regardless of how constraining a factor cost is, the majority of respondents will still try to eke out as much as an extra 50% for the local ecotypes (Fig. 17).

## Provide Research, Continuing Education & Technical Documents

### A. Research and education needs identified by our respondents

An overwhelming portion of respondents (95%) want better availability of technical information (Table 6). Species lists are the most desired type of technical document (66%). This is consistent with respondents’ answers to a previous question indicating that 72% of respondent organizations use lists for species selection (Fig. 5). These findings suggest that access to regional lists authored by qualified ecologists would be very useful to the majority of respondents. Published lists could be used by both NPM consumers and producers, and by getting both groups to focus on the same subset of species (compared to the thousands that are native), published lists could contribute to improving commercial availability.

*“Many people seem not to know where to start. Many are wholly unaware of the benefits of natives, let alone knowing what local ecotypes are.”*

- Survey Respondent

The majority of write-in comments are seed related (19), seeking either technical information for working with native seeds (ripeness, harvest, drying, storage, viability, germination, etc.) or help locating qualified professionals or commercial sources. Nearly as many are about research needs (17) and fact sheets wanted (16). Respondents also want improved commercial availability information (n=13), in agreement with the high approval rating for the concept of an online marketplace (11) (Fig. 13, 14).

Research has no value unless it is transferred to the public through outreach and education. In keeping with all prior surveys (Table 2), respondents to the current survey said that better educational opportunities and more fact sheets and other outreach materials would be helpful. Fifty-six percent of respondents with preference for local ecotypes rated existing continuing education opportunities as either mediocre or below average. Respondents who rated continuing education as above average are concentrated in major urban areas (Chicago, New York, Philadelphia, and Washington, D.C.). Respondents from the more southern portions of the survey area and respondents from the Appalachians were more likely to report below average educational opportunities.

A few issues surrounding the lead time problem, whose potential solutions were already discussed, are specific to continuing education and outreach and so we discuss those here. For example, it may be that some NPM users don't have a good grasp of plant and seed production timelines, and this prevents them from planning far enough ahead to experience good commercial availability. Newsletters and/or professional conferences that serve both the grower and buyer communities could be helpful.

Type of Information	Percent
ecoregional species lists	68%
plant establishment protocols	66%
seeding rates/planting densities	65%
species fact sheets	61%
plant communities and associated species	56%
propagation protocols	54%
seed transfer guidelines	43%
reference site information	41%
template garden designs	31%
landscape maintenance tips	31%
if other, please describe:	15%
none of the above	5%

**Table 6.** Please select all that apply. Which resources would be helpful to your organization? n=617. [Q26]

**B. Continue necessary research but take practical steps to dramatically and rapidly increase the supply of appropriate seed.**

We prompted respondents to tell us what types of protocols they had developed, and most have not developed any (Table 7). Even if NPM users work with a fraction of the 18,000 vascular plant species native to the United States and Canada (Flora of North America Editorial Committee), then thousands

of seed germination, seed testing, seed storage, seed and plant production, and field establishment protocols still need to be developed. Furthermore, these protocols need to be sensitive to regional variation in factors such as, for example, seed stratification requirements. Users themselves have made some progress toward this end, with 48% of respondents indicating that their own organization has developed at least one such protocol. However, the dearth of widely available, shared protocols<sup>7</sup> suggests that most of these are reserved for in-house use and are never published. Rather than having each NPM user responsible for developing their own protocols, it would be better if protocol development were publicly funded. This would result in

<sup>7</sup> The US Forest Service's Native Plant Network provides 3,143 protocols, each covering some aspect of the production of 1,972 plant species.

Type of Protocol	Percent
none	52%
seed collection	34%
plant establishment	31%
seed storage	25%
germination	20%
seed cleaning	20%
plant production	18%
seed transfer/seed movement	13%

**Table 7.** Please select all that apply. What types of native plant protocols has your organization developed? n=534. [Q24]

over huge distances (Table 4), Kilkenny’s concept of a research network needs to be implemented on a national scale. In addition to resolving the prevalent confusion around what is meant by “local” and “native”, these studies would empower us to predict climate change’s effects on plant distributions (Havens et al., 2015; Plant Conservation Alliance, 2015; Kilkenny, 2017).

However, the research needed to delineate empirical STZs for hundreds or even thousands of species across the nation will take years, possibly decades to conduct, even if adequately funded. The harsh reality is that while we wait for the science, NPM users must continue to make risky decisions about where to obtain their materials, even though they know they are being forced into making bad choices, as borne out by this survey.

In addition, the ambiguity over what is "local" is problematic in procuring NPMs. When it comes to writing project specifications and contracting with growers, terms like “local ecotype”, "locally sourced", or other qualifiers become part of the contract language. Until we get to a point where NPM users can write a spec requiring plants to come from a specific, *available* seed source, the procurement of NPMs will remain flawed and often harmful. For all of these reasons, a risk management approach to sourcing seed is warranted. Risk management exists as a discipline in finance, medicine, and other fields. In principle it seeks to identify risks, identify options to minimize those risks, and then to take steps to minimize the probability of negative outcomes in the face of uncertainty. We have identified the risk - placing maladapted seed into the landscape. Certain developments such as mapping provisional seed transfer zones (Bower, St. Clair, and Erickson, 2014.), help to minimize the risk. A more direct way to minimize the risk would be to get as many geo-referenced, genetically diverse, appropriately sampled and accessioned seed collections as possible into the hands of native plant and seed users and producers. This could be accomplished through a network of regional, active seed banks<sup>8</sup>. Seed banks that offer sufficient variety,

*“We have questions about how much to plant to assure success, how close should planted patches be to assure cross-pollination, what are the best plant communities (so far we have tried to match conditions with donor site), how to protect plants from herbivory (deer, groundhogs, small rodents), and how to avoid inbreeding depression.”*

- Survey Respondent from a small, urban municipality trying to restore its remaining natural areas

<sup>8</sup> Active seed banks are designed to provide short- to mid-term storage of seed under accepted protocols to maintain seed viability for years to decades until needed. Seed is intended for active use for NPM production and other related purposes rather than long-term storage intended to conserve seed as a hedge against losses in nature.



*“I am interested in regions to our south, as a way to prepare for and adapt to a changing climate. Does it still make sense to use plants only from our current ecoregion?”*  
- Survey Respondent

quality, and quantity of geo-referenced seed would allow end users to source materials from similar habitats that are near their work sites. In so doing, they would lower risk and cause the least possible harm given the choices available at that time. End users able to specify production from these selections could contract directly with producers to custom grow. It would also potentially lead producers into these markets based on demonstrable and increased demand for these more-locally sourced products.

Eventually, when empirical STZs are delineated, users will be able to implement them more quickly with well-stocked, active seed banks already in place.

This approach has been used effectively for twenty-five years in New York City at the Greenbelt Native Plant Center (GNPC). Without the benefit of STZs or (until recently) even provisional STZs, the GNPC takes a risk management approach to its plant production. On average it maintains 2,000 accessions of wild seed of approximately 500 species native to NYC in its seed bank. With many populations in decline or extirpated from the City’s parks, seed is scouted and collected from nearby healthy populations, carefully recording data about each collection site. Each collection receives a unique accession number that follows each of the half million plants a year through production at the nursery. This allows the staff to make informed decisions about pairing seed source to outplanting location and allows them to tailor production to meet specific outplanting site conditions as needed. Following this approach the GNPC has over time placed in excess of 12 million plants into the natural and built environment of NYC, and almost certainly at lower risk for maladaptation than if we had obtained those plants from open market sources with available stock of unknown or distant provenances.

### 3. Conclusions

The one thing that the 760 NPM users who responded to this survey have in common is that, in order to perform some essential landscape management work, they need access to a reliable supply of native plants and seeds. This survey is not the first to document the poor commercial availability of the NPMs needed to manage the American landscape. Instead, it adds to the body of evidence created by nine prior surveys, further documenting the poor commercial availability of NPMs and the preference for local ecotypes. This survey covers a larger geographical area than its predecessors, and adds input from regions that had not been surveyed before. This survey is the first to ask about preference for cultivars, straight species, or local ecotypes; the first to analyze responses about commercial availability in the context of these preferences; and the first to show how far respondents who prefer local ecotypes must go to secure native seed. Cumulatively, these surveys document that the United States' commercial shortage of NPMs is wide-ranging and chronic. Our findings support the National Seed Strategy's (Plant Conservation Alliance, 2015) call to meet our nation's growing demand for genetically appropriate NPMs, as well as some of their more specific recommendations such as building a network of seed banks and seed storage facilities; delineating empirical seed transfer zones; developing propagation, storage and use protocols; an online marketplace; and educational programs for producers and users.

*"I would be happy to propagate & grow out local ecotype. Get me the seeds. Costs may be slightly higher, and there will probably be some delay to have sizable plants, but we would happily grow more local ecotypes. Thanks!"*

- Survey Respondent who runs a nursery in the Mid-Atlantic

Our survey results indicate that land managers are moving away, or want to move away, from reliance on cultivars of native species and toward the use of local ecotypes, with 74% of survey respondents expressing a preference for local ecotype NPMs and only 0.3% expressing a preference for cultivars. The poor commercial availability of local NPMs places respondents in a position where they must continually incorporate non-local NPMs into their project sites, risking project failure and/or degradation of natural areas.

Optimally, the movement from cultivars to local ecotypes would rely on a science-based understanding of what constitutes "local". The National Seed Strategy calls for the development of empirical seed transfer zones for major restoration species (Plant Conservation Alliance, 2015). Without this critical information, our survey respondents have been left to develop a variety of interpretations of local, mostly associated with political boundaries, distances, or biogeographical regions. At the end of the day, respondents needing native seeds must go to whatever commercial sources exist, and these are usually much farther afield than their own interpretations of local ecotype would allow. To counter this, approaches are needed to lower the risks and increase the choices in available NPM's so that those risks can be better managed.

We also asked what respondents thought of potential solutions to the commercial shortage of NPMs. Like prior surveys (Table 2), this survey shows that NPM users feel they would benefit from better technical support. They want more fact sheets and better educational opportunities. This is however, the first survey to ask respondents about the possibility of sharing demand and supply information in an online forum, an idea that received overwhelming support.

The findings of this survey support several of the actions recommended by the committee that wrote the National Seed Strategy (Plant Conservation Alliance, 2015). Most of our respondents believe their demand for NPMs will only increase with time, which will exacerbate this already bad situation. Like survey authors before us, our hope is that these survey findings can be used to

facilitate the development of the more robust NPM supply chain, improved technical information, and better market information, that respondents want.

## Acknowledgments

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## Appendix A: Methods

We sought to find those who use native plants in their work and to get them to take a survey about their practices and issues. Unfortunately, the true population of native plant users is not known, and so it is not possible to design a precise scheme for sampling them randomly. Previous survey authors (Table 2) generally tackled this issue by defining the population as all members of an association, and sending surveys to some subset of that association. We opted instead to cast a broad net, attempting to capture as many responses as possible from all the diverse types of native plant users we could find. To be clear, this was not a survey to determine whether or not the general population of plant users prefer natives, or how they see the definition of native, or whether they have difficulty purchasing natives. Our approach provided a broad picture of the issues facing users of native plants in the Eastern United States.

Survey questions were developed by a panel of five native plant experts, (Table 1), and two survey experts. We developed the survey using Qualtrics software (2018). The majority of questions were multiple choice with an option to include open-ended comments. There were also questions about quantities (pounds, acres, years, etc.), and about level of agreement (Likert-type scale). The number of questions ranged from 10 to 42, depending on answers the respondent provided along the way (see Flow Chart, Appendix B). Many questions allowed respondents to provide more than one answer, in these instances percentages were determined by dividing by the number of respondents, not the number of responses, so that the total typically exceeds 100%. Respondents were also permitted to skip questions. For these reasons, the number of respondents per question is quite variable. Respondents were not provided with a definition of “native” because their perception of this concept was part of what we wanted to explore. To detect any questions that might be misinterpreted, a pilot survey was tested by ten NPM users, and their feedback led to improvements of the survey document.

In February 2018, we emailed survey announcements to potential respondents in all 26 states east of the Mississippi River, including businesses, non-profits, municipalities, counties, states, and federal agencies known to use native plants and/or seeds. We asked them to recommend additional potential respondents, and to share fliers promoting the survey through their own social networks.

The survey was conducted online through a link provided on our marketing materials. Reminder emails and phone calls were used to reach non-respondents. Responses were monitored as they came in, and we solicited additional responses from states with low response rates. The survey was closed after 1,000 responses had been received, on April 26, 2018. The survey attracted 1,023 login events, but after removing those that answered no questions, or only the demographic questions, the number of usable responses is 760. The outreach methods do not permit us to calculate a survey response rate.





JMP (Pro 14.1, SAS Institute) and R (3.6.1) were used to generate frequencies, contingency tables, Pearson’s Chi-square Tests and Fisher’s Exact Tests, Student’s t-tests, and make multiple pairwise comparisons. We used the Bonferroni adjustment (for a family-wise critical value of .05) to prevent over-reporting of statistical significance when multiple comparisons were made, but the disadvantage of the Bonferroni adjustment is that it is prone to under-report actual differences. Both test p-values and Bonferroni results (significant or not) are reported in tables, but only Bonferroni results are shown in graphs. Excel for Mac (version 16, Microsoft) was used

to prepare data for entry into statistical software packages, double-check results, and prepare graphs. Maps throughout this report were created using ArcGIS software by Esri (ArcMap 10.7). Respondent locations were randomly relocated within their state-by-Level III ecoregion polygon, thus protecting their identity without altering conclusions that can be drawn based on their locations.


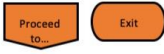


# Flow Chart Legend

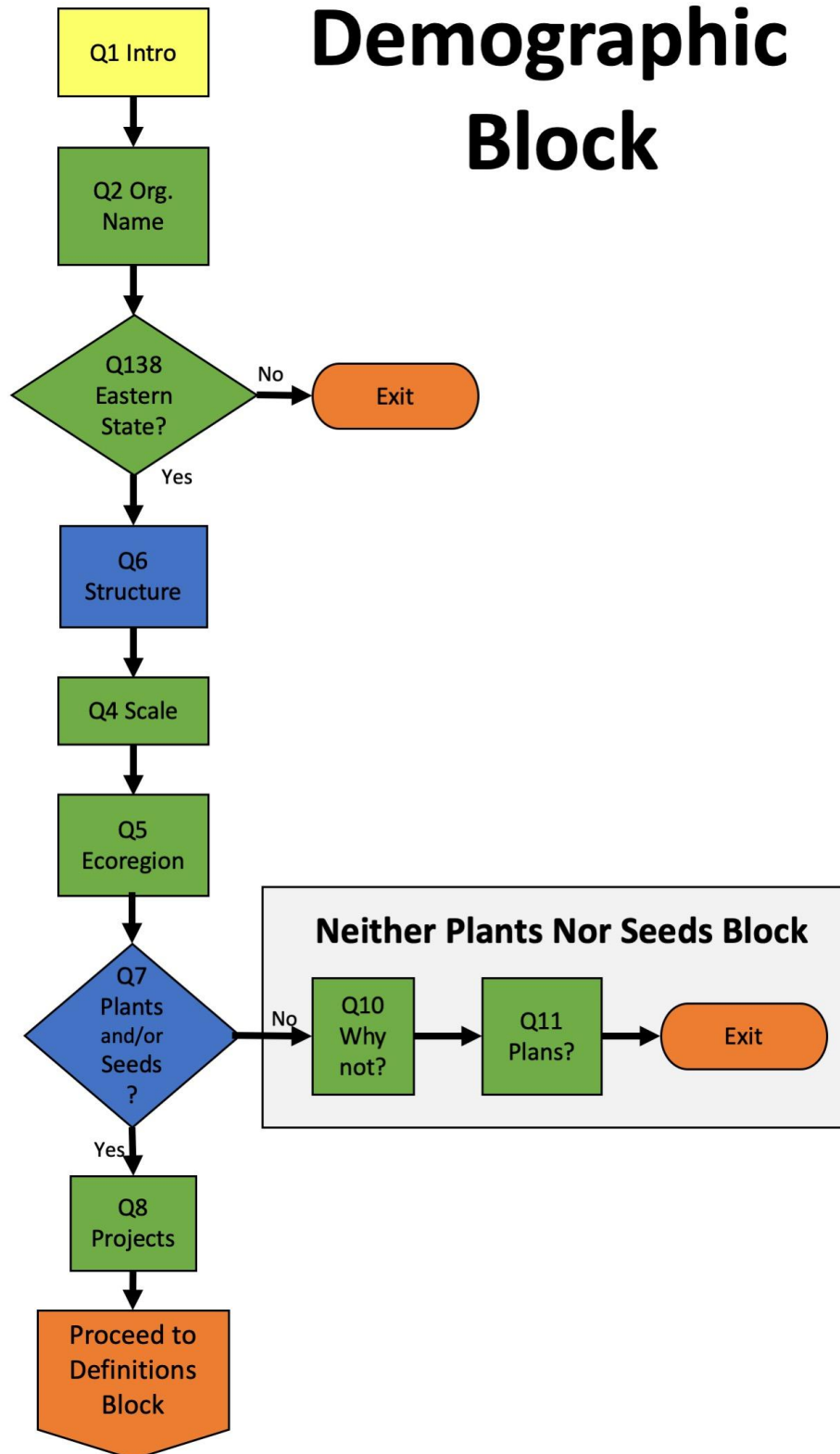
## Questions

-  Question does not affect flow.
-  Response to this question affects survey flow at this point.
-  Response will affect flow later.
-  Response to earlier question affects flow here.

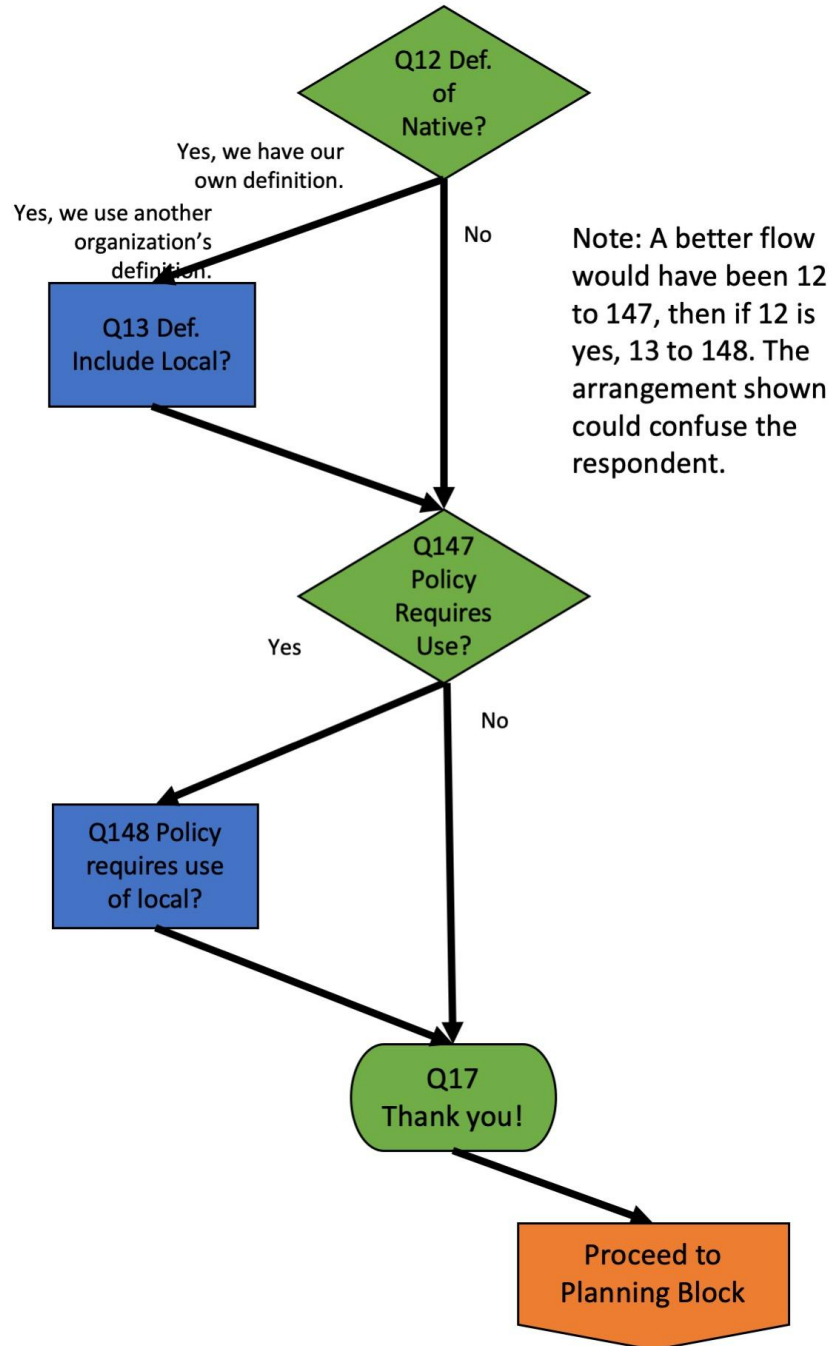
## Non-questions

-  Information for respondent.
-  Respondent proceeds to next block or to exit screen.

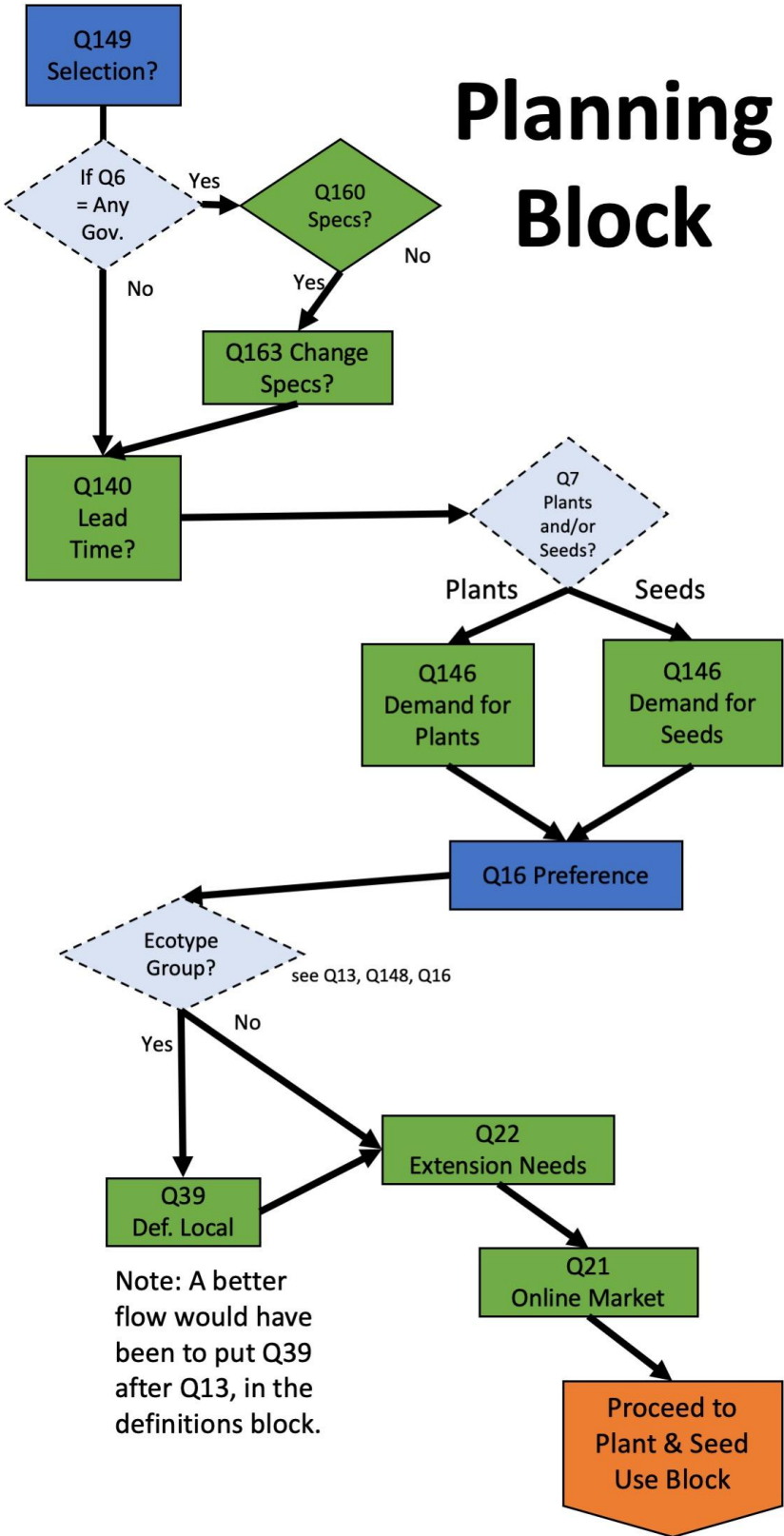
# Demographic Block



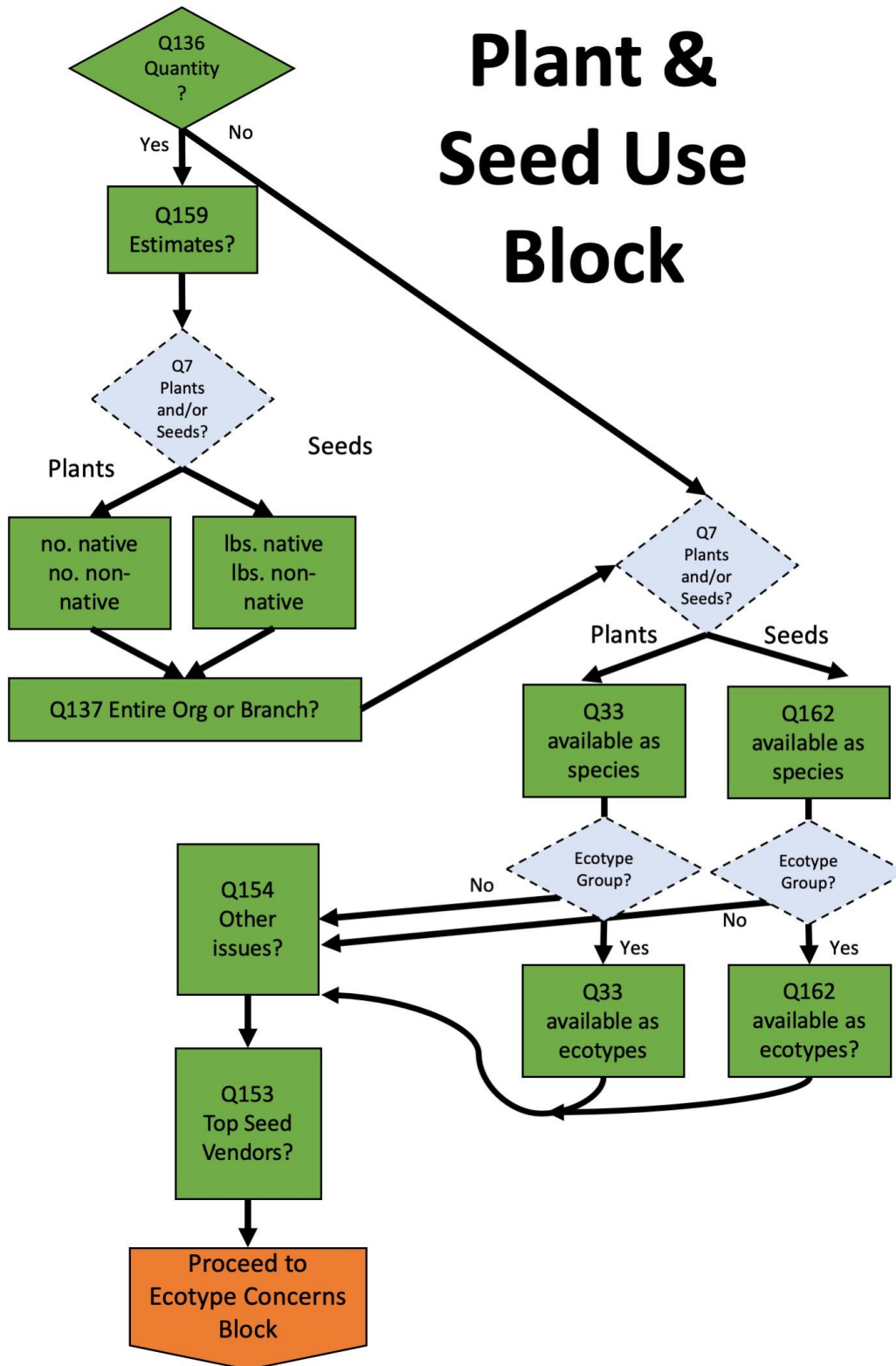
# Definitions Block



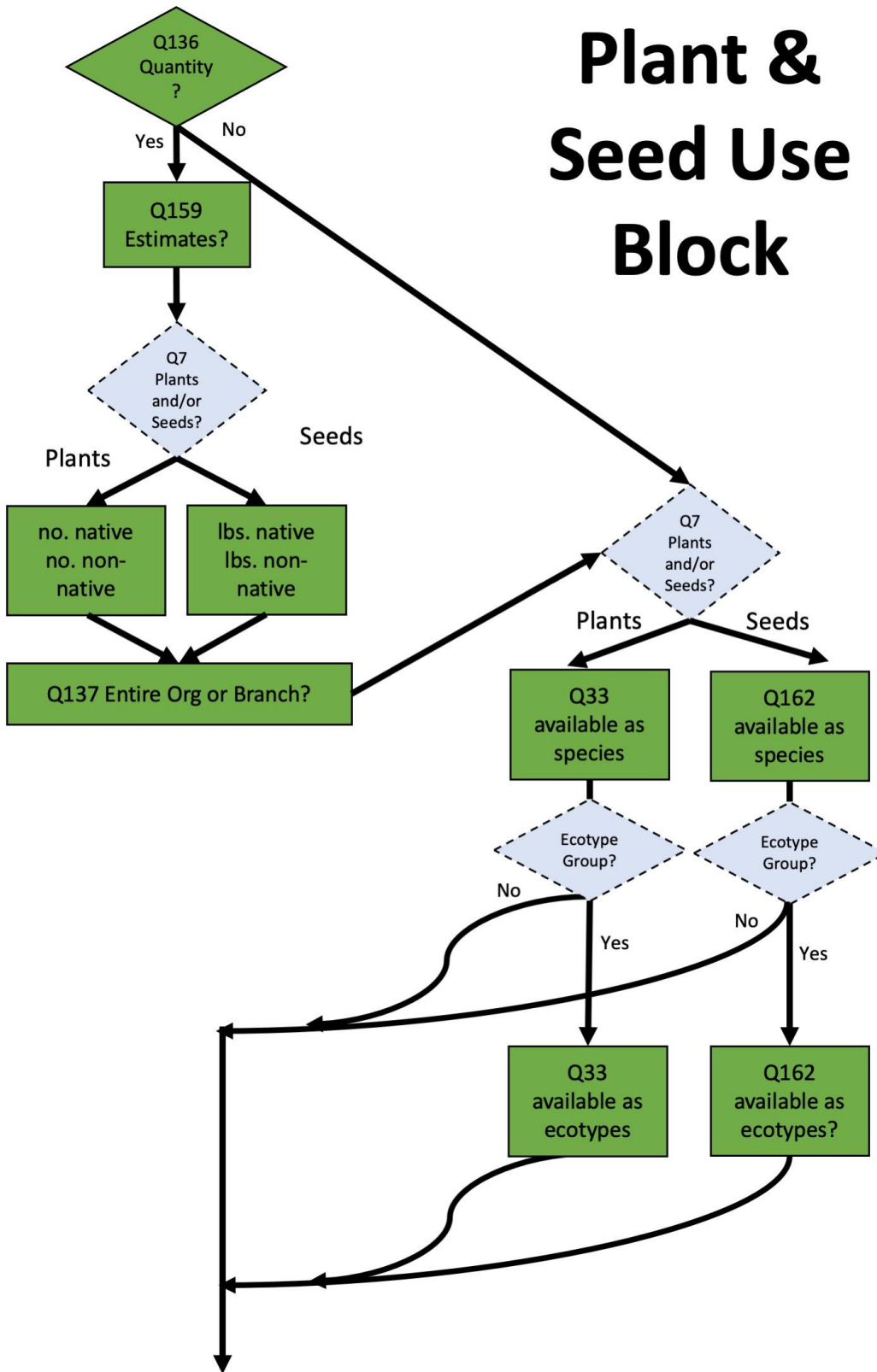
# Planning Block



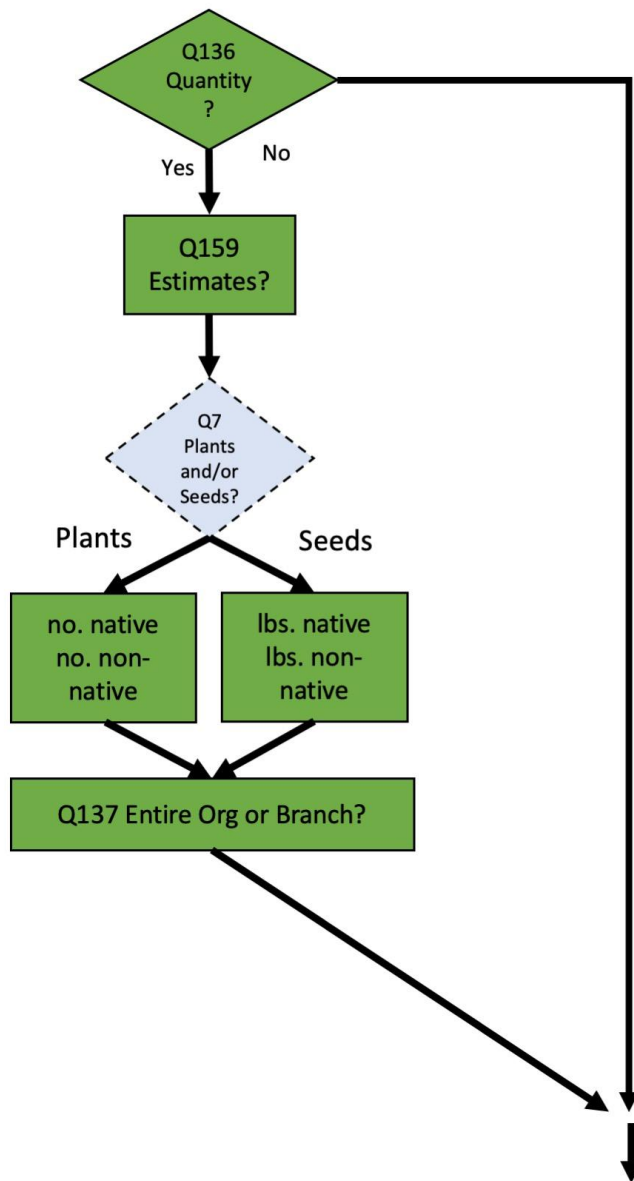
# Plant & Seed Use Block

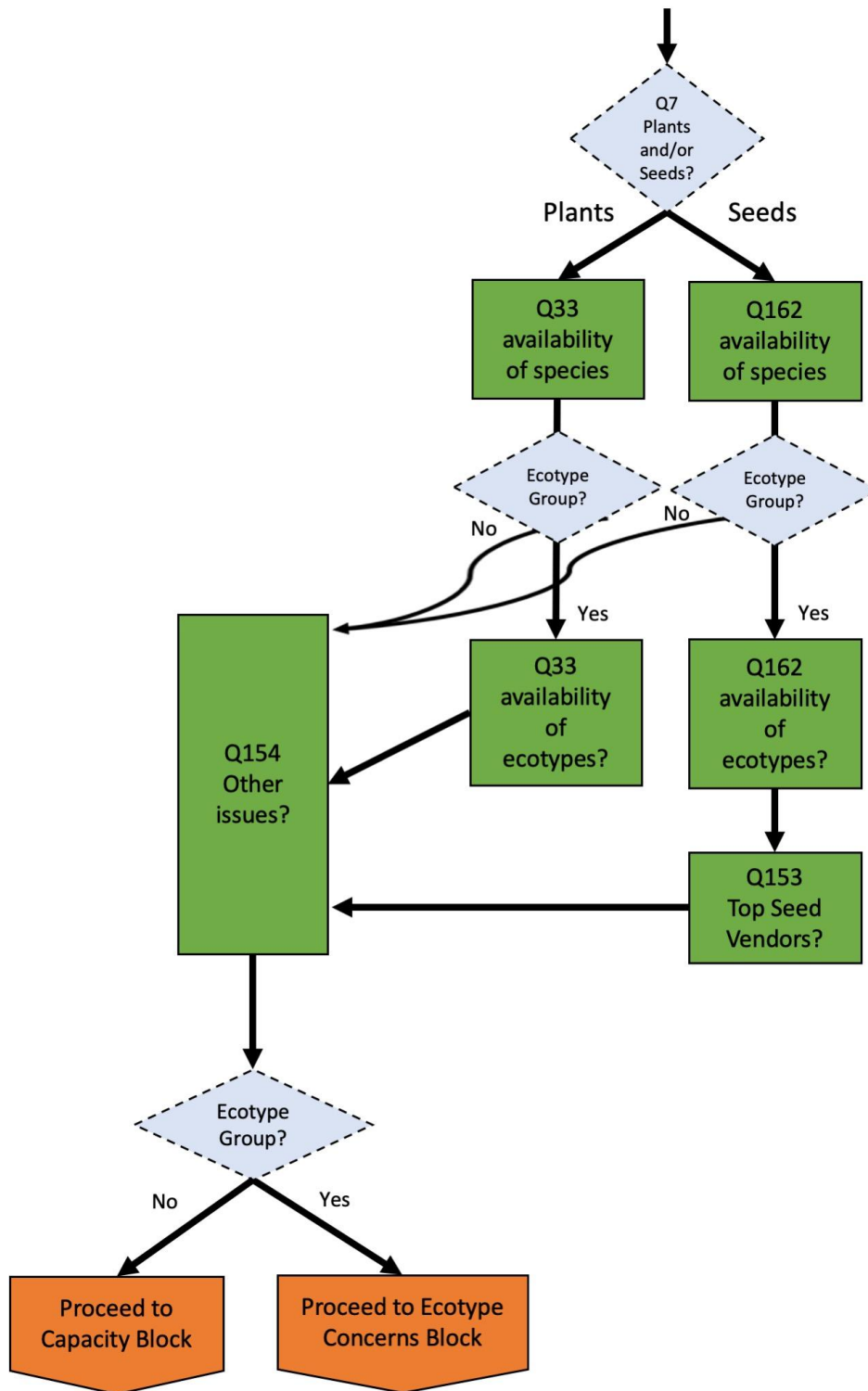


# Plant & Seed Use Block



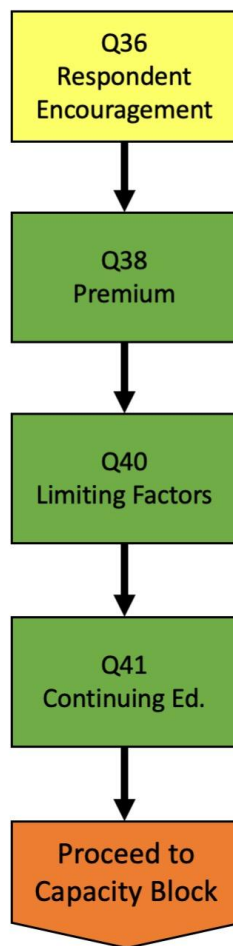
# Plant & Seed Use Block



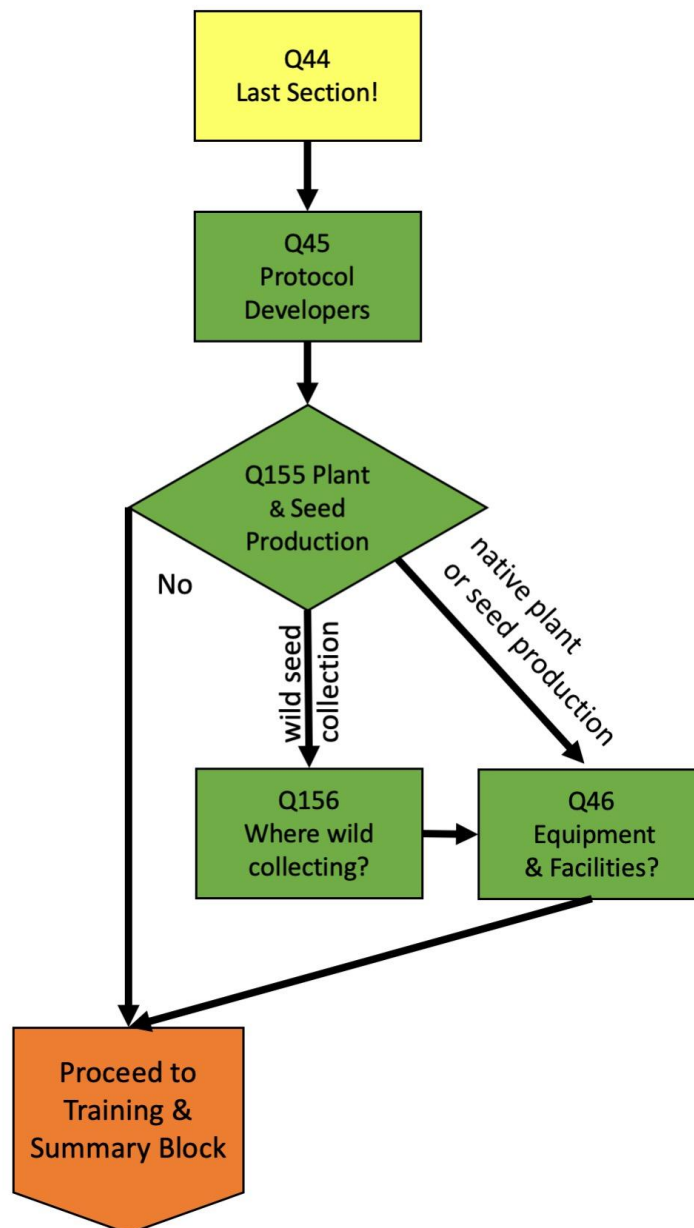




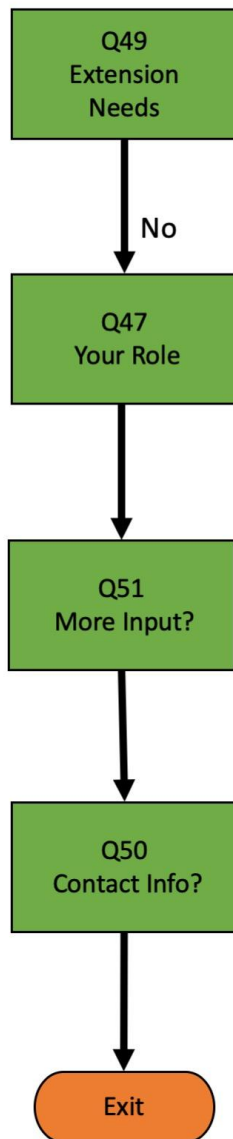
# Ecotype Concerns Block



# Capacity Block



# Training & Summary Block



## Appendix C: Survey Questions

The precise language used for questions and answer choices offered are important, especially to those readers who are attempting to craft their own survey. In this section of the appendix, we offer those details.

### **Q1 Your Work Matters: Tell Us About Your Native Plant and Seed Needs**

The purpose of this survey is to assess demand for native plants and seeds in the Eastern United States. By answering these questions, you will be helping our team establish an ecoregional native plant materials development program throughout the Eastern U.S. Our long-term goal is to ensure a healthy private-sector native plant and seed industry capable of meeting your needs for locally-adapted, genetically-diverse native plant materials. There are no known risks associated with participating in this survey. Your participation is completely voluntary. You may choose not to take part at all, or not to answer certain questions. If you decide not to participate, you will not be penalized or lose any benefits for which you would otherwise qualify. This survey contains up to 38 questions and will take approximately 15 minutes to complete. When we write our report about this survey, the information we collect will be compiled to protect your identity. We will not give your contact information or survey answers to any other organization or person. By participating in this survey you are indicating that you are at least 18 years of age; the study has been explained to you; your questions have been fully answered; and you freely and voluntarily choose to participate in this research project.

#### **Our Team:**

- Mid-Atlantic Regional Seed Bank
- New England Wild Flower Society
- North Carolina Botanical Garden
- University of Maryland Extension

*If you have any questions about the research itself, please contact:*

Sara Tangren, PhD  
Home and Garden Information Center  
University of Maryland Extension  
Central Maryland Research and Education Center  
12005 Homewood Rd.  
Ellicott City, MD 21042  
stangren@umd.edu or (301) 580-6237

This study has been reviewed according to the University of Maryland, College Park, Institutional Review Board procedures for research involving human subjects. *If you have any questions about your rights as a survey participant, please contact:* Institutional Review Board  
University of Maryland  
1204 Marie Mount Hall  
7814 Regents Drive  
College Park, MD 20742  
(301) 405-4212

## **Q2 Organization/Company Information**

This information is used to help us analyze the data. Under no circumstances would you or your organization be singled out in any summary of the survey results. Our findings will be aggregated so that individuals and their organizations remain anonymous.

- Organization name
- Department, branch office, or other sub-unit name, if applicable:

## **Q138 Organization/Company Location**

The objective of this survey is to characterize native plant use and assess native plant needs in the Eastern United States. Please select from the list of states below to indicate where your office is located. If your state is not included, but your work with native plants is conducted in any of the states listed, please choose 'Other' at the bottom of the list to continue with the survey.

## **Q6 Please select the option that best describes your organization's structure.**

- private company/commercial business
- non-profit
- government: federal
- government: state
- government: county
- government: municipal
- working group/collaborative
- if other, please describe:

## **Q4 Please select the term that best describes the scale at which your organization operates.**

- local/municipal
- regional
- statewide
- multi-state
- nationwide

**Q5 Please click on the map below to select ecoregion(s). When clicked, a green highlight will appear over the selected ecoregion. You can deselect any ecoregion by clicking it a second time. Note: For the purpose of this survey, we have defined the 'Eastern United States' as all areas east of the Mississippi River. Which EPA Level III Ecoregion(s) is/are served by your organization?**

## **Q7 Does your organization use native plants or seeds in its projects?**

- native seeds only
- native plants only
- both native seeds and native plants
- neither native seeds nor native plants

**Q8 Please select all that apply. For which purposes does your organization use native plant materials?**

- to manage/steward lands we own (or easements, etc.)
- ecological restoration

- mitigation/ecosystem creation
- land reclamation
- post fire/storm rehabilitation
- roadside vegetation management
- flood/water resource management
- wildlife habitat improvement
- pollinator support
- green infrastructure
- horticultural landscapes
- to produce plants to sell
- if other, please describe:

**Q10 Which factors are preventing your organization's use of native plants? Please select all that apply.**

- lack of commercial availability
- lack of sourcing guidelines
- lack of information on use
- lack of project lead time
- lack of organizational experience
- lack of organizational interest
- lack of organizational awareness of benefits
- natives more difficult to establish
- higher cost
- no policy encouraging or requiring use
- we don't use any plant material in our work
- if other, please specify:

**Q11 Does your organization have plans to use native plants or native seeds in the future?**

- yes (please tell us why)
- no (please tell us why)
- I don't know

**Q12 Does your organization have a definition of "native plant"?**

- yes
- no
- We refer to an another organization's definition, and that organization is
- I don't know

**Q13 Does the native plant definition used by your organization make any reference to ecoregion, seed zone, local provenance, or otherwise specify plants with a local genetic origin?**

- yes
- no
- I don't know

**Q147 Is your organization subject to a policy that recommends or requires the use of native plants? (This can include SOPs, agency manuals, etc.)**

- yes
- no
- I don't know

**Q148 Does the policy guiding your organization's native plant use specifically recommend or require the use of locally-adapted (local ecotype, local provenance, etc.) plant materials?**

- yes
- no
- I don't know

**Q149 Please select all that apply. Typically, how does your organization choose the native plant species it uses?**

- we choose species based on commercial availability
- we choose species based on lists we have developed of local native plants
- we choose species based on reference site information
- species selection is handled by outside contractors/designers/consultants
- if other, please describe:
- I don't know

**Q163 Please respond to the following statements about determining project specifications. (agree, disagree, don't know)**

- My agency would be open to changing project specifications to include the use of locally-adapted, native plants and seeds.
- My office/department is allowed to change project specifications to include the use of locally-adapted, native plants and seeds.
- Within my job duties, I am empowered to change project specifications to include the use of locally-adapted, native plants and seeds.

**Q140 Typically, how far in advance is your organization able to forecast plant material needs?**

- less than 1 year
- 1-2 years
- 2-3 years
- 3 years or longer
- I don't know

**Q146 How do you expect your organization's demand for native plant materials to change over the next 10 years?**

- Native Plants - (our demand will increase, decrease, stay the same, I don't know)
- Native Seeds - (our demand will increase, decrease, stay the same, I don't know)

**Q16 The following question is about *preference*, not actual purchasing or current use. Which statement best describes your organization's preference when using native plants and/or seeds.**

- We generally prefer local ecotypes (genetically appropriate, local provenance).
- We generally prefer species.
- We generally prefer cultivars.
- We don't have a preference.
- If other, please describe:
- I don't know

**Q39 Please select all that apply. Which concepts are included in your organization's interpretation of local provenance?**

- EPA Level III Ecoregions (Omernik ecoregions)
- EPA Level IV Ecoregions (Omernik ecoregions)
- Plant Hardiness Zones
- empirical seed transfer zones
- provisional seed transfer zones
- 50-mile radius
- 100-mile radius
- greater than 100-mile radius
- within the county
- within a regional, multi-county area
- within the state
- if other, please describe:
- I don't know

**Q22 How useful would your organization find an online listing of commercially-available, ecoregional native plant materials?**

- not useful
- slightly useful
- moderately useful
- quite useful
- extremely useful
- I don't know

**Q21 Would your organization be willing to share plant use/plant needs information if it could result in increased commercial availability of locally-adapted native plants and seeds?**

- yes
- no
- maybe
- I don't know
- additional comments:

**Q136 Can you estimate the total amount of plant materials your organization uses in a typical year?**

- My organization tracks this information and I can provide a rough estimate now
- My organization could provide an estimate after checking our records
- No, my organization does not track this information



- I don't know

**Q159 Please estimate the quantities of plant materials your organization uses in a typical year. If none, enter '0.'**

- approximate number of plants
- approximate pounds of seed

**Q137 Please specify if the quantities you estimated are for your:**

- entire organization
- region, department, or office only (please describe):

**Q33 The following question asks about *native plants only*, not seeds. Which choice best describes your general experience with sourcing native plants?**

- The species my organization wants to use are available as plants: never, rarely, sometimes, often, mostly with a few exceptions, always, I don't know
- The species my organization wants to use are available as plants in our preferred ecotype: never, rarely, sometimes, often, mostly with a few exceptions, always, I don't know

**Q162 The following question asks about *native seeds only*, not plants. Which choice best describes your general experience with sourcing native seeds?**

- The species my organization wants to use are available as seeds: never, rarely, sometimes, often, mostly with a few exceptions, always, I don't know
- The species my organization wants to use are available as seeds in our preferred ecotype: never, rarely, sometimes, often, mostly with a few exceptions, always, I don't know

**Q154 Please tell us about any recurring issues you have related to the availability of native plant materials and/or local ecotypes.**

**Q153 In no particular order, please list your organization's top 5 commercial sources of native seeds.**

**Q38 If there were a cost difference, approximately how much more would your organization be willing to pay for genetically appropriate, local provenance plants and seeds?**

- no more
- up to 50% more
- up to 100% more
- greater than 100% more
- if other, please describe:
- I don't know

**Q40 How limiting are these factors to your organization's use of local ecotype native seeds and plants? (not limiting, somewhat limiting, limiting, very limiting)**

- cost
- lack of commercial availability
- lack of seed transfer guidelines
- lack of project lead time
- lack of policy encouraging or requiring use
- lack of organizational experience
- lack of organizational awareness of benefits

**Q41 How adequate are the conferences and/or other continuing education opportunities offered through your professional associations with respect to the use of local ecotype native plants and seeds?** 1=poor, 2, 3=average, 4, 5=excellent (Note to readers, in retrospect we would change “average” to “adequate” because sometimes what is typical is either good or bad, and that is the information we were really after.)

**Q45 Please select all that apply. What native plant protocols has your organization developed?**

- germination protocols
- plant establishment protocols
- plant production protocols
- seed collection protocols
- seed cleaning protocols
- seed storage protocols
- seed transfer/seed movement protocols
- if other, please describe:
- none of the above
- I don't know

**Q155 Please select all that apply. Although this survey is focused on native plant and seed use, some of you also engage in some level of production. Does your organization engage in any of the following production-related activities?**

- wild seed collection
- native plant production
- native seed production
- none of the above
- additional comments:

**Q156 Please select all that apply. Where does your organization collect wild seeds?**

- on our organization's lands
- on private lands not owned by our organization
- on public lands not owned by our organization
- if other, please describe:
- I don't know

**Q46 Please select all that apply. Which of the following resources does your organization have?**

- propagation facilities

- greenhouses
- land for production
- irrigation
- seed collecting/harvesting machines
- seed cleaning equipment
- seed drying facilities
- seed storage facilities
- if other, please describe:
- none of the above
- I don't know

**Q49 Please select all that apply. Which resources would be helpful to your organization?**

- ecoregional species lists
- species fact sheets
- propagation protocols
- seeding rates/planting densities
- plant establishment protocols
- seed transfer guidelines
- reference site information
- information on plant communities and associated species
- template garden designs
- landscape maintenance tips
- if other, please describe:
- none of the above

**Q47 Please select all that apply. How would you describe your role, in relation to your organization's use of native plant materials?**

- I select native plant species for projects.
- I make purchasing decisions related to our procurement of native plants and/or native seeds.
- if other, please describe:
- none of the above

**Q51 This survey is being disseminated to individuals who work with native plants across all sectors (public, private, non-profit) and at all scales. As such, the questions may not adequately capture your organization's experiences and concerns in regard to native plant availability and use. Please use this space to share anything else with us that we haven't asked you about.**

**Q50 You are NOT required to provide your contact information. However, if you do provide it, it will allow us to follow up with you about an answer you have provided, to contact you about the results of the survey, or to inform you about programs that are developed as a result of the survey findings. We will not publish or share your contact info with others for any purpose.**

- Your name:
- Your work email:

- Please re-enter your work email for accuracy: