A survey of native plant materials use and commercial availability in the Eastern United States

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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

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

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

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

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

Very difficult to find seed-grown stock of shrubs or trees—everything is clonal. —Survey respondent

The demand seems to be increasing from the residential gardener in the past 5 years or so. We see the need for educational materials, planting templates, and other tools to continue to increase as we meet the demand of our clients. —Survey respondent

ABSTRACT

We report on the opinions of respondents to a survey of native plant material (NPM) users east of the Mississippi River. We sought respondents who would have a sufficient depth of experience and interest to be able to answer the survey questions. To find potential respondents, we first built a geographically diverse list of NPM-user organizations and then asked them to help us promote the survey through their social networks. Survey respondents expressed a preference for local ecotypes (74%) and almost no interest in cultivars (0.3%). Respondents identified commercial availability as the greatest barrier to their use of local ecotypes. Of the respondents, 92% use native seeds, and those who prefer local ecotypes are shopping farther afield than their concept of "local" would support. The most popular seed vendor is on average 584 km (363 mi) away from the respondent's location, and the second most popular is 1296 km (805 mi) away. Respondents who think of local as being in-state buy out-of-state 85% of the time. Of the respondents, 90% have less than 2 year's lead time before acquiring NPM, which is not enough time to have wild seeds agronomically increased or plants contract grown. Given those circumstances, 83% would be willing to pay a premium to obtain the ecotypes they want. Among potential solutions to the commercial shortage problem, 99% of respondents supported creation of an online marketplace for sharing supply-and-demand information. Respondents expect their demand for NPMs to increase, highlighting the importance of addressing these issues now.

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KEY WORDS

native seeds, wild-collected seeds, lead time, local ecotype, cultivar, procurement policy, willingness to pay a premium

NOMENCLATURE

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INTRODUCTION AND LITERATURE REVIEW

In 2018, we conducted a survey about native plant material (NPM) use in the eastern United States. Our motivations were to better understand the challenges NPM users face and to collect their insights on potential solutions. Some of our questions (see Appendix) were based on items listed in the National Seed Strategy (PCA 2015). We were also inspired by previous surveys (Table 1), which are cited throughout this article.

One challenge of surveying respondents' opinions about native plants is that they have many interpretations of what constitutes "native" and "local ecotype." Prior surveys took various 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.

The National Seed Strategy uses the term "locality-specific" to refer 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" (PCA 2015). The phrase "local ecotype" is commonly used among practitioners to represent this concept, and we follow that convention here.

Of the 4 prior surveys that asked, all concluded there was confusion about what constitutes "native" or "local" (Table 1). Both Hooper (2003) and Peppin and others (2010) concluded that confusion impedes progress in improving the commercial availability of local ecotype materials.

Of the 3 prior surveys that asked, respondents consistently expressed high levels of concern about the genetic origin of native plants and seeds (Table 1). The concern expressed by all those respondents is supported by a large body of science that indicates the benefits of using locally genetic material and the disadvantages of using NPMs from sources that are too dissimilar or too distant. Peppin and others (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 and Montalvo 2004) and threaten the long-term sustainability of restored sites (Lynch 1991; Hufford and Mazer 2003), as well as other local populations (Linhart 1995; Montalvo and

TABLE 1

Summary of prior native plant material surveys.

Year	Author(s)	Respondents	Region	*n*	Definition confusion	Local preference	Commercial availability	Cost	Research, education	Demand
1998	Waterstrat, Deeds, Harkess	Mostly nursery owners	SE US	196	Not asked	Not asked	Poor selection, quantity	Not asked	Not asked	+
1999	Tamimi	Landscape architects	Hawaii	29	People vs. plants	Not applicable	The greatest challenge	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 limiting	LUM, PPP, PE, CE, POP	+
2003	Hooper	Landscape architects	Utah	136, 15	About "native" 86%	Prefer in-state 87%	Most limiting factor 79%	Serious factor 28%	LUM, POP	+
2007	Brzuszek, Harkess, Mulley	Landscape architects	SE US	145	Not asked	Not asked	Greatest challenge 63%	Not limiting	POP	+
2009	Brzuszek, Harkess	Wholesale, retail	SE US	129	Not asked	Not asked	Greatest challenge 15%	Not limiting	CE, POP	+
2010	Brzuszek, Harkess, Kelly	Master Gardeners	SE US	979	Not asked	Not asked	Greatest challenge 68%	Not limiting	POP	+
2010	Peppin, Fule, Lynn, Mottek-Lucas, Sieg	Native seed suppliers, users	Arizona, New Mexico	37, 33	About "local" 65%	Concerned about source 93%	Greatest challenge 27%	One of the greatest obstacles 22%	SP, STZ	Not asked
2011	Kauth, Pérez	Wildflower growers	Florida	51	About "native" 64%	Concerned to some degree 90%	Poor species 77%, poor seed 54%	Lowest ranked concern	CE, PE, SP	+

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.

Ellstrand 2001) with which they may inter-breed." Baughman and others (2019) conducted a meta-analysis of 75 prior research projects, concluding that "locally sourced plants likely harbor adaptations at rates and magnitudes that are immediately relevant to restoration success."

This survey builds on the work of 2 predecessors in documenting respondents' willingness to pay a premium. Hooper (2003) 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.

Prior survey authors also reported a need for research on propagation protocols and landscape uses. Their respondents indicated the need to educate professionals about how establishing and maintaining native landscapes differ from establishing and maintaining conventional, horticultural landscapes.

The current survey is the first to ask respondents about their preference for cultivars, 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 acquire native seed. This survey is also the first to ask respondents about lead time (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).

Viewed collectively, prior surveys (Table 1) have documented a chronic commercial shortage of NPMs. Our findings corroborate and build upon those of prior survey authors. Our survey results will be a useful tool for our colleagues in all sectors of the native plant materials industry.

METHODS

Target Population and Sampling Approach

Given practical constraints, prior researchers (Table 1) limited their survey target population to members of a well-defined organization. Advantages of this approach include that potential respondents can be randomly selected from the organization's membership list; that people who do not respond can be asked why; and that, in writing up results, statistically significant findings can be presented as representative of the organization. The disadvantage is that no single organization can portray the experiences and concerns of the broader community of NPM users.

We chose instead to expand our survey target population to encompass the broadest possible range of NPM users. We quickly realized, however, that asking people questions they cannot answer would be a source of survey error (Fowler 2013). For example, new NPM users would lack the purchasing experience to answer questions about commercial availability. Also, a certain level of engagement is required to reflect on the types of products being used or to be able to envision solutions to problems faced by the community. We therefore narrowed our target population to NPM users of the eastern US who are sufficiently experienced and engaged to be able to answer the survey questions. For brevity, we will refer to our target population as "sufficiently engaged NPM users."

Like prior authors, we chose the most random and unbiased approach available to us given the practical constraints that we faced. That approach is described below. The defining challenge of leaving the single organization approach behind is that the population of NPM users, sufficiently engaged or otherwise, is not known, and so it is not possible to design a precise scheme for randomly sampling them. Sudman (1976) addressed this common survey situation when he published *Applied Sampling* as a guide "for researchers who have limited resources and statistical backgrounds and who wished to maximize the usefulness of the data they obtain." He discussed credibility conditions for small samples, such as having widespread geographic coverage; including a discussion of the limitations of the data; having adequate sample size with appropriate sample execution; and making optimum use of available resources. We have attended to these conditions in this project.

We took the multistage approach to finding potential respondents by first assembling a list of many organizations, as recommended by Fowler (2013) and Creswell (2018). In situations such as ours, in which we have no pre-defined sampling frame, using multiple, diverse sources to find respondents improves the representation and diversity of the sample (Kirchherr and Charles 2018). Thus, we assembled our list of organizations through multiple sources including the internet (by far the most productive source), our own contacts, the contacts of 8 colleagues we selected for their extensive and diverse professional backgrounds (as recommended by Kirchherr and Charles 2018), and an outreach booth at the 2017 National Native Seed Conference. We also focused on broad geographic coverage. If a state was under-represented (Figure 1), we increased internet research, cold calls, and consultation with existing contacts to find more organizations there.

Because of unforeseen events, we no longer have all our records about building the list of NPM-user organizations. The quantifying terms we use in this paragraph are therefore approximate. The first stage of our effort produced a list of approximately 600 organizations. We conducted an email and telephone outreach campaign to find a point-of-contact in each organization. At about two-thirds (400) of the organizations, we found someone who was willing to take the survey and (or) to promote the survey link using their organization's social network. Practical considerations prevented us from asking for membership lists, including that many of the organizations were not membership organizations and, given modern privacy and security concerns, those that possessed membership or email lists would be unlikely to share them. The approach of

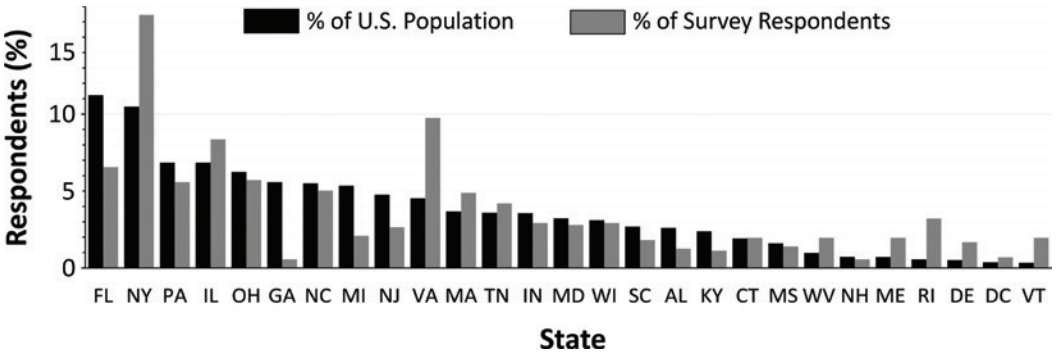

Figure 1. Geographic origin of respondent organizations ($n = 717$) [Q1, Q2].

selecting randomized, qualified respondents within organizations was not an option. Instead, we asked organizations to do the outreach and share the link for us. Ultimately, this approach allowed us to reach a larger and more geographically diverse audience and to obtain a higher response rate (Fricker 2008; Fowler 2013) than we could have on our own.

Sources of Bias

We believe the most serious source of coverage error in our sample is voluntary response bias, which is a common source of bias in surveys (Fowler 2013; Sedgwick 2013). Organizations who chose to assist us and individuals who chose to take the survey may be more deeply engaged with the topic than those who chose not to do so. As a result, this survey may show more use and (or) a higher degree of certain concerns than would be present in a broader population of sufficiently engaged NPM users, and it will certainly show a higher degree of concern than in an even broader population of NPM users who are new to the topic or who are not specifically interested in it. Accordingly, throughout this article, we present our findings as the opinions of respondents rather than trying to generalize our findings to our entire target population or to an even broader population of all NPM users. Users of our information should take these issues into account.

Development of Questions and Survey Execution

Questions (see Appendix) for an internet survey were developed by a panel of 5 native plant experts and 2 survey experts. Most questions were multiple choice with an option to write in additional information. A few multiple-choice questions offered ordinal answer options because we deemed the task of quantifying an answer, for example, estimating percentage success of their NPM purchase history, to be too cumbersome for a 15- to 20-minute survey. The number of questions ranged from 10 to 42, depending on answers the respondent provided along the way. Respondents were also permitted to skip questions. For these reasons, the number of respondents per question is quite variable.

We decided against providing respondents with definitions of "native" or "local" because their perceptions of these concepts were part of what we wanted to explore. We also decided against providing respondents with definitions of "seeds" and "species," and against asking questions to explore their perceptions of these concepts. The benefit of providing a definition, or adding more questions, would be reduction in survey error caused by miscommunication. The disadvantage, however, includes losing unanticipated observations in the write-in comments and making the survey longer.

To detect any questions that might be misinterpreted, we tested a pilot survey with 10 NPM users, and their feedback led to improvements in the survey document. Prior to release, the survey was approved by the University of Maryland Institutional Review Board for compliance with policies involving research on human subjects.

In February 2018, we emailed survey announcements to our organizational points-of-contact. If we saw that a point-of-contact had not completed the survey within 2 wk of being sent the link, or again at 4 wk, a reminder email was sent. The survey was closed at 1023 logins, on 26 April 2018. Our resulting useable sample of 760 geographically dispersed responses demonstrates appropriate sample execution and the optimum use of available resources. Our methods do not permit us to calculate a survey response rate.

Data Analysis

We conducted statistical testing procedures for the collected data to better understand differences among respondents. We report results here to avoid the appearance of making claims about differences among respondents with no statistical evidence. We make no inference back to our target population of sufficiently engaged NPM users in the East.

Multiple choice questions that provided nominal data were analyzed with non-parametric tests as described in McDonald (2014). Pearson's chi-square test of independence was used to determine whether the frequency distribution of answers to a single question was more uneven than would be likely to happen by chance alone. When a frequency distribution was

found to contain significant differences, we conducted multiple pairwise comparisons using 1 × 1 tests of independence. 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. Pearson's chi-square test of homogeneity was used to determine whether the cross-tabulation of respondents' answers was more different than would be likely to happen by chance alone. When cross-tabulation of responses resulted in expected values of fewer than 5 respondents, we performed Fisher's exact test instead. For multiple choice questions that allowed respondents to provide more than one answer, percentages were determined by dividing by the number of respondents, not by the number of responses, and so the total exceeds 100%.

Six of the questions in this survey offer Likert-type multiple-choice options (for example, never, rarely, sometimes, and so forth) resulting in ordinal data that can be assigned numerical values (0, 1, 2, and so on) and can be successfully analyzed with statistical tests based on normal distributions (Norman 2010; MacDonald 2014). This approach takes full advantage of the value of ordinal data while providing statistics that are already familiar to most readers (means, standard deviations, confidence intervals, and *t*-tests). Even though repeated research has shown these analyses are robust with respect to violation of the assumption of normality (Norman 2010), we note that for the 5 Likert-type questions in this survey for which these tests were applied, response histograms are unimodal and reasonably bell-shaped, supporting the idea that they were drawn from underlying, continuous, and reasonably normal distributions. We use these test results only to compare how subsets of respondents ordered themselves with respect to the same question (Fowler 2013).

Some rather small differences proved to be statistically significant, so we did not report them unless we also found them meaningful. Accordingly, we also report Cohen's D, a statistic that provides a measure of effect size.

Respondent locations were determined by checking the coordinates of their internet service provider's local hub against the states and Level III Ecoregions where they work. If there was disagreement, then the coordinates of their office address were checked and used. Prior to drafting maps, respondent location points were randomly relocated within the polygon formed by the overlap of their state and EPA Level III Ecoregion, thus protecting their identity without altering conclusions that can be drawn based on location.

Our goal was to provide a broad, descriptive picture of the issues facing NPM users in the eastern US, specifically those users with sufficient experience and interest to be able to answer the survey questions, and we were successful in that endeavor. The results presented below apply to our respondents. We encourage future researchers to obtain the resources needed to work toward providing more exact values for the entire population utilizing more advanced statistical procedures.

RESULTS AND DISCUSSION

Who Are Our Respondents?

Respondents come from all 26 states east of the Mississippi River, with no state having fewer than 4 respondents (Figure 1). As expected, the general trend was that more populous states were the source of more respondents. Respondents conduct their work within all 32 US EPA Level III Ecoregions (Woods, Omernik, and Brown 1999) east of the Mississippi River (Figure 2), with no ecoregion having fewer than 16. More than half of respondents indicated that their organization serves a single ecoregion, and 91% serve 5 or fewer [Q5].

Of respondent organizations, 88% operate at scales ranging from local to statewide, 10% at a multi-state scale, and 2% at a national scale (n = 708) [Q3]. The general structure of their organizational affiliations is shown in Table 2. Some of our respondents are affiliated with the same types of organizations covered by earlier surveys (Table 1): landscaping businesses, plant nurseries, and Master Gardeners. Because we rejected a

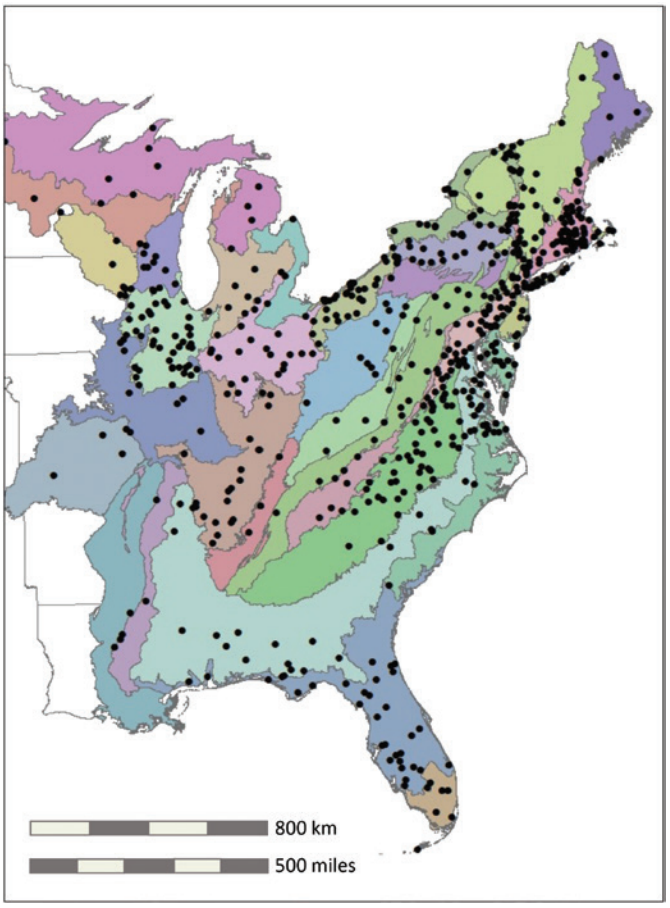

Figure 2. The 32 Level III Ecoregions in the survey area and respondent organization locations (n = 629 respondents, 1700 responses) [Q5]. Base map from US EPA NHEERL (2013).

TABLE 2

*Types of organizations represented in the survey (*n = *722) [Q4].*

Organizational structure	Respondents (%)
Nonprofit organization	29
State government	21
Federal government	16
For-profit business	14
County government	8
Other	7
Municipal government	3
Collaborative	2

"pre-defined sampling frame," however, this survey is the first to include opinions of NPM users affiliated with parks, colleges, landscape restoration companies, conservation nonprofits, watershed organizations, land trusts and conservancies, public forests, public gardens, highway departments, natural resource departments, neighborhood associations, schools, Master Naturalists, native plant societies, invasive plant management organizations, and a seed bank, as well as unaffiliated individuals (n = 709).

The majority of respondents are engaged in selecting species (78%) and (or) making purchasing decisions (61%), while 5% are not engaged in either [Q28]. Government respondents indicated that they have flexibility in terms of specifying the use of locally native plants for their projects at the agency (97%, n = 258), department (98%, n = 281), and individual level (91%, n = 278) [Q8].

The geographic breadth, organizational variety, and level of engagement in decision making reflected by respondents' answers to our demographic questions indicates that our outreach methods were successful in recruiting a broad range of respondents.

Definitions of Native Plant and Local Ecotype

Of respondent organizations, 78% have a definition of "native plant": 64% use an internal definition, 15% refer to another organization's definition, and 22% operate with no official definition (n = 562) [Q9a]. Of organizations with a definition, 81% include within it some concept of local genetic origin. However, these organizations have diverse interpretations of what constitutes "local" (Table 3). Political boundaries play a prominent role in defining local. This response is almost certainly a practical matter: Slightly less than half of respondents represent government agencies. The lead author, however, had many students who were surprised to learn that state boundaries have no biological meaning and 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."

TABLE 3

Concepts that respondent organizations include in their understanding of what constitutes local provenance, χ^2 (10, n = *1202 responses) = 468,* P *<.0001; 537 respondents.*

Concept of local	Respondents (%)
Multi-county	48[a]
Plant hardiness zone	34[bc]
State	30[bc]
County	25[bc]
160 km (100-mile radius)	20[cdef]
EPA Level III ecoregion	18[cdef]
80 km (50-mile) radius	16[def]
EPA Level IV ecoregion	14[defg]
A radius over 160 km (100 miles)	9[fgh]
Provisional seed transfer zone	6[ghi]
Empirical seed transfer zone	3[hi]

Notes: Proportions followed by the same letter are not significantly different using a Bonferroni corrected alpha = .0028 [Q9c].

Very few respondents use either provisional or empirical seed transfer zones (STZs). Provisional STZs (Bower, St Clair, and Erickson 2014) are estimated based on climatic, edaphic, and other indirect evidence. They are not species-specific and are intended as a stopgap measure in lieu of actual empirical data. Empirical STZs are research-derived zones within which seed may be safely translocated. Empirical 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 and others 2015). They are determined by comparing the adaptive traits of multiple plant populations using common garden and reciprocal transplant studies (PCA 2015). No empirical STZ results are available for areas east of the Appalachian Mountains.

Respondents also made several good points in their comments, for example, that natural range and habitat should be included in any concept of native, and climate change must be considered as we move forward. These thoughts are consistent with Havens and others (2015), who instead of putting strict geographic limits on sourcing, such as political boundaries or radii, recommended a more complex approach that takes species biology, habitat, and climate change into consideration.

Preferences and Policies

The majority of respondent organizations (74%) prefer local ecotype NPMs, while 21% prefer straight species, 0.3% prefer cultivars, and 5% have no preference, χ^2 (1, n = 640) = 813, P <.0001 [Q14]. This outcome was surprising to us because 39% of our respondent pool engages in horticultural landscaping.

However, these results are consistent with the findings of all 3 prior surveys that asked respondents about these preferences (Table 1).

Of respondents, 59% said that their organization has a standard operating procedure, agency manual, or other policy that recommends or requires the use of native plants, and 67% of those (40% overall) have a policy that specifies the use of local ecotypes [Q10].

Species Selection Methods

Most (72%) respondents use lists to help them select species for a project, but majorities also resort to selecting whatever species are commercially available (57%) and (or) make use of reference sites; χ^2 (1, n = 1286 responses) = 297, P <.0001, Bonferroni corrected alpha = .0167; 660 respondents [Q11].

How Respondents Use Native Plant Materials

Of respondent organizations, 95% use native plants and 92% use native seeds. The types of projects for which they use NPMs are indicated in Table 4. Respondents left comments about additional NPM uses that were not included in the multiple-choice options, or that were more specific, including education, research, restoration after invasives, reforestation, shoreline stabilization, rare plant conservation, food production, and biofuels.

Supply and Demand: What Limits Respondents' Use of Ecotypes?

Respondents who want to use local ecotypes said that availability, cost, and lead time limit their ability to do so. Commercial availability is the greatest challenge, with 94% of respondents describing it as limiting to at least some degree, and most often as "very limiting," χ^2 (3, n = 442) = 94.29, P <.0001 (Figure 3).

"Cost" was most often perceived as "somewhat limiting," χ^2 (3, n = 436) = 94.59, P <.0001. Of the 8 prior surveys that asked about cost (Table 1), 5 found it not limiting and 3 found it limiting to varying degrees. "Project lead time" was also most often perceived as "somewhat limiting," χ^2 (3, n = 422) = 70.42, P <.0001. Lead time shortages are driven by natural events, market forces, and (or) government procurement policies beyond any one buyer's control (Peppin and others 2010; PCA 2015). Of respondents, 90% have less than 2 y of lead time (42% <1 y, 48% 1-to-2 y, 6% 2-to-3 y, 4% more than 3 y; n = 610) [Q12]. This amount of time is insufficient to order plants, other than those that are already commercially available. In author Ed Toth's experience managing New York City's Greenbelt Native Plant Center, 15 mo to 5 y are needed to custom-grow plants (a growing season for wild seed collection, plus a winter season for cold stratification, plus 3 to 12 mo for herbaceous plugs or 1 to 5 y for container trees and shrubs). Lead times for agricultural production or "increase" of seed, often referred to as "bulking," are even greater. They range from 5 to 10 y, depending on factors such as need to collect wild seed, need to develop initial foundation seed, species biology, seed viability, and quantities needed. A majority of respondents rated other multiple-choice options offered (policy encouraging use, awareness of benefits, seed transfer guidelines, and organizational experience) as "not limiting."

For-profit businesses are the only type of organization with the majority of respondents reporting less than a year of lead time (n = 95). This response might be because activities with longer lead times are generally the purview of government agencies and nonprofit organizations, or because for-profit businesses are often brought on board late in the project process.

TABLE 4

Types of projects that respondents use native plant materials for, χ^2 (1, n *= 3615 responses) = 1240,* P *<.0001; 681 respondents.*

Response	% Respondents
Ecological restoration	85[a]
Pollinator support	82[a]
Wildlife habitat improvement	79[a]
To manage/steward our lands	64[b]
Mitigation/ecosystem creation	47[c]
Horticultural landscapes	39[c]
Flood/water resource mgt	29[de]
Green infrastructure	27[de]
Land reclamation	24[def]
Roadside vegetation mgt	21[efg]
Post-fire/storm rehabilitation	16[fgh]
To produce plants to sell	14[gh]

Notes: Values followed by the same letter are not significantly different using a Bonferroni corrected alpha = .00333 [Q7].

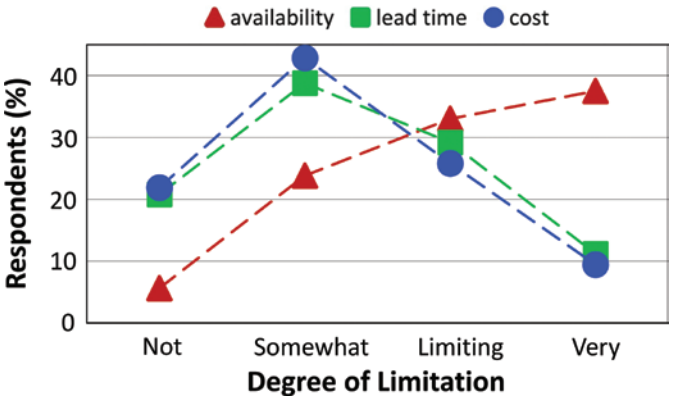

Figure 3. Factors that limit respondents' use of local ecotype seeds [Q23]. Responses for local ecotype plants are nearly identical and not shown. Note: Because of the ordinal nature of the *x*-axis, the connecting dashes accurately reflect increase or decrease, but not rates of increase of decrease.

Availability of Species and Ecotypes

Respondents rated the commercial availability of native seeds on a 0-to-5 (never-to-always) Likert-type scale (Figure 4). Respondents that prefer to work with local ecotype seeds most often rank them as "sometimes available" (mode = 2, mean = 2.1, sd = 1.2, n = 389), with only 15% describing them as "always" or "mostly available." Respondents that prefer to work with straight-species seeds also most often rank them as "sometimes available" (mode = 2, mean = 2.9, sd = 1.0, n = 104), with only 32% describing them as "always" or "mostly" available.

The results for commercial availability of local ecotype plants are similar. Only 12% of survey respondents describe the ecotype plants they need as "always" or "mostly" available (m = 2.1, sd = 1.0, n = 462). The commercial availability of straight-species plants is not good either, only 27% describe them as "always" or "mostly" available (m = 2.8, sd = 1.0, n = 609) [Q18].

Availability of Native Plant Materials: Geography

Respondents were asked to list up to 5 of their top commercial sources of native seed (Table 5). On average, respondents purchase native seeds from vendors who are 673 km (418 mi) away. Respondents who prefer locally native seeds go much farther afield than they would like. Those who conceive of local as an 80 km (50 mi) radius are, on average, ordering seeds from vendors 669 km (415 mi) away. Similarly, respondents who prefer a 160 km (100 mi) radius are ordering seeds from vendors 604 km (375 mi) away. Respondents who buy from the most popular vendor are on average 584 km (363 mi) away. Those who buy from the second-most popular vendor are on average 1296 km (805 mi) away. Respondents who think of local as being in-state are buying out-of-state 85% of the time (n = 138).

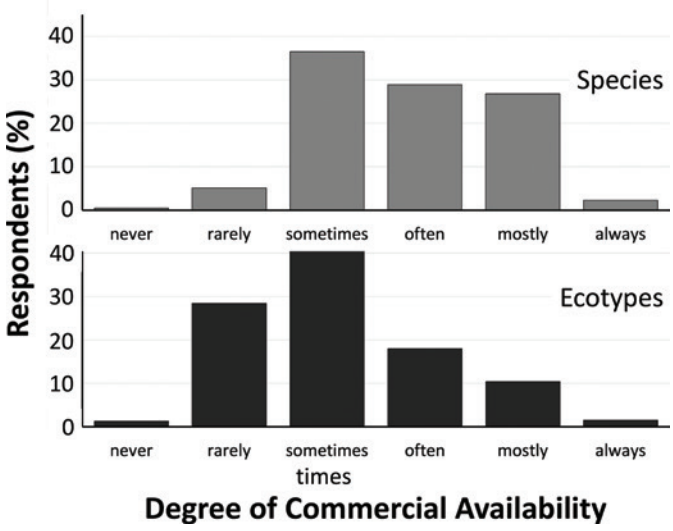

Figure 4. Commercial availability of native seeds as reported by respondents who prefer straight species (n = 104) or local ecotypes (n = 389), two-tailed t-test for unequal variances, $t(184) = 7.37$, $P < .0001$, Cohen's D = .78 [Q14xQ19].

The measure of distance is further complicated by the fact that native seed vendors typically do not provide buyers with the provenance of the wild seed sources used for their production, and distance to seed source is the actual concern. As a result, kilometers-to-seed-source could differ significantly from kilometers-to-vendor.

Even though wild collection is not a commercial source, so many people wrote it in that it ranked third (15%). The actual rate of wild collection is much higher. We will return to this topic in the section on Users That Produce Their Own Seeds and Plants.

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

Availability is an issue and where the stock comes from is unknown.
—Residential landscape designer from the Mid-Atlantic

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

I find that many species were originally sourced from the Midwest, and that even producers in the East got their original material from places [other than the East]. —Survey respondent from East of the Appalachians

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

TABLE 5

Average distance, as the crow flies, between respondents and their commercial seed sources.

Seed vendor	Respondents (%)	km
A	47	584
B	22	1296
Wild collection	15	NA
C	13	642
D	10	1044
E	6	177
F	5	153
G	4	314
H	4	150
I	4	251
J	3	195
K	3	237
L	3	710

Notes: Vendors selected by more than 10 respondents are listed (n = 429 respondents, 611 responses) [Q21]. 1 km = 0.62 mi

webpage (https://mdflora.org) lists 17 native plant vendors within state boundaries, but no native seed companies. So, the distance between respondents and their plant vendors would be much less than the distance between respondents and their seed vendors. The situation is similar, however, in that many native plant vendors do not publicize the provenance of their wild seed sources. For example, in her study of plants sold as native in Utah, Hooper (2003) found that the plants had actually originated from a pool of nurseries spanning 12 states. Our respondents are well aware of these issues: When offered the opportunity to provide any additional comments about commercial availability [Q20], 39 respondents complained that vendor labeling makes it difficult to determine the genetic origin of NPMs.

Proximity to a native seed vendor does not impact respondents' perceptions of native seed availability. For instance, a subset (n = 27) of the respondents who prefer Level III Ecoregion seeds (Figure 4, top panel) work in the same Level III Ecoregion as where their native seed vendor is headquartered. And yet, these respondents experience the same low degree of commercial availability (m = 1.9, sd = 0.92) as other respondents do (m = 2.1, sd = 1.2, n = 389).

Geographically, respondents find the commercial availability of local ecotype plants to be fairly uniform. However, they find the commercial availability of local ecotype seed to be better in Wisconsin, Illinois, Indiana, and Ohio (Figure 5; mean = 2.6, sd = 1.1, n = 92), and considerably worse elsewhere (mean = 1.9, sd = 1.1, n = 288, Cohen's D = 0.66).

Of respondents, 75% expect their organization's demand for native plants to increase over the next 10 y, 22% expect demand to remain the same, and 3% expect demand to decrease (n = 573, Q13). Responses were nearly identical for native seed demand (77%, 21%, 2%, n = 548). The expectation of increased demand was true in all 32 ecoregions surveyed. Our findings continue a pattern established by the 8 prior surveys that asked about future demand, all of which reported expected increases (Table 1).

An Open Question about Availability Issues

When provided an opportunity to tell us anything else they wanted to "about availability issues" [Q18], respondents reiterated their concerns about poor commercial availability of local ecotype NPMs (122) and 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 1 respondent wrote that cultivars are sometimes useful in formal landscapes.

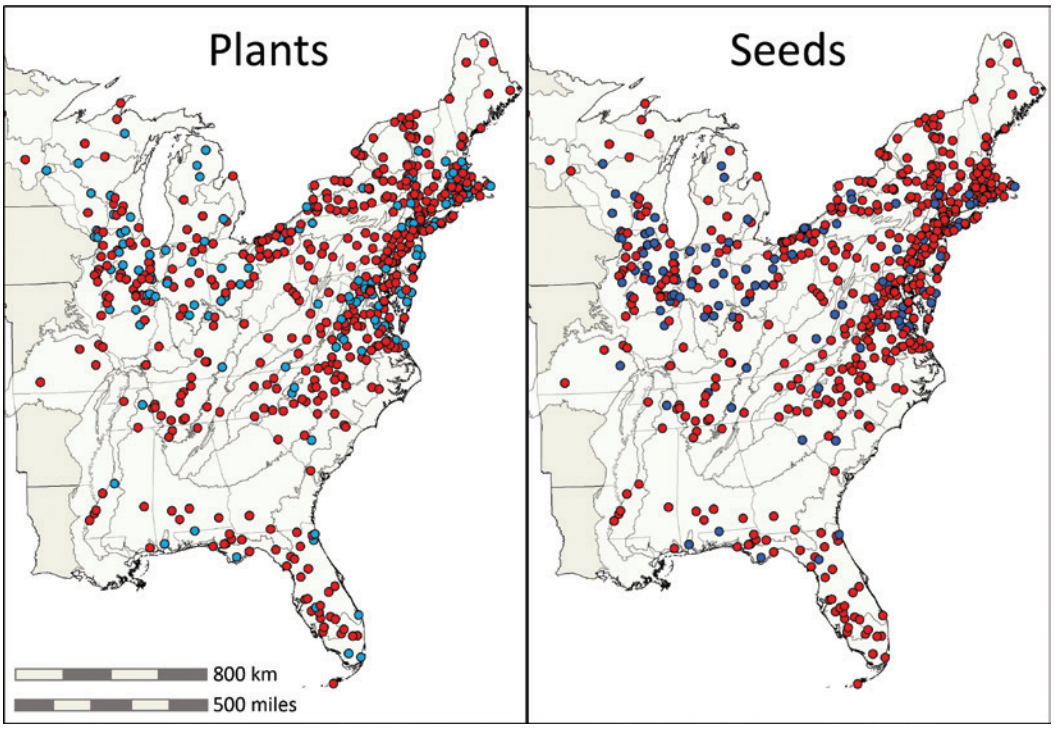

Figure 5. Commercial availability of local ecotype native plants (*left*) and seeds (*right*) on a scale of 0 to 5 (never to always). Respondents who rank availability on the poorer half of the scale (0, 1, 2) are shown in red, those on the better half of the scale (3, 4, 5) in blue.

In response to an open-ended survey question, 39 respondents told us that vendor labeling makes the genetic origin of "native" plant material unclear. As demonstrated by the labels at a plant sale (*left*) in Baltimore County, Maryland, creeping phlox (*Phlox stolonifera* Sims [Polemoniaceae]) is being sold as a "US Native." The natural range of this species, however, is limited to a small fraction of the US, as indicated by the bright green counties on the Biota of North America map (*right*) (Kartesz 2014). Furthermore, the label provides no information on whether the plants are cultivars or straight species. Flower/label photo by Judy Fulton, EcoPlant Consulting

They wrote about contracting and procurement problems (15), and the related issue of inappropriate substitutions (10). They told us they need more technical information (13) and that they have problems with seed mixes (10). For example, 1 respondent described how the only commercially available meadow mix, which contains alien species, shapes public perceptions and expectations of what constitutes a native meadow where he works. Nine respondents wrote about the difficulty of finding wild populations for collecting source seeds, some attributable to habitat destruction. Seven respondents wrote about the confusion surrounding what constitutes a native plant and how that relates to commercial availability.

Users Who Produce Their Own Seeds and Plants

The survey software failed to record "none of the above" responses for question 26. This left us unable to tally the total negative responses, as well as the total respondents, *n*, which is the denominator for the calculation of percentages. To obtain an estimate of *n*, we averaged *n* values for the 2 preceding and the 2 following questions (m = 596, sd = 41.8). We used these statistics to estimate percentages and calculate 95% confidence limits for those estimates.

Although we targeted NPM users for this survey, 38% of respondents engage in native plant production (95% CI [36, 41]). This percentage is well in excess of the 14% who indicate they sell plants, suggesting that much of the plant production is for internal use. Fewer engage in native seed production (23%, 95% CI [22, 25]).

Of respondents, 58% engage in wild seed collection (95% CI [55, 63]). We were surprised by this high rate, even though it is similar to findings of the Florida survey, where 61% of native wildflower producers said they wild-collect seeds (Kauth and Pérez 2011). Wild seed is necessary to support native plant and seed production efforts, but having large numbers of organizations wild-collect in a decentralized, unplanned, and unmonitored way increases the threat of overcollection. Of the respondents who wild-collect, 78% do so on land owned by their organization, with 41% collecting *only* from their own land (*n* = 332) [Q26b]. Forty-four percent wild-collect on public

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

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

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

We need to consider plant/seed availability when creating the designs. There are many species that I would love to specify, but cannot 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

land they do not own or manage, 48% do so on private land they do not own.

Among respondents who wild-collect seeds, only 31% have seed storage facilities. While this may indicate that some wild collectors are putting seed to immediate use, it also indicates that the majority of those collecting seed do not have the means to store it properly to maintain anything but very short-term viability. Furthermore, only 24% of wild-seed collectors and 44% of seed producers have even basic seed-cleaning equipment. We did not ask more questions about production practices, quantities, or species because the focus of this survey is native plant and seed use.

Potential Solutions

Create an Online Marketplace

Commercial availability might be improved if there were a better connection between those with needs and those with supply. Respondents overwhelmingly agreed (99%) that an online marketplace, where vendors could post their inventory and buyers could post their needs, would be useful (Figure 6). The National Seed Strategy (PCA 2015), 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." Most organizations would be willing to share information regarding their NPM needs if it would improve commercial availability (75% would, 24.5% might, 0.5% would not, $n = 594$) [Q16].

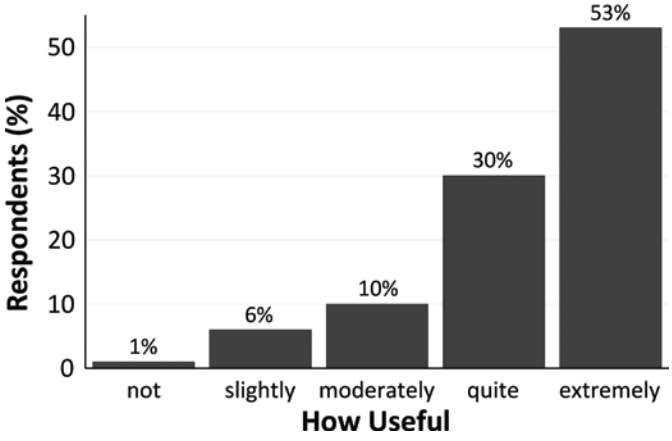

Figure 6. The usefulness of an online listing of commercially available, ecoregional native plant materials ($n = 641$) [Q16].

Provide Research, Continuing Education, and Technical Documents

In keeping with all prior surveys (Table 1), respondents to this survey (95%) want better availability of technical information (Table 6). Ecoregional species lists are the most desired type of technical document. Published lists would focus both users and producers on the same subset of species (compared to the thousands that are native), and in so doing could also help improve commercial availability.

Among respondents with a preference for local ecotypes, 56% rated existing continuing education opportunities as either mediocre or below average ($n = 400$) [Q24]. Respondents who rated continuing education as above average are concentrated in major urban areas (Chicago, New York, Philadelphia, and Washington, DC).

Charge Premiums

It is possible that commercial producers would be motivated to produce more ecotypes if they knew how many buyers would

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

Nurseries rarely offer natives (except a few classics) and rarely even seem to know which plants are native and which are not.
—Survey respondent from the Mid-Atlantic

Project leads do not have adequate information resources to make sound decisions (e.g., lists of local species and ecotypes are not available). —Survey respondent from an East Coast land conservancy

More research needed on life history, ecology, and soil mycorrhizae relationships. —Survey respondent

We need information about maintenance: mowing schedules, best practices for managing roadside natives. Successful case studies.
—Survey respondent

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

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

More research needed on impact of hybridized and cultivars of native plants in restoration landscapes. More research needed on impact of herbivory on forest and urban habitat restoration projects (deer, geese, beaver). —Survey respondent from an engineering firm

It would be valuable to have more information on establishment and maintenance since these landscapes are vulnerable to invasive weeds and deer. Many more plantings and much research and prevention needs to be done. —Survey respondent from a landscape architect business from New England

TABLE 6

Types of technical information respondents would find helpful (n = 617 respondents; 3314 responses) [Q27].

Type of information	Percentage
Ecoregional species lists	68
Plant establishment protocols	66
Seeding rates/planting densities	65
Species fact sheets	61
Plant communities and 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

Buying materials from small local companies is difficult for us due to our state procurement policies. —Survey respondent

Again, include growers in your design and development phase. —Survey respondent

Planning to implementation may be as short as a few months so availability can drive the species lists we use. —Survey respondent

I try to design with known availabilities. If I can't find it, I won't include in plant design. —Survey respondent

pay a premium for them. Of respondents that prefer local ecotypes, 83% would pay a premium to obtain the ones they want. 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. Even though 78% of respondents find cost to be limiting to at least some degree (Figure 3), most respondents would still pay as much as an extra 50% more for the local ecotypes they want (Figure 7).

Improve Lead Time and Procurement Policies

Respondents with shorter lead times are more likely than their counterparts to select species based on commercial availability (Figure 8). By contrast, respondents' use of plant lists, reference sites, and contractors for selection of species was independent of lead time. Given that contractors hired late in the project are the last professionals to know which plants will be needed, a potential solution would be 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

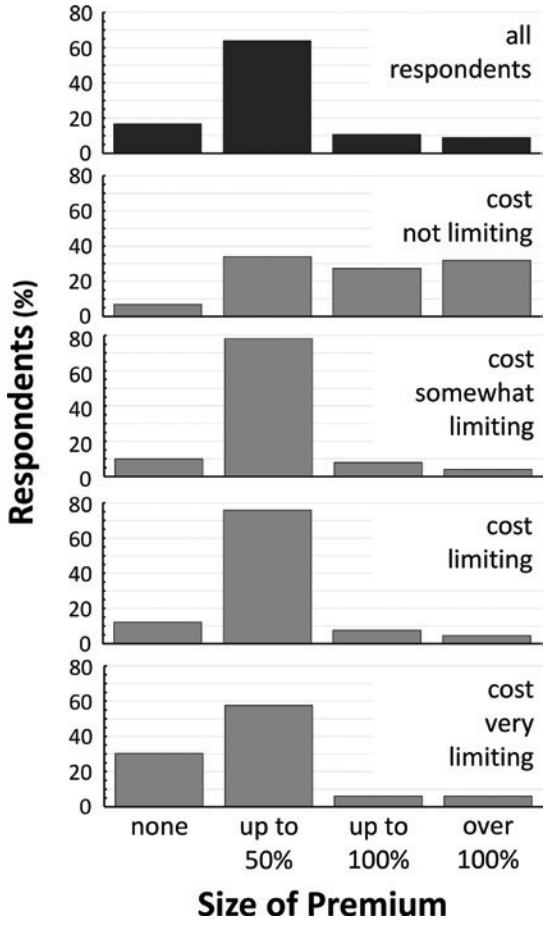

Figure 7. How much more respondents would be willing to pay (*x*-axis) for the local ecotype plants they want (*n* = 336). The lower 4 panels divide respondents according to how limiting the cost of native plants is for them (*n* = 44, 101, 66, and 33, respectively) [Q22xQ23a]. Responses for seeds are nearly identical and not shown. Fisher's Exact Test of Independence (*n* = 244, *P* <.0005) [Q22xQ23a].

contractors to install (Monan 2019). Peppin and others (2010) proposed reducing lead time by providing more storage facilities for bulked seed and using contract-growing arrangements. Some federal agencies use a procurement method called "Indefinite Delivery, Indefinite Quantity" (IDIQ) to warehouse contractor-produced seed in anticipation of post-wildfire needs.

Municipal, state, and federal agencies 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 such groups use NPMs, significant impediments to timely sourcing exist in procurement policy. Almost without exception, plants cannot be procured during planning and project design stages, but only after a contract has been awarded. Mostly this limits NPM availability to existing stock and forces contractors to seek NPMs farther afield than project specifications indicate.

Other relevant procurement issues include sole-sourcing, open-bidding, and funding allocations. Sharing of innovative

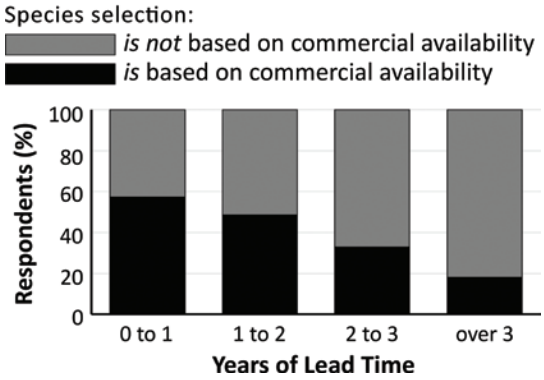

Figure 8. How lead time affects whether respondents select species based on commercial availability, χ^2 (3, n = 577) = 19.422, P = .0002 [Q11xQ12].

procurement policies can expedite improved practices. For instance, the 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 NPMs (Jao 2015). The National Seed Strategy (PCA 2015) also recognizes 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."

A network of active, regional, public native seedbanks that offer a sufficient variety, quality, and quantity of appropriately collected, geo-referenced seed would empower users to quickly source materials from a specific, *available* seed source. This network would reduce the risk of placing maladapted seed into the landscape and alleviate several of the aforementioned challenges respondent organizations face, such as short lead times; poor commercial availability; and inadequate resources for wild-collecting, cleaning, and storing seeds. By collaborating with property owners, seedbanks also help to manage and conserve wild source populations. Peppin and others (2010) proposed providing growers with starter seed; Havens and others (2015) called for the banking of as many species as possible; and the National Seed Strategy (PCA 2015) also calls for the use of active seedbanks.

We would like to grow more local ecotypes if seed were more available.
—Survey respondent who produces native plants

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

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

CONCLUSIONS

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 commercially produced 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 9 prior surveys, further documenting the poor commercial availability of NPMs and the preference for local ecotypes. Our findings support the National Seed Strategy's (PCA 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 seedbanks and seed storage facilities; delineating empirical seed transfer zones; developing propagation, storage, and use protocols; creating an online marketplace; and providing educational programs for producers and users.

Most of our respondents believe their demand for NPMs will increase with time, which will exacerbate the commercial availability situation. Like survey authors before us, our hope is that these 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.

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APPENDIX: 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.

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/ multistate/ 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*

Q10b 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/ 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*

Q18b Which choice best describes your general experience with sourcing native plants? The species my organization wants to use are available as plants <u>in our preferred ecotype</u>: *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*

Q19b Which choice best describes your general experience with sourcing native seeds? The species my organization wants to use are available as seeds <u>in our preferred ecotype</u>: *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 <u>plants</u>? 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*

Q23b Same as Q23a but with respect to seeds

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: _____*

Q26b 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, nonprofit) 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: _____

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