Restoring species diversity: uncovering gaps in the United States native seed market

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• Re-establishing native plant communities depends on the availability and effective use of seeds/plant material.
THE FOUR GOALS
of the “National Seed Strategy for Rehabilitation and Restoration”

GOAL 1
Identify seed needs, and ensure the reliable availability of genetically appropriate seed.

GOAL 2
Identify research needs and conduct research to provide genetically appropriate seed and to improve technology for native seed production and ecosystem restoration.

GOAL 3
Develop tools that enable managers to make timely, informed seeding decisions for ecological restoration.

GOAL 4
Develop strategies for internal and external communication.
GOAL 1

Seed planning and production

Identify seed needs, and ensure the reliable availability of genetically appropriate seed.
GOAL 1

Seed planning and production

Objective 1.1

Capacity to meet seed needs for restoration

Identify and Assess the Seed Needs of Federal agencies and the Capacity of Private and Federal Producers

Increasing Federal agency use of native conservation seed will stimulate seed supply and also help smaller organizations and private landowners access more native plant materials. Actions under this objective will lead to a better understanding of the overall capacity of Federal agencies to meet their stabilization, rehabilitation, and restoration needs with native plant materials. The assessment will
Seed planning and production

Objective 1.1

Identify seed needs and assess the seed needs of Federal agencies and the capacity of private and Federal production.

Increasing Federal agency seed supply will stimulate seed supply from smaller organizations and more native plant material objective will lead to a better overall capacity of Federal seed production and related staff, nurseries, storage facilities, tools, equipment, and costs. It will seek information specifically on seed supplies that help resist nonnative plant competition and that provide habitat for at-risk species, including pollinators. It will also identify strengths and weaknesses in seed production and facilities networks and needs for new infrastructure, staffing, and training. Production and infrastructure needs could be prioritized by habitat (e.g., for species such as pollinators and sage-grouse) and/or by seed zone. Other results of this action would include the creation of a map of agency production and storage facilities, the evaluation of investment needs and seed use policies, and the discussion of concerns and benefits related to the use of native and non-native seeds.

Action 1.1.2 Identify and inventory agency and private sector seed collections, nurseries, and storage capacity.

This action will identify existing agency seed supplies and related staff, nurseries, storage facilities, tools, equipment, and costs. It will seek information specifically on seed supplies that help resist nonnative plant competition and that provide habitat for at-risk species, including pollinators. It will also identify strengths and weaknesses in seed production and facilities networks and needs for new infrastructure, staffing, and training. Production and infrastructure needs could be prioritized by habitat (e.g., for species such as pollinators and sage-grouse) and/or by seed zone. Other results of this action would include the creation of a map of agency production and storage facilities, the evaluation of investment needs and seed use policies, and the discussion of concerns and benefits related to the use of native and non-native seeds.
GOAL 1

Seed planning and production

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Identify seed needs and assess the seed needs of Federal agencies and the capacity of private and Federal production facilities.

Action 1.1.1 Identify and inventory agency and private sector seed collections, nurseries, and storage capacity.

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Capacity to meet seed needs for restoration

Increasing Federal agency seed need will stimulate seed supply with native plant material objective will lead to a better overall capacity of Federal stabilization, rehabilitation with native plant materials.

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Assess seed supplies

Reviewing results to determine strengths and weaknesses across Federal agencies. This action will identify existing agency seed supplies and related staff, nurseries, storage facilities, tools, equipment, and costs. It will seek information specifically on seed supplies that help resist nonnative plant competition and that provide habitat for at-risk species, including pollinators. It will also identify strengths and weaknesses with agency and private sector seed production and facilities networks including new infrastructure, staffing, and training.
GOAL 1

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Identify seed and assess the seed needs of Federal agencies and the capacity of private and Federal production facilities.

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The right seed in the right place at the right time
Diverse set of needs

- Small-scale vs. Landscape-scale
  - Variable quantities
- Variety of ecosystems (e.g., prairies, woodlands, deserts, grasslands, forests)
  - Many different species
- Local material
- Genetically diverse material
- Readily available
• Difficult to get the right seed for particular species and places

• Relying solely on wild collection is not feasible
  • Hard to find/limited access
  • Unpredictable seed production
  • Over-harvesting remnant populations

• Demand for locally collected seed exceeds supply

• Issue of scale
Native Plant Market

- Large, diverse, and growing industry
- Coincided with growth in restoration efforts (~1950s)
- Functions as a reliable and cost-effective supply of native plant materials to support restoration efforts
  - Overcome supply shortages
- Wide range of producers and consumers
  - (Government agencies, NGOs, private sector industries, universities, small independent vendors)
Effective Partnerships

• Commercial industry can have a direct impact on restoration success
  • Species diversity, quality of seed, etc.

• Partnership between land managers and seed producers to identify needs is critical
  • Native plant market is at the intersection of those two parties

Dumroese et al. 2012
http://www.grainews.ca/2016/03/14/managing-mustard-on-the-prairies/
What do we know about this industry?
Knowledge based almost entirely on a handful of reports/studies

- Late 1990s - early 2000s
- Western-focused
- Small number of vendors
- Surveys

To date, there has been no nationwide quantitative assessment of the native plant industry
Gaps in our knowledge

- Very little known about the industry
  - Species availability?
  - Seed collection protocols?
  - Economic constraints?
  - Effective communication among producers, consumers, land managers, and researchers?
What are we missing?
Identifying Gaps

• Many approaches:
  • 1) Species richness

≠?
Identifying Gaps

• Many approaches:
  • 1) Species richness
  • 2) Taxonomic (Families)

Wickstrom et al. 2001
Identifying Gaps

- Many approaches:
  - 1) Species richness
  - 2) Taxonomic (Families)
  - 3) Ecology (Growth Habits)

Identifying Gaps

- Many approaches:
  1) Species richness
  2) Taxonomic (Families)
  3) Ecology (Growth Habits)
  4) Conservation (By Rank)

<table>
<thead>
<tr>
<th>Rank</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>GX</td>
<td>Presumed Extinct (species) — Not located despite intensive searches and virtually no likelihood of rediscovery. Eliminated (ecological communities) — Eliminated throughout its range, with no restoration potential due to extinction of dominant or characteristic species.</td>
</tr>
<tr>
<td>GH</td>
<td>Possibly Extinct (species) — Missing; known from only historical occurrences but still some hope of rediscovery. Presumed Eliminated — (Historic, ecological communities): Presumed eliminated throughout its range, with no or virtually no likelihood that it will be rediscovered, but with the potential for restoration, for example, American Chestnut (Forest).</td>
</tr>
<tr>
<td>G1</td>
<td>Critically Imperiled — At very high risk of extinction due to extreme rarity (often 5 or fewer populations), very steep declines, or other factors.</td>
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<tr>
<td>G2</td>
<td>Imperiled — At high risk of extinction due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors.</td>
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<tr>
<td>G3</td>
<td>Vulnerable — At moderate risk of extinction due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors.</td>
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<tr>
<td>G4</td>
<td>Apparently Secure — Uncommon but not rare; some cause for long-term concern due to declines or other factors.</td>
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<tr>
<td>G5</td>
<td>Secure — Common; widespread and abundant.</td>
</tr>
</tbody>
</table>
Identifying Gaps

• Many approaches:
  • 1) Species richness
  • 2) Taxonomic (Families)
  • 3) Ecology (Growth Habits)
  • 4) Conservation (By Rank)
  • 5) Geography (By Region)
    • Distribution of vendors
    • Sold where they grow?

https://www.boundless.com/
Objectives: **Identify Seed Needs**

Provide a “snapshot” of the native plant industry by…

- 1) Compiling a list of the species commercially available in the United States
- 2) Identifying gaps based on taxonomy, ecology, conservation, and geography
- 3) Crudely assessing how frequently local and genetically diverse material is available

**Action 1.1.2** Identify and inventory agency and private sector seed collections, nurseries, and storage capacity.
<table>
<thead>
<tr>
<th>Directory</th>
<th>Website</th>
</tr>
</thead>
<tbody>
<tr>
<td>Native Seed Network**</td>
<td><a href="http://www.nativeseednetwork.org/">http://www.nativeseednetwork.org/</a></td>
</tr>
<tr>
<td>Lady Bird Johnson Wildflower Center National Supplier Directory**</td>
<td><a href="http://www.wildflower.org/suppliers/">http://www.wildflower.org/suppliers/</a></td>
</tr>
<tr>
<td>Plant Iowa Native</td>
<td><a href="http://plantiowanative.com/">http://plantiowanative.com/</a></td>
</tr>
<tr>
<td>Plant Native</td>
<td><a href="http://www.plantnative.org/nd_idtoks.htm">http://www.plantnative.org/nd_idtoks.htm</a></td>
</tr>
<tr>
<td>Grand Prairie Friends</td>
<td><a href="http://grandprairiefriends.org/nurseriesIA.php">http://grandprairiefriends.org/nurseriesIA.php</a></td>
</tr>
<tr>
<td>Native Plant Material Sources</td>
<td><a href="http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_006679.pdf">http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs142p2_006679.pdf</a></td>
</tr>
<tr>
<td>Reforestation, Nurseries, and Genetic Resources</td>
<td><a href="http://www.rngr.net/resources/directory">http://www.rngr.net/resources/directory</a></td>
</tr>
<tr>
<td>Native Plants for the Intermountain West</td>
<td><a href="http://www.wyoextension.org/westernnativeplants/growers.php">http://www.wyoextension.org/westernnativeplants/growers.php</a></td>
</tr>
</tbody>
</table>
Data collection

• ~1,300 vendors nationwide (L48, AK, and HI)
• Used website URLs or contact information to obtain species lists for all possible vendors
  • Updated when necessary
• Noted:
  • 1) Periodic wild collection
  • 2) Continuous nursery propagation
  • 3) Purchase material elsewhere
  • 4) Collected locally
• Data corrected for synonymy and spelling errors using USDA PLANTS database

• Added fields from USDA PLANTS database
  • Taxonomy (Category, Symbol, and Family)
  • All Ecology fields (Duration, Growth habit, and Native Status)
  • Almost all Legal Status fields (e.g., Invasive status, Federal T/E status, State T/E status, etc.)

• Added NatureServe global conservation ranks (G1-G5)
Generated an incredible amount of data

- Obtained 601 species lists (46% of the total no. of vendors)
- **109,572 species total**
  - 16,584 unique species
- 413 (32%) vendors were without websites (small local businesses)
  - Received emailed lists from 48 vendors
Species Richness:

- Only 23% of native species found in the USDA PLANTS database are commercially available
  - 5,942 of 25,414

Taxonomy:

- 46% of the plant families are represented
  - 250 of 548
Thistles and Milkweeds

- **7 species of *Cirsium***
  - Cirsium discolor
  - Cirsium undulatum
  - Cirsium nuttallii
  - Cirsium texanum
  - Cirsium occidentale var. venustum
  - Cirsium horridulum var. horridulum
  - Cirsium hordilulum var. vittatum

- **34 species of *Asclepias***
  - Asclepias syriaca
  - Asclepias incarnata
  - Asclepias hallii
  - Asclepias lanuginosa*
  - Asclepias fascicularis (weed)

- Only represented 20 times in the dataset...
- Represented >1,000 times in the dataset
Growth Habits

- Forbs most commonly produced
- Less conspicuous growth habits (e.g., ferns, mosses) not well represented

Figure 1. Frequencies of commercially available growth habits (actual values in red).
- Preference for perennial species

Figure 2. Frequencies of commercially available annuals, biennials, and perennials (actual values in red).
Conservation Ranks

- Vulnerable species underrepresented
- More imperiled and critically imperiled species than expected
- Only 5,003 of the 16,584 total species are secure/common native species (G4/G5)

Figure 3. Frequencies of commercially available species by conservation rank (actual values in red).
# Production Details

<table>
<thead>
<tr>
<th>Action</th>
<th>No. of Vendors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous nursery propagation</td>
<td>529</td>
</tr>
<tr>
<td>Periodic wild collection</td>
<td>97</td>
</tr>
<tr>
<td>Purchased elsewhere</td>
<td>28</td>
</tr>
<tr>
<td>Local ecotypes</td>
<td>51</td>
</tr>
<tr>
<td>Genetic engineering</td>
<td>3</td>
</tr>
</tbody>
</table>

- This is a crude assessment
- Predominately continuous nursery propagation
Geography

<table>
<thead>
<tr>
<th>Region</th>
<th>Number of Vendors</th>
</tr>
</thead>
<tbody>
<tr>
<td>West</td>
<td>523</td>
</tr>
<tr>
<td>Central</td>
<td>411</td>
</tr>
<tr>
<td>East</td>
<td>341</td>
</tr>
<tr>
<td>Hawaii and Alaska</td>
<td>28</td>
</tr>
</tbody>
</table>
Implications

• On track, but room for growth

• Increase diversity of available species
  • No. of natives, less “popular” growth habits, certain families, vulnerable species

• Research: Best production strategies for new species
  • Species biology

• Local material/genetic diversity
Future Work

• Endless possibilities for ways to look at this data
  • Currently in the beginning stages
  • Analyze by region, ecoregion, etc.

• Distribute the data to make it as useful as possible

• Update directories
Acknowledgements

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Washington, D.C. February 13-16, 2017

This and additional presentations available at http://nativeseed.info