GLOBAL TREES CAMPAIGN

BRIEF 5

How to collect seeds from threatened tree species

Credit: Sociedade Chauá

> "Collecting high quality seed is essential for producing good seedlings for restoration and conservation"
>
> Nogueira & Medeiros (2007)

This brief was written by Pablo Hoffmann, Santiago Velazco and the Chauá team [1]

1. Sociedade Chauá is a NGO working for the conservation of natural ecosystems and biodiversity in Paraná, Brazil: http://www.chaua.org.br/

Introduction

Knowing when, where and how to collect seeds from wild trees is a first step towards banking seed and/or growing rare or threatened species. However, poorly designed or followed procedures may result in the collection of low quality seed or, worse, may harm populations of tree species already at risk from extinction. The purpose of this brief is to provide guidance on how to sustainably collect high quality seed from rare or threatened species in order to aid their conservation in the wild.

Who is this guidance for?

This brief is for individuals in conservation organizations (NGO's, forest departments, protected area managers, botanic gardens) or anyone tasked with restoration of threatened tree species. Although specialised training is not required, it is essential to first **practice seed collection techniques on non-threatened taxa before attempting to collect from threatened species.**

The Global Trees Campaign is a partnership between:

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Before you start

Before going to the field, follow our step-by-step guide to ensure you are well prepared to know when, where and how to collect seeds from your target species.

STEP 1: Find out who already has, or is collecting, seed from your target species

Botanic gardens or seedbanks may offer a source of seed from your species, reducing your need to travel to, and collect seed from, valuable wild populations. BGCI's PlantSearch database (http://www.bgci.org/plant_search.php) holds information on which botanic gardens cultivate certain plants. However it should be noted that ex-situ collections are often derived from a small number of closely related individuals. Therefore, if you aim to use seed that is genetically representative of the species, it is essential to obtain seed of known wild origin.

Avoid over collection of seed by finding out if other people are collecting seed from your target species. Rather than putting additional pressure on wild populations, collaborate with these people to ensure all seed is collected in a sustainable manner.

STEP 2: Know your species in advance

Existing information on your target species should be collected and stored in one place, with backup copies kept elsewhere. Review published literature, reports and flora, visit botanic gardens or herbaria, consult specialists or interview people living in the areas where the species occurs. If time is limited, at least make sure you know what to look for (see 'Identification Issues'), when to collect seeds (see 'Phenology') and where to go (see 'Location').

IDENTIFICATION ISSUES

What features will you use to identify your species in the field and how will you tell it apart from closely related species? For seed collection trips it is also important to know **how to identify the species by its flowers and fruits and seeds** (see Page 3 for images of these stages for one species). Consult botanists who specialise in the relevant plant family or look up floras (books on the plants of a particular area) for identification help.

PHENOLOGY

When should you go seed collecting? In addition to knowing the appearance of your species' flowers, fruits and seeds you'll need to know **what time of year each stage of reproduction occurs** (these vary for different species). Use this information to develop a seed collection calendar (see Page 3 for an example) that will ultimately guide when you choose to go on seed collection trips.

LOCATION

Where will you find your target species? If your target species has been surveyed recently, you may already know where to find candidate seed-producing trees (known as **mother trees**). However if no such data exist, you may need to carry out your own reconnaissance trips or surveys to understand the distribution of the species. For more guidance see **GTC brief 1: 'How to survey an area for threatened trees'.**

STEP 3: Develop a seed collection calendar

Based on your initial research, develop a seed collection calendar as a means to plan trips to the field. Include information on when your species is expected to (a) to flower, (b) produce immature fruits and (c) when these fruits are likely to mature (and therefore be ready for collection). You might find it helpful to include notes on how to identify flowers, immature or mature fruits in the field.

Species	J	F	M	A	M	J	J	A	S	O	N	D	Notes
	Bu = Buds; **Fl** = Flowering; **Im** = Immature Fruits; **M** = Mature Fruits												
Species 1		Bu	Fl	Fl	Fl	Im	M						Fruits turn black when ripe
Species 2	Bu	Fl	Fl			Im	Im	M					Rainy season triggers fruiting
Species 3	Bu/Fl	Fl	Im	M			Bu	Fl	Im	M			Fruits turn from green to red when ripe

Note that the phenology of a given species may vary (a) from year to year or (b) between populations found in different locations. This may be related to the physiology of the species itself or due to climatic fluctuations.

Therefore it's essential to improve the accuracy of your seed collection calendar by monitoring actual changes in the phenology of your target species during collection trips. It might be helpful to take photographs of different reproductive stages, and record the date they were taken, to guide future field trips.

Photographs of different reproductive stages for *Cyphomandra diploconos*, a small tree from Southern Brazil

Flowers at different stages of maturity

Flowers with very young fruits in the same inflorescence

For this species, a tranverse section reveals differences between mature and immature fruits. Here, an immature fruit has a hard, white flesh with underdeveloped seeds

Mature fruits for this species have juicy, yellow flesh with fully developed seeds ready for collection

TOP TIP

Having a seed collection calendar is particularly helpful for certain species. Trees with *dehiscent fruit* (dry fruit that split open to release their seeds) must be harvested before seeds are dispersed and scattered far from the mother tree.

For species with *fleshy fruits*, mature fruits must be harvested before they are all predated by animals.

STEP 4: Acquire field equipment

- **GPS** and extra batteries.
- **Tree-climbing equipment** (including ropes, a helmet, harness).
- **Compass** and **Topographic maps**
- **Tree loppers.**
- **Weather-resistant** field notebooks; mechanical pencils.
- **Secateurs.**
- **Binoculars** for identifying tall trees (looking at leaves, flowers, fruits in the canopy).
- **Throw lines** and weighted bags (for facilitating fall of seeds).
- **Camera** for recording plant features – or equipment to ID flowers later.
- **Tarpaulin** or **buckets** (for collecting falling seeds).
- **Food, water, personal gear** and **mobile phone**
  Mesh bags (for tying round seed heads awaiting seed dispersal).
- **First-aid kit.**
- **Wicker basket, paper bags** or **breathable containers** (for temporary storage of fruits and seeds).
- **Field guide** or **notes** for identification.
- **A cool box.**

STEP 5: Make sure your team has the right skills

1. **Experience with seed collection:** It is essential to practice seed collection techniques on non-threatened taxa **before** collecting from threatened species. Without sufficient experience, your team may damage individual trees or cause unnecessary loss of seed material that could add further risk to species survival.

2. **Navigation:** Seed collection involves navigating between trees in their wild habitat. At least one member of your team should be able to:

   (a) Interpret landscape features from a topographic map;

   (b) Read approximate latitude and longitude from a specific point on the map;

   (c) Record locations of trees on the GPS or re-locate a tree with GPS coordinates already recorded.

3. **Tree climbing:** This should only be carried out by trained individuals and should never be carried out alone and always with somebody with first aid training. References for guidance on tree climbing are provided on page 8.

4. **First aid and health and safety training:** Seed collection may involve travelling to remote areas with difficult terrain and may involve tree climbing. It is essential to evaluate the risks beforehand and to take steps to minimise these.

5. **Plant identification:** Identification of the species of interest is critical. Although it does not necessarily require a botanist, at least one team member needs to be familiar with local flora and know how to identify difficult species. For guidance on identification, see GTC Brief 2 'How to Collect Voucher Specimens'.

In the field: selecting mother trees for regular seed collection

Before beginning regular seed collection you might want to make a reconnaissance trip to mark and identify candidate mother trees to return to later in the year. It is important to select mother trees that: (1) will provide a reliable source of seed and (2) are found across a range of different locations to maximize the genetic diversity of the seeds you are collecting.

(1) Desirable characteristics for an individual mother tree

- Reproductively mature
- Produce a viable source of seed
- Exhibit basic representative characteristics of the species (e.g. typical size, canopy structure and foliage)
- Easily accessible by trails or roads to facilitate regular seed collection

(2) Maximising genetic diversity of seeds collected from mother trees

- For each species, aim to collect from as many different populations from different locations as your resources allow for.
- For each known population, aim to collect seed from 50 individuals, or fewer, depending on your resources and the number of trees remaining
- Where possible, avoid in-breeding by collecting from mother trees found at least 100 meters apart from each other

The above guidance represents an ideal sample. In reality, for rare species, you may only be able to identify a few populations (or even a few individuals) to collect seed from. In these cases, collect a proportion of seed from any healthy individuals that you can find (although see Page 6 for guidance on over-collection).

Keeping records on your 'mother trees'

Once you have selected your mother trees, mark each tree in a way that does not harm the individual and provide it with an individual code. For valuable timber species a precise GPS reference should be taken instead of marking the tree, so as not to draw attention to the individual and risk it being felled. For each mother tree, record information on:

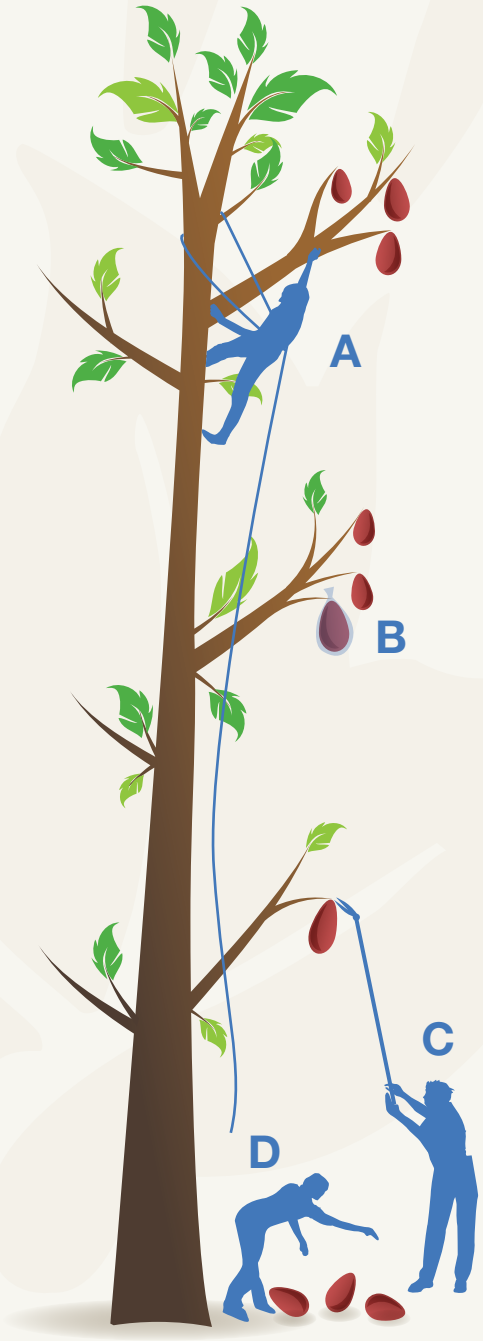
- Date observed
- Species and family
- Area of origin and a GPS reference for localization
- Height, diameter at breast height and canopy diameter
- Forest layer (e.g. understory, canopy, emergent)

These data represent vital background information for any seed you collect in the future. They may explain variable survival rates amongst your seedlings (e.g. some mother trees may produce healthier seedlings than others) and they may also guide your choice of planting sites in the future (e.g. you should aim to plant seedlings in areas of similar habitat and provenance to the mother tree).

Seed Collection Methods

Choice of seed collection method depends on the shape and height of the tree, fruit characteristics, site conditions and the skills held by your team. A brief introduction to four possible methods is provided below. **It is essential not to harm individual trees when collecting seed. Take great care not to damage the seeds to avoid unnecessary loss of viable material.**

TOP TIP **Assess viability of a small sample of seed from each tree before continuing with collection. Large-scale collection of non-viable seed may be a waste of effort. For guidance on techniques available for assessing seed viability, see GTC Brief 6.**



A **Tree climbing** can allow for efficient collection of seeds beyond the reach of long-handled tools. It also allows for more careful selection of target fruits. There are a number of different tree-climbing techniques available but all of these should be carried out by trained tree climbers only. For further guidance on tree-climbing techniques see references provided on Page 8.

B **Tying mesh bags around seed heads** is a useful technique for capturing seeds from dehiscent fruits that would otherwise be dispersed far from the mother tree.

C **Pruning seed directly from the tree** is an effective technique when seeds are clustered at the end of branches. It involves using secateurs or tree-pruners, attached to a rod of metal or bamboo. This method can cause some damage to branches and foliage, so should be used with extreme care for rare species.

D **Collecting seeds from the ground** consists of searching areas underneath the mother tree, after a natural or induced drop. It is most effective for species that produce large and heavy fruits that fall on the ground without opening, or for large seeds that are spread by wind.

Seeds collected from the ground may however obtain a high number of damaged seed and can easily be confused with seeds from other species occurring nearby.

Shaking the trunk or the branches can speed the process up, with buckets or tarpaulin placed on the ground to catch falling seeds. A rope with a weighted end can be thrown among the branches to expedite the fall of fruits and seeds.

TOP TIP **Do not over-harvest fruits. The Millennium Seed Bank advises that you *take no more than 20% of the mature fruits available from each tree on the day of collection.* Taking too many fruits affects the natural regeneration of the species and decreases a source of feed for native fauna.**

What next?

Immediately after collection it is important to clean leaves, twigs and other debris from fruits and seeds and store them in separate containers for each different mother tree. Containers should be labeled with:

- A code specific to the mother tree and target species
- Details of the collection site
- Date of collection

Avoiding loss of seed viability

If you plan be in the field for a long duration, the seeds should be removed from the fruit in-situ. This will prevent yeast from developing on fleshy fruits. As an added bonus, it will reduce the weight and volume of the bags, making it easier to handle and transport the seeds in the field. If you are leaving the field on the same day you can process fruits back in your laboratory or nursery.

Where possible, do not allow seeds to have direct contact with the forest ground. This will help to minimise exposure to pathogens, fungi and pests.

During collection and transport, extreme humidity or temperature can lead to loss of viability in the collected seeds. You can take steps to avoid exposing seeds to these conditions by:

- Airing any wet seeds before putting them in containers
- Not filling the containers up to the top with seeds
- Using containers with good aeration. Consider using wicker baskets or other containers made out of jute or nylon-mesh
- Never placing containers or bags in large piles
- Locating containers in a cool box or in a sheltered place out of direct sunlight

Did you know?

Different species produce different seed types that can broadly be defined as *orthodox* or *recalcitrant*. Recalcitrant seeds lose viability quickly and need to be processed almost immediately. On the other hand, orthodox seeds have greater storage capacity, although may still lose viability if they are not handled with care.

What to do with your collected seeds

After bringing your collected fruits and seeds safely back to your base you'll need to decide how to process them. If you haven't done so already, a first step will be to extract seeds from the fruits and clean them from debris.

Finally you'll need to decide what proportion of your seeds you want to store and what proportion you want to prepare immediately for germination. For more guidance on germination see GTC Brief 7.

If seeds are orthodox, or if the species is poorly represented in ex-situ collections, it makes sense to bank at least a subset of the seeds to ensure a longer-term supply.

For more in-depth guidance on how to process your collected seeds, see GTC brief 6: 'How to store seeds or prepare them for germination'.

Selected references and further guidance

References and further guidance on some of the methods described in this brief are provided below.

General guidance on seed collection

Aguiar, I.B., Piña-Rodrigues, F.C.M. and Figliolia, M.B. (1993). Sementes Florestais Tropicais. *Brasília: Associação Brasileira de Tecnologia de Sementes - Comitê Técnico de Sementes Florestais: p.349.*

Millennium Seedbank Project – Technical Information Sheet 03 – Seed Collection Techniques: **http://bit.ly/gtc_ref_5a0**

Nogueira, A. C e Medeiros, A. C. de S. (2007). Coleta de Sementes florestais nativas. Circular Técnica: nº 144, PR, p.11: **http://bit.ly/gtc_ref_5a1**

USDA Forest Service's Wood Plant Manual – Chapter 3 – Seed Harvesting & Conditioning **http://bit.ly/gtc_ref_5a2**

Guidance on tree climbing and seed collection techniques

FAO Corporate Document Repository -Seed Collection: **http://bit.ly/gtc_ref_5b**

Tree Climbers International: **http://bit.ly/gtc_ref_5c**

Guidance on sampling design for seed collection

CPC – Center for Plant Conservation. 1991. Genetic sampling guidelines for conservation collections of endangered plants. In: *Genetics and conservation of rare plants,* edited by Falk, D.A. and Holsinger, K.E. Oxford University Press, New York.

Guerrant, E.O. Jr., Havens, K. and Maunder, M. (eds.) (2004). Revised genetic sampling guidelines for conservation collections of rare and endangered plants. In: *Ex situ plant conservation: supporting species survival in the wild,* edited by E.O. Guerrant Jr., Havens, K. and Maunder, M. Pp 419 – 439. Island Press, Washington D.C.

Guidance on keeping an ex-situ collection

Farnsworth, E. J., Klionsky, S., Brumback, W. E. and Havens. K. (2006). A set of simple decision matrices for prioritizing collection of rare plant species for ex situ conservation. *Biological Conservation,* 128:1-12.

Oldfield, S. and Newton, A.C. 2012. Integrated conservation of tree species by botanic gardens: a reference manual. Botanic Gardens Conservation International, Richmond, UK: **http://bit.ly/gtc_ref_5d**

For more information, or to download the other briefs in this series, visit
www.globaltrees.org/resources/practical-guidance

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