So, You Want to Start a Seed Bank:

Road Map for a Native Seed Collection and Banking Program

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April 2019
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1. Purpose: Why do you want to build a seed bank?

Native seed collection and banking programs can have many objectives and serve several functions. From indefinite, long-term preservation of local seeds to supplying revegetation projects with high quality local seeds, a seed bank will require careful planning and implementation to succeed. Common seed bank objectives include:

A) **Long Term Seed Conservation**

- Preserve genetic and species diversity
- Protect species from climate change, natural disasters and human disturbances
- Facilitate research

B) **Site Specific Reclamation or Landscaping**

- Provide locally sourced native species for revegetation of disturbed sites
- Reestablish ecological integrity of disturbed sites, re-stabilize ground surfaces
- Improve aesthetic quality

C) **Commercial Enterprise** - native seeds may be collected for sale to corporate and private consumers

- Economic development
- Local job opportunities
- Renewable Resource

2. Timing: How long will this seed bank last?

Determining how long you intend for your Native Seed Bank and Collecting Program to operate is crucial to informing the policies and infrastructure your project will require.

A) **Long Term Seed Storage**

- You may wish for your seed bank to endure indefinitely

B) **Site Specific Reclamation**

- Based on intended duration of the project
- May range from a single season to multiple years

C) **Commercial Enterprise**

- Do you expect to supply consumers with locally sourced native seeds for the foreseeable future?
- Future expansion of a project should be considered.

3. Space and Location: How much space will you need, and where will it be located?

The spatial requirement of a project will be largely influenced by the number of species you intend to collect and bank. The volume of seeds should also be considered. The volume of seeds collected will increase by the number of locations and populations harvested. Location is also a key detail to consider before creating a Native Seed Collection and Banking Program.

A) **Long Term Seed Storage**

- A large space to accommodate seeds from many species.
- Large spaces for interim storage, processing, drying, and storing seeds.
- An office space to accommodate administrative duties.
- The location should be secure and impervious to damage in order to protect the seeds.
- Consider possible future conditions predicted under a changing climate, such as differing temperature, permafrost, and moisture/precipitation regimes.

B) **Site Specific Reclamation**

- Influenced by the size of the site intended for reclamation and the diversity of species required.

C) **Commercial Enterprise**

- Space requirements depend on the operations of the project and the targeted customers.
- Large space to accommodate many seeds varieties to suit projects with diverse needs.
- Is retail or office space necessary? Consider convenience and accessibility for customers.

4. Species: What seeds do you need?

The goal of a native seed collection and banking program may be to have as many species from as many locations as possible, or focus on more specific criteria. It is important to prioritize available species to guide collections and banking processes.

Whether or not a seed is orthodox must be determined. Orthodox seeds are able to be stored for long periods of time and still maintain viability. Recalcitrant seeds cannot withstand the drying and freezing associated with long-term storage and are therefore difficult to preserve (Rao et al., 2006).

A) **Long Term Seed Storage**

- Culturally significant species
- Rare or vulnerable species
- Ecologically important species

B) **Site Specific Reclamation**

- Consult your local revegetation experts for suggestions on what species to prioritize to meet your site-specific requirements and revegetation objectives.

C) **Commercial Enterprise**

- Familiarize yourself with consumer demands and economical species

Desirable characteristics include:

- Aesthetically pleasing species
- Species tolerant of harsh conditions
- Species with quick growing properties

Plant Propagation Protocols

Once you have identified your target species, research their associated harvest considerations, processing requirements, storage behavior and germination treatments.

- Native Plant Network – Propagation Protocol Database

https://npn.rngr.net/propagation/protocols

- University of Washington – Propagation Protocols for Pacific Northwest Plants

http://courses.washington.edu/esrm412/protocols/protocols.htm

- Kew Seed Information Database

http://data.kew.org/sid/

5. People: Who is involved? What do they do?

Governance refers to the process in which a group of individuals work together to assure the health of an organization.

- Ethical, legal, political and financial aspects of the project
- May be controlled by a public agency or board of elected volunteers
- Guided by transparent operational plans and locally developed rules and regulations,
- Governed by open source, free access and seed sovereignty principles.

Management is the administrative, technical, organizational and financial elements and the coordination, execution and monitoring of key tasks in maintaining a seed bank.

Ownership & Users
Determining who maintains ownership of seeds is another step that should be taken before the seed banking program begins.

- Will the seed bank act as a storage facility where various collectors can keep their seeds free of charge while maintaining ownership?
- Will private ownership pay collectors for deposited seeds and assume ownership of seeds?

Funding
Funding may come from a large variety of sources and may be influenced by the purpose of your program

- Analyze costs of establishing and maintaining your seed bank.
- Know how long your current funding will last.
- Identify where you may find additional funding.

6. Budget: How much will it cost and where will the funding come from?

Create a budget plan that includes

- Acquiring and maintaining equipment and space
- Various insurance and utility costs
- Hiring and paying personnel for collections, sales and administrative duties
- Training staff or volunteers
- Advertising for Collections for Sale
- Long-term budgets encompass more uncertainty than short-term budget plans – be prepared to be flexible and have some reserves to adapt to changes in expenses
- If you are creating the seed bank as part of a business or non-profit, management and budget tools may be available from local business support organizations to guide your planning.

7. Risk Management: What challenges may arise?

Threats to Native Seed Collecting and Banking programs may be natural or man-made. Risk Management is not intended to eliminate all potential risks but instead involves identifying risks, analyzing likelihood of occurrence and potential impacts.

Some threats to seed banking projects are:

Lack of funding – long term seed bank projects require reliable funding.

Energy Security – a seed bank will need to have reliable access to adequate energy supply over its lifetime.

Lack of maintenance – the seed bank building, along with freezers and other equipment will require regular maintenance to ensure the viability of the project.

Human threats – sabotage or civil unrest may purposefully or inadvertently cause damage to the physical building or power supply of the seed bank.

Poor management –can be mitigated with comprehensive policies and detailed procedures.

8. Collecting: How will you collect the seeds?

Collecting seeds safely and efficiently requires considerable planning before heading out to the field. Check out the RBG Kew "Field Manual for Seed Collectors" for details on planning a seed collecting expedition as well as seed and data collection methods.

Population Analysis

- See the link below for details on how to locate and define populations for harvest. Also included in the sheet is a sample "Pre-Collection Checklist"
- http://brahmsonline.kew.org/Content/Projects/msbp/resources/Training/02-Assessing-population.pdf

Forecasting

- Forecasting involves visiting your identified populations before they are ripe and predicting when to return for collections.

Permits and Authorization

- Appropriate permits and authorization should be obtained well in advance of collection activities.
- Obtain permission from landowners, and relevant government authorities. Consult your local Agriculture and Forestry Departments to learn more.
- If you intend to collect seeds for commercial purposes, obtaining permission from the appropriate First Nation is best practice.

Species Identification

- Accurate identification of target species in the field will help to improve efficiency of seed collecting.
- Field Guides should be taken into the field whenever possible.
- Collect, press and dry a plant specimen if unsure of identification. Go to the link below to see the RBG Kew technical information sheet on creating a herbarium specimen. http://brahmsonline.kew.org/Content/Projects/msbp/resources/Training/15-making-herbarium-specimens.pdf

Data Collection

- Collectors should record data while in the field, including plant community, location, longitude, latitude, and elevation.
- An example of a seed collection form can be found the "Native Woody Plant Seed Collection Guide for British Columbia" (Banerjee et al., 2001)

- The collection data should be saved and managed as a long-term record which can easily be accessed by future users.

Collectors

- Collectors may be volunteers or staff. Determine how you intend to pay staff.
- Collectors paid by volume of seed collected may work faster but may require more supervision to ensure quality harvests.

Safety

- Collectors should be familiar with safety hazards in the field such as sun exposure, bear encounters and inclement weather.
- Field safety may be regulated in your jurisdiction and may also be dependent on the status of your collectors (employees or volunteers). Contact appropriate local regulators for more information.
- Collectors should have detailed maps of the area, appropriate clothing, equipment and communications devices. First aid training is recommended and may be required by local regulations.
- Safety plans should be devised and shared with collectors.

Conservation

You should also check the conservation status of targeted species as some species may be subject to management or protection. Some valuable sources are:

- NatureServe (explorer.natureserve.org)
- COSEWIC (www.wildlife-species.canada.ca/species-risk-registry)
- CITES (www.cites.org)
- IUCN Red List (www.iucnredlist.org)

9. Infrastructure and Logistics:

The collection and banking of seeds requires various infrastructure and equipment. The costs of building, acquiring and maintaining the various spaces and equipment can be high and will be influenced by the purpose of your project, as well as the temporal and spatial scope. The likelihood of expanding your native seed collecting and banking program should be considered when initially designing your program.

Transportation - of collectors to and from harvest sites, and the transportation of seeds and materials should be considered.

- Some seeds may be damaged by the heat associated with extended periods of time in parked vehicles.
- Vehicles with four-wheel drive will be useful in navigating rugged terrain.
- Helicopters may be a viable option for collecting cones from tall conifers and accessing rugged, isolated areas; however, helicopter travel tends to be extremely expensive, sensitive to inclement weather, and more restricted in spatial capacity for equipment and people compared to other transportation methods and should not be casually proposed without consideration for budget and logistics.

Processing - The seeds of many species require processing or cleaning prior to storage.

- This may include de-winging, extraction from cones, removal of various structures etc.
- These processes may require various equipment that should acquired before collections begin to ensure proper post-harvest handling of seeds.
- Understanding and implementing seed handling protocols for your prioritized species will prevent damage and increase viability.

Drying - Drying methods will vary based on volume of seeds and space availability.

- RBG Kew Millenium Seed Bank Partnership has created a technical information sheet on small-scale seed drying methods.
- http://brahmsonline.kew.org/Content/Projects/msbp/resources/Training/08-Small-scale-drying-methods.pdf
- Information on the design and costs of purpose-built drying rooms can be found in the Technical Information Sheet 11 published by the Millennium Seed Bank Partnership.
- http://brahmsonline.kew.org/Content/Projects/msbp/resources/Training/11-Seed-drying-room-design.pdf

Testing - Seed should be tested for viability, insect damage and seed borne fungi.

- Space must be available for these practices and should be able to be properly sterilized to prevent contamination. See RBG Kew Technical Information Sheet 1 for more information on seed testing. http://brahmsonline.kew.org/Content/Projects/msbp/resources/Training/01-Comparative-longevity.pdf

Cold Storage - Once seeds have been dried to the appropriate moisture content, freezing is essential to preserve the seeds.

- Small scale seed banks may rely on small on deep freezers, the standing variety preferable over the chest style.
- Larger operations may use purpose built cold storage rooms or industrial walk in freezers. See RGB Kew Technical Information Sheet 12 for more detail on the costs and benefits of freezers and cold rooms http://brahmsonline.kew.org/Content/Projects/msbp/resources/Training/12-Cold-room-design.pdf

Propagation – If you intend to plant and grow your seeds, other costs must be considered.

- For examples of how much a greenhouse can cost based on size and materials, see "Build a Greenhouse" on the Home Advisor website (https://www.homeadvisor.com/cost/outdoor-living/build-a-greenhouse/).

10. Additional Seed Collection & Banking Resources

- The Native Plant Society of BC https://npsbc.wordpress.com/
- Alberta Native Plant Council https://anpc.ab.ca/

Identification & Species Information

- iNaturalist.org
- eFloras.org
- PlantsOfTheWorldOnline.org by Kew Science
- Flora of the Yukon Territory by William J. Cody

Collection Manuals

- The Woody Plant Seed Manual. Agricultural Handbook No. 727. By F.T. Bonner & R.P. Karrfalt (2008).
- A Field Manual for Seed Collectors. Royal Botianical Gardens, Kew.
- A Field Guide to Collecting Cones of British Columbia Conifers by F.T. Portlock (1996)
- The Collection, Storage, Treatment and Handling of Conifer Tree Seed. Reproductive Material #3. By J. Fennessy (2002)

Revegetation Guides

- Yukon Revegetation Manual: Practical Approaches and Methods by P.E. Matheus & C.M. Omtzigt (2013)
- Native Plant Revegetation Manual for Denali National Park and Preserve by R.V. Densmore, M.E. Vander Meer & N.G. Dunkle (2000)
- Boreal Plant Species for Reclamation of Athabasca Oil Sands by A. Smreciu, K. Gould and S. Wood (2014)

The Millennium Seed Bank is a growing collection of seeds from around the world, aiming to provide a safety net for species at risk of extinction. They hope to conserve 25% of the world's plant species by 2020! Follow the link below to see more on long-term seed conservation!
https://www.kew.org/wakehurst/whats-at-wakehurst/millennium-seed-bank

To learn about the science behind plant and seed conservation visit
https://www.kew.org/science

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