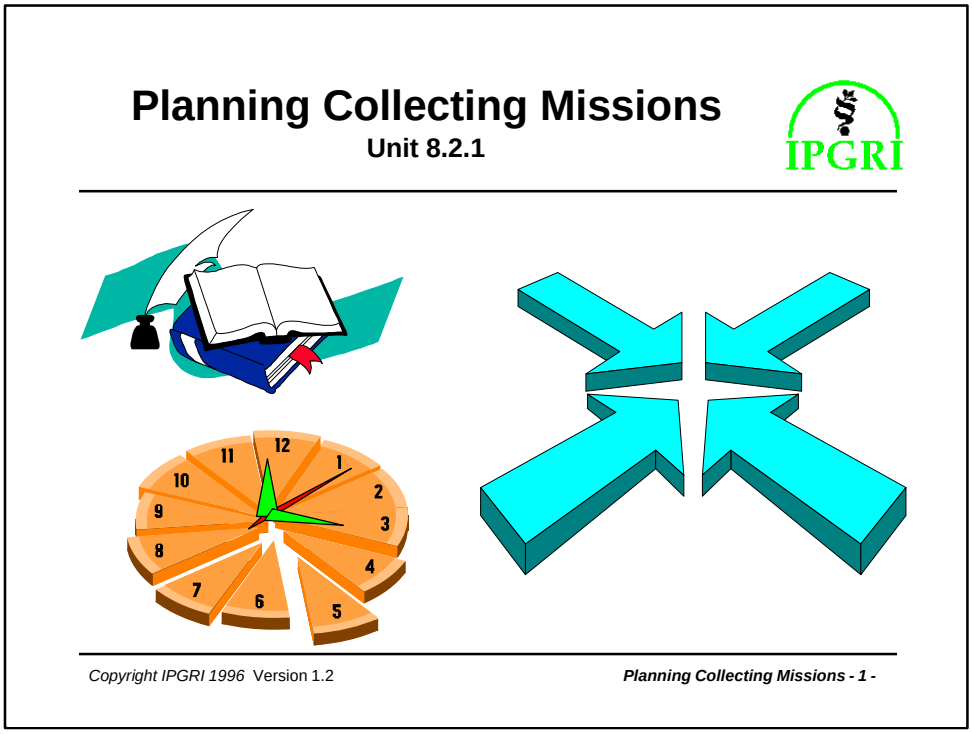


Unit 8.2.1 - Planning Collecting Missions

Version 1.2

Objective

Following a presentation and discussion of the topics, the trainee will be able to summarize the technical and logistical issues which have to be addressed when planning a collecting mission.

Acknowledgments

Training support materials developed by Kevin Painting, IPGRI, Rome. Illustrations by Lyndsey Withers, IPGRI and Microsoft Corporation.

Principal Source: Guarino, L., Ramanatha Rao, V. and Reid, R., Eds. (1995). Collecting Plant Genetic Diversity. Technical Guidelines. CAB International, Wallingford on behalf of the International Plant Genetic Resources Institute (IPGRI) in association with the Food and Agricultural O rganization of the United Nations (FAO), The World Conservation Union (IUCN) and the United Nations Environment Programme (UNEP).

Planning Collecting Missions

- Technical Planning
  - What
  - Where
  - Why
  - When
- Logistical Planning
  - How

Technical planning addresses the scientific issues involved in mounting a collecting mission. In particular it addresses the questions *what, where, why* and *when*:

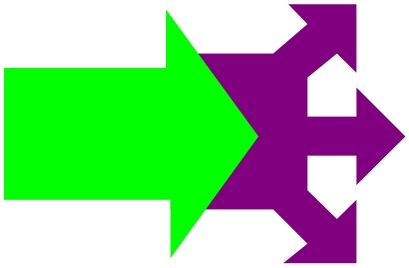
- ***What*** should be collected and in what form
- ***Where*** it should be collected from
- ***Why*** it should be collected
- ***When*** it should be collected

Logistical planning is concerned with the practical arrangements which have to be made to ensure the technical planning can be implemented effectively. It is therefore concerned with ***how*** the collecting mission should be organized - the composition of the team, the itinerary, the transport required, the equipment and so on.

➨ *The technical planning of a collecting mission is undertaken in parallel with the logistical planning*

Topic 1 - Technical Planning

- Establish that Collecting is Necessary
- Develop Sampling Strategy
- Decide what Equipment and Techniques to Use
- Decide what Documentation to Take



There are a number of sometimes complex issues which have to be addressed when planning collecting missions. For the technical planning of a mission these issues will be dealt with in the following order and by asking the following questions:

- **Establish that Collecting is Necessary**

What is being collected and why? Are there any alternatives to collecting the material?

- **Develop Sampling Strategy**

How is the target species distributed? What is the breeding system? What is the genetic variation within the target populations? How does this variation differ with ecogeographic factors? When is the fruiting period and is there any geographic variation in this? What information is available on the physical, biotic and human environment?

- **Decide what Equipment and Techniques to Use**

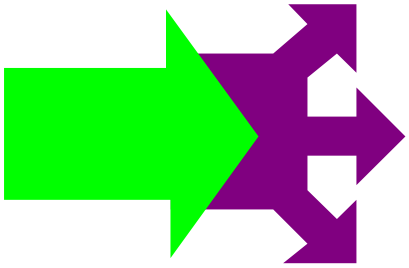
What type of material is being collected (seeds, vegetative material)? What requirements are there for handling and storage of this material on the proposed collecting mission?

- **Decide what Documentation to Take**

e.g. maps, taxonomic identification aids, checklists, language guides etc.

Technical Planning

- Establish that Collecting is Necessary
  - Develop Sampling Strategy
  - Decide what Equipment and Techniques to Use
  - Decide what Documentation to Take



Establish that Collecting is Necessary

- Collecting is necessary
  - on scientific grounds
- Collecting mission is appropriate
  - for the partners involved

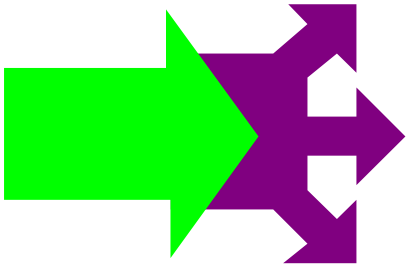
As seen in an earlier unit, the reasons usually given for collecting are one of the following: (a) Rescue Collecting; (b) Immediate Use; (c) Gap Filling; (d) Research Purposes; and (e) Opportunistic Reasons.

It is important from the very beginning to establish that collecting the target germplasm in the target region is *necessary*, that is, it can be justified scientifically. This is because collecting can be costly and a drain on often limited resources and, if not carried out carefully, it can cause damage to populations and their habitats both at the target site and at sites where the germplasm is subsequently moved. It can also be wasteful of resources if the material is already available in *ex situ* collections. Re-collecting is however justifiable if the material is not available from *ex situ* collections (or available in inadequate amounts) or if the conserved material did not reflect the diversity of the target genepool.

Another consideration relevant to logistical planning is whether the collecting mission is *appropriate* for the partners involved, that is, whether it is an effective use of available resources. This consideration is relevant when planning the *strategy* for a collecting mission *e.g.* whether to plan and execute the mission centrally or to involve local organizations and local people.

Technical Planning

- Establish that Collecting is Necessary
- **Develop Sampling Strategy**
- Decide what Equipment and Techniques to Use
- Decide what Documentation to Take



Develop Sampling Strategy

- Decide how many populations to sample
- Decide how many plants to sample in each population
- Decide how to choose the individual plants in each population
- Decide the kind and the amount of material to be sampled per plant

?Note: the summaries on sampling may have to be modified after writing 8.1.4 Sampling Strategies and 5.2 ecogeographic surveys as inevitably some overlap here.

The usual purpose of collecting is to collect, in a series of accessions, a representative sample of the genetic diversity of a taxon that exists in a particular region. In order to do this, a strategy needs to be developed which effectively captures this genetic diversity in the accessions collected. The strategy developed is called the *sampling strategy*.

A basic sampling strategy consists of four components:

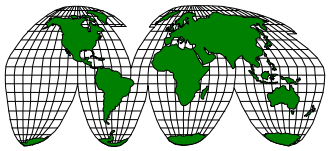
- Decide how many populations to sample on the collecting mission
- Decide how many plants to sample in each population
- Decide how to choose the individual plants at the collecting site
- Decide the kind and the amount of material to be sampled per plant

In order to make the best decisions here, considerable information is required about the nature of the target region (*e.g.* topography, geology, soil, climate, vegetation etc.) and the target species (distribution, phenology, reproductive biology, genetic diversity, ethnobotany, storage behaviour etc.). When this information has been synthesized (such as in the form of an ecogeographic survey - see unit 5.2), a number of options for sampling the target species can be developed.

The strategy that is finally adopted will depend to a large extent on the time and resources available and any practical arrangements made for the collecting mission during the logistical planning.

Sampling Strategy - Information Required (1)

- Geographic/climatic
  - topography, geology, soil, climate, vegetation, land use



- Socioeconomic
  - population data, agricultural survey data, economic indicators, infrastructure, level of services ...

Information on the Target Region

The information required falls into two categories: (1) **Geographic/climatic information** - including topography, geology, soil, climate, vegetation, land use; and (2) **Socioeconomic information** - including population data, agricultural survey data, economic indicators, and information on the infrastructure. Analysis of this information will allow the collector to:

- Define ecogeographically distinct areas in the target region for sampling
- Estimate the extent of biodiversity based on the heterogeneity in the target environment - the natural *and* human environment
- Assess the threat of genetic erosion
- Predict the presence / absence of a species or genotype based on its ecological preferences
- Predict the best timing for collecting

Information on the human and physical environment is also useful later on - it will help collectors orient themselves in the field and thoroughly document the collecting mission.

Sampling Strategy - Information Required (2)

- Distribution
- Reproductive Biology
- Ethnobotany
- Storage Behaviour
- Phenology

Information on the Target Species

- **Distribution in the Target Region.** Much of this information can be gathered from reports of previous collecting missions. Passport data from such missions can be used to identify potential collecting sites and, together with any additional characterization and evaluation data, be used to pin-point the occurrence of specific traits and elucidate patterns of variation in the target region.

- **Reproductive Biology** - including mating system, pollination mode and levels of morphological polymorphism. These profoundly the sampling strategy as they determine to a large extent the distribution of genetic variation both between and within populations

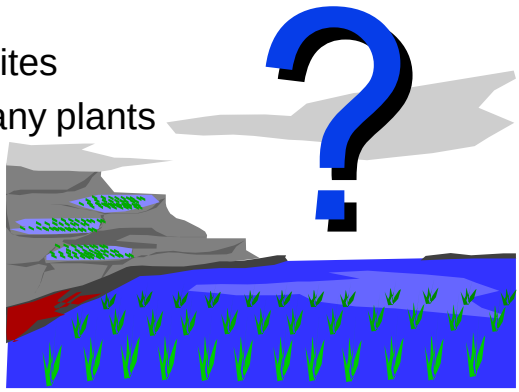
- **Ethnobotany -** an understanding of how the target species are classified, used and maintained by local communities will assist the collector in deciding where to look, what to look for, what to collect (and how) and how to use it subsequently.

- **Storage Behaviour** - information here will also be used in logistical planning for deciding which equipment to take, the length of the mission etc.

- **Phenological data** - used to decide *when* to collect.

Basic Sampling Strategy (1)

- Identify areas
- Decide which sites
- Decide how many plants



- **Identification of distinct areas within the target region for sampling**

Analysis of information on the human and physical environment together with information on the distribution of the target species will enable the collector to divide the target region into a number of clearly distinct areas on the basis of ecological, botanical, agricultural or socio-economic factors. From these areas, a number of populations (*i.e.* collecting sites) are selected for sampling.

- **Decide how many populations to sample on the collecting mission and from which areas**

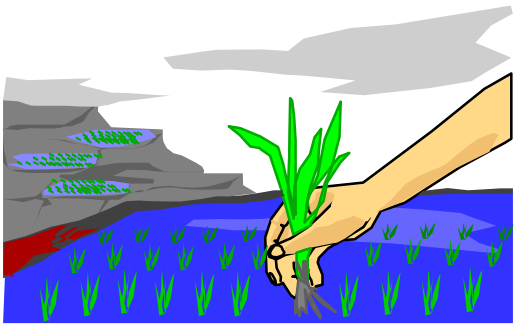
A common starting point is to aim to collect a total of 50 populations per species per region and modify this according to distribution data and knowledge of the reproductive biology of the target species. More sites are generally sampled in those areas where the target species is more common or where genetic variation is more conspicuous. Where little or no information is available on the distribution of the target species, the widest range of different ecogeographic conditions possible is selected.

- **Decide how many plants to sample in each population**

Commonly the aim is to collect from 50 individuals. This is usually increased if the sample is subsequently split or duplicated or if any loss is anticipated due to low seed viability or quarantine procedures etc.

Basic Sampling Strategy (2)

- Decide how to choose individual plants



- **Decide how to choose the individual plants at the collecting site**

Generally, individuals are sampled at random from the collecting site. If the site contains distinct microenvironments, these are sampled separately. For many populations of wild species a sub-population structure can evolve, necessitating a random *stratified* sampling approach (*i.e.* a random sampling from different microsites). Any bias in the sampling should be avoided - unusual or rare variants can be collected but should be processed separately from other material.

Basic Sampling Strategy (3)

- Determine the type of material to sample and the amount

- **Determine the type of material to sample and the amount**

Type: vegetative material or seed ?

In view of the difficulties encountered when collecting vegetative material, it is usually only performed when seed collecting is problematic or impossible. Collecting vegetative material is generally a less effective way of capturing the genetic diversity (due to the smaller sample size and slower collecting speed). Additionally, the material often requires special handling (e.g. *in vitro* techniques, storage and quarantine). It is however carried out for vegetatively propagated crops (e.g. roots and tubers), where seed production is irregular and intermittent (e.g. many perennial species) and where seed is unavailable at the time of collecting.

Seeds are generally easier to handle and store than vegetative material although recalcitrant seeds need special care.

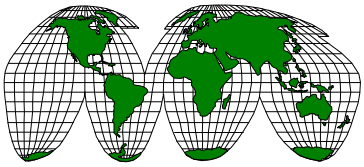
Pollen is collected and used in breeding programs, commonly to bridge the gap between male and female flowering. It is little used in conservation because it is often produced in amounts which are insufficient for conservation purposes and because of problems of poor longevity on storage.

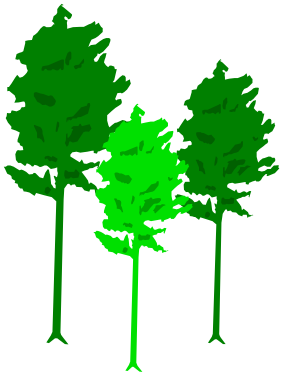
The Amount

Sufficient material should be collected per plant to ensure that the plant is represented in future duplicates. These requirements are usually dictated by subsequent processing of the material.

Modifications to the Strategy - Distribution

- Narrow Geographic Range
- Wide Habitat Diversity
- Rare Species
- Interpopulation Migration





The basic strategy needs to be modified to take into account particular features of the distribution of the target species, its reproductive biology and life history. These can be summarized as follows:

Distribution

- **Narrow geographic range** - sample fewer sites with more individuals per site and more propagules per plant

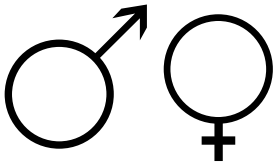
- **Wide habitat diversity** - species are more likely to diverge in different habitats so more populations should be sampled and fewer individuals per population taken.

- **Species is rare** - it can be difficult to reach a target of 50 individuals therefore sample fewer individuals but sample more sites and more propagules per plant.

- **Interpopulation migration** - where migration rates appear to be high, populations are more likely to share their alleles therefore sample fewer, but widely-spread, sites.

Modifications to the Strategy - Reproductive Biology

- Mating System
  - Outbreeding Species
  - Self-Fertilizing Species
- Pollination Mode



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Reproductive Biology

These factors profoundly affect the sampling strategy as they determine to a large extent the distribution of genetic variation both between and within populations.

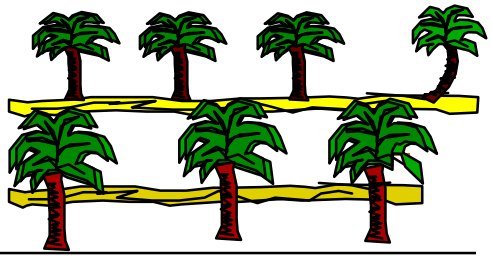
- **Mating system: outbreeding species** - the number of populations sampled in an area can be reduced and the number of individuals per site increased because the genetic variation is more widely distributed in the population. There is also less of a need for stratified sampling.

- **Mating system: self-fertilizing species -** there is a greater variation between populations than with outbreeders so the number of sites should be increased with a reduction in the number of individuals sampled. Certain natural populations have a local sub-population structure which calls for stratified sampling. The sample size of highly polymorphic populations should be increased.

- **Pollination mode** - this can affect the genetic make up on progeny from a single fruit. In wind pollinators, the seed are usually the progeny of different sources of pollen whereas for animal pollinators the seed are usually the progeny of a single source of pollen. Samples from animal pollinated species should therefore contain seeds from several randomly chosen fruits.

Modifications to the Strategy - Life History

- Vegetative Reproduction
- Fecundity
- Flowering and Seed Maturation



Life History

These factors affect the type and amount of collectable material and the timing of a collecting mission.

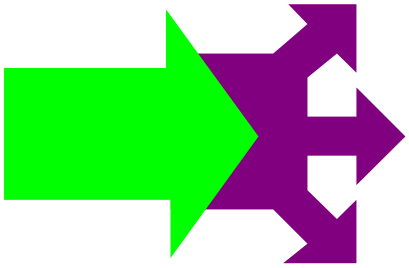
- **Vegetative reproduction.** The collecting window is much generally much larger for collecting vegetative material than for seeds. In perennial species, vegetative material is available throughout the year. In this case, the number of propagules collected at each site can be reduced as recollection of material (if necessary) is made easier. If available, both seeds and vegetative material should be collected especially for poorly-known species or where quarantine procedure are uncertain.

- **Fecundity**. Where a species produces few propagules, more plants should be sampled per site.

- **Flowering and seed maturation.** The collecting window is narrower in species which have highly synchronized flowering. In species with indeterminate flowering, only a proportion of the population (and therefore a proportion of the total genetic variability) is available for sampling at any one time. Therefore plants with different maturities should be sampled and possibly other types of propagules taken. Some species have synchronized flowering with indeterminate fruit production which increases the flexibility of sampling (e.g. perennial *Glycine* species).

Technical Planning

- Establish that Collecting is Necessary
- Develop Sampling Strategy
- **Decide what Equipment and Techniques to Use**
- Decide what Documentation to Take



Decide what Equipment and Techniques to Use (1)

Dependent upon:

- Type of Germplasm
- The Need to Process the Material

The decisions made here will depend entirely upon:

- **The type of germplasm collected** (e.g. seeds, cuttings, pollen, embryos etc.) - specialized equipment may be needed to collect the material; subsequently the material must be packed and handled carefully to avoid any loss in viability.

- **The need to process the material in the field** (e.g. seed cleaning / drying) - certain species may require processing to minimize loss in viability or for quarantine purposes.

Decide what Equipment and Techniques to Use (2)

Seeds

- Simple equipment
- Recalcitrant seed need special care
- Dry orthodox seeds only when necessary

Seeds

Simple equipment is used in seed collecting, often only gloves, secateurs, trays and bags. For tree species, more specialized equipment is called for (*e.g.* climbing equipment, saws, safety equipment, tree measuring equipment etc.). Additional equipment will be needed if it is decided to clean, dry or otherwise process the material in the field.

Most recalcitrant seeds require packing in moist, aerated polythene bags and can be sensitive to chilling and higher temperature shifts. This necessitates careful transport to avoid loss in viability. It can also affect the timing of a mission.

Orthodox seeds are dried in the field only when:

- the expected viability losses are unacceptable under the ambient atmospheric conditions; **and**
- it is not possible to reduce the time spent in the field in order to reach a base which has seed drying facilities.

The expected viability losses on the collecting mission can be predicted from meteorological data for the collecting region (monthly temperature and relative humidity values) combined with the known or inferred viability losses of the species under a range of ambient atmospheric conditions.

For fleshy fruits, if circumstances permit, it is better to leave the seeds in the fruits and keep the fruits at ambient temperature with aeration. If this is not possible, the seeds are removed, hand-cleaned and air dried to the ambient moisture levels. Procedures are discussed in more detail in unit 8.2.3.

Decide what Equipment and Techniques to Use (3)

Vegetative Material

- Harvesting Tools
- Cleaning Supplies
- Packaging Equipment

Greater need to process material

Vegetative Material

Fairly simple equipment is used in vegetative collecting and depends on the type of material being collected (*e.g.* root/tuber, cutting, whole plant etc.) and the species. The equipment required comprises the following basic elements:

- *Harvesting tools* - *e.g.* knives, trowels, secateurs etc.
- *Cleaning supplies* - *e.g.* brushes, water, disinfectants, fungicides etc.
- *Packaging equipment* - *e.g.* labels, paper bags, newspaper, polythene bags, soft packing material, trays, crates. For material that needs to be kept cool, insulated boxes and one or more refrigerators containing frozen gel-packs may be required.

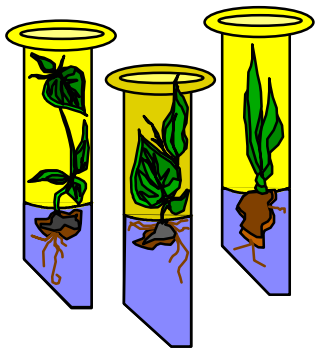
Compared with seed material, there is frequently a greater urgency to process the material after collecting and so a prompt return to base is often necessary.

Decide what Equipment and Techniques to Use (4)

IPGRI

in vitro

- Harvesting tools
- Cleaning/sterilising supplies
- Culture Medium
- Packaging Equipment



In Vitro Material

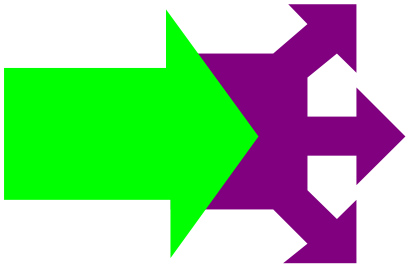
The essential equipment used for collecting *in vitro* material is as follows:

- *Harvesting Tools* - knives, scalpels, forceps, dishes, cork borers etc.
- *Cleaning/Sterilizing Supplies* - sterilants (*e.g.* disinfectants, ethanol, fungicides), sterile water.
- *Culture Medium* - appropriate liquid or solid culture medium and sterile plastic containers
- *Packaging equipment* - *e.g.* labels, soft packing material, insulated trays / boxes, crates and refrigerated containers.

The conditions in the field restrict what is technically possible when collecting *in vitro* material, so the emphasis is on keeping the material as viable as possible in the relatively short time period rather than attempting to propagate the material. Contamination by microorganisms is an additional problem as the culture medium can support the growth of certain microorganisms; there is accordingly an emphasis on the use of aseptic techniques. Procedures used in handling in vitro material are covered in more detail in unit 8.2.3.

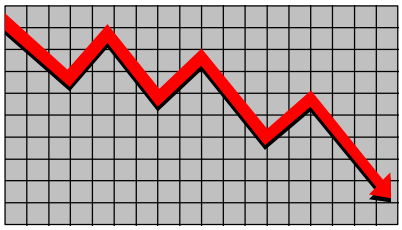
Technical Planning

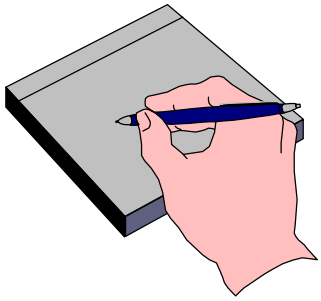
- Establish that Collecting is Necessary
- Develop Sampling Strategy
- Decide what Equipment and Techniques to Use
- Decide what Documentation to Take



Decide what Documentation to Take

- Environmental Information
- Identification Aids
- Ethnographic Information





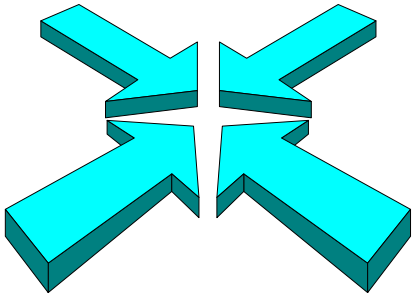
Much information is gathered in the course of technical planning is in the form of maps, books, surveys, flora, reports and so on. However, not all this documentation needs to be taken to the field, only documentation of immediate value. Generally, the less that is known about the target taxa and region, the more that needs to be taken in the form of documentation. This includes the following categories:

- *Environmental information* - *e.g.* road maps, topographic maps, soil maps, vegetation maps and protected area maps;
- *Identification aids* - *e.g.* local / regional Flora, annotated checklists of target taxa, botanical keys, field guides, descriptions of pests and diseases;
- *Ethnographic information* - *e.g.* language guides, annotated lists of local terms

As much reading up as possible on the target taxa and region should be done at the *planning stage* of a collecting mission so that the mission itself can concentrate on collecting germplasm.

Topic 2 - Logistical Planning

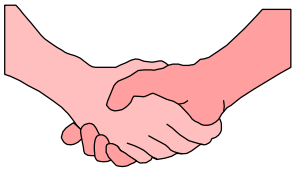
- Partners in Collecting
- Collecting Team
- Itinerary
- Duration
- Transport
- Equipment
- Permits
- Collecting Proposal



Logistical planning is concerned with the practical arrangements which have to be made to ensure the technical planning can be implemented effectively. It is therefore concerned with ***how*** the collecting mission should be organized.

Partners in Collecting

- Resources are limited
- Local organizations have extensive expertise
  - Regionally based agricultural stations
  - Government support services
  - Universities and colleges
  - NGO's
  - Local communitues



The aim of collecting is to collect, in a series of accessions, a representative sample of the genetic diversity of a taxon that exists in a particular region. Because resources are so often limited it is important that the collecting is carried out in the most effective way possible, making the best use of available resources and involving the most appropriate partners. The choice of partners is crucial as it can also affect how well the germplasm is subsequently conserved and evaluated.

An important decision that has to be made is which local organizations to involve (if any) and their collecting responsibilities. Local organizations can have extensive local ecogeographic and cultural knowledge. They can judge the best time for collecting and may be able to collect throughout the fruiting season and successive seasons. Potential partners could include any of the following:

- *Regionally based agricultural research stations*
- *Government support services - e.g.* agricultural extension services
- *Provincial universities and colleges*
- *Non-governmental organizations (NGOs)*
- *Local community organizations* - grass-roots organizations, federations or networks and national farmers 'associations.

The Collecting Team

Composition

- Team Leader
- Driver
- Specialists

- *Team should not be too large*

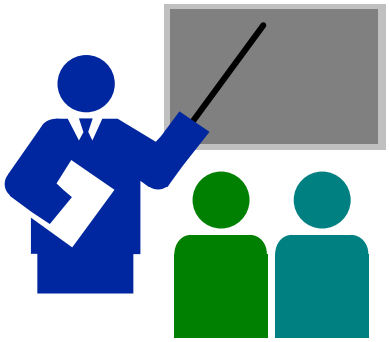
Collecting teams should contain suitable experts for the target taxa and region but should not be so large that they cause disruption of local life and difficulties in the coordination and transportation of the team members. For institutional collecting, teams are commonly three to five people in total. A typical collecting team comprises:

- *A Team Leader/Coordinator* - in charge of administrative and logistical arrangements;
- *An Experienced Driver* - who is familiar with the target region and driving on difficult terrain and has no other major duties on the mission;
- Other participants with the following expertise (as appropriate):
  - Social scientist, familiar with the target region and gender issues;
  - Specialist for the target taxon;
  - Herbarium taxonomist, especially in wild species collecting;
  - Language fluency
  - Plant pathologist
  - Microbiologist

The Itinerary

- A List of Target Areas
- The Route to take
- The Timings
- The Duration

The itinerary highlights future needs



An itinerary is a useful planning tool if prepared early on as it focuses attention on what will be needed to carry out the mission. An itinerary consists of the following items:

- A list of target areas to be visited
- The route to be taken - which roads, rivers etc. will be followed
- The timing of each visit
- The overall duration of the collecting mission

A well-planned itinerary will highlight the need for the following:

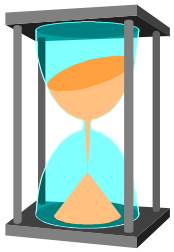
- **Permits** - or letters of introduction travel / collecting for each region
- **Transport** - type of transport and any accessories and supplies required
- **Accommodation** - need for camping equipment and supplies if no accommodation available
- **Collecting bases** - need for (and location of) a home base and any temporary bases to process collected material

An itinerary will inevitably be refined and modified throughout the planning process as further information is received about the availability of resources etc. It may also have to be changed in the field due to changing circumstances or opportunities.

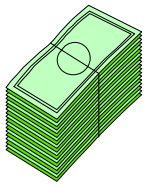
The Duration

Limited by:

- Cost
- Need to process germplasm
- Other commitments



➨ *One month is sufficient for single crop species*



Three important factors affect the duration of a collecting mission and its itinerary:

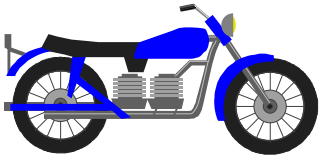
- **Cost** - long missions are expensive to run. The duration and itinerary may have to be changed for purely financial reasons.
- **The need to process the germplasm** - this will limit the time spent in the field or between base
- **Other commitments** - of collecting team members, vehicles on loan for only a short period etc.

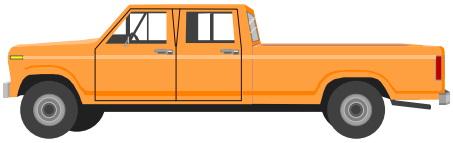
For single species (single crop) collection missions, **one month** or less is usually sufficient.

The main problem with short collecting missions is that diversity can be overlooked. This is particularly true for single-species collecting in target regions with are diverse in climate and topography when harvesting times can be different. In multi-species collecting, harvesting times can be different within the same area necessitating a return trip where possible.

Transport

- Organize well in advance of the mission
- Usually 4-wheel drive vehicles
- Other transport may have to be considered



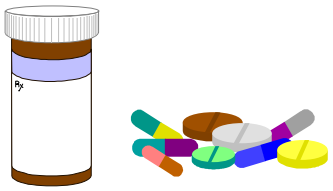


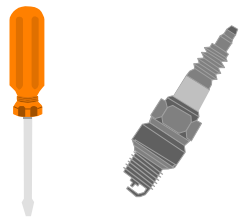
Transport is needed to move around the collecting region and should be organized early on in the planning stage as the restricted availability of vehicles can be a serious problem.

Commonly, one or more well-equipped four-wheel-drive vehicles are used. In certain remote areas, travel on foot or by pack animal maybe necessary. Canoes or small boats may have to be used in wetland areas. Motorcycles have also been used in some localities.

Equipment

- Vehicle Supplies
- Camping Equipment
- Medical Supplies



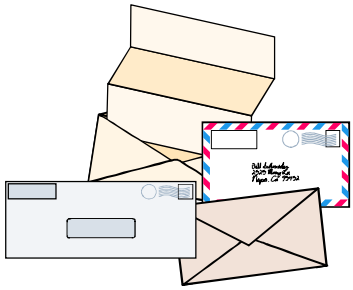


The technical planning identifies the specialized collecting equipment that will be required. The itinerary will highlight what additional travelling equipment and supplies will be necessary. These can be summarized as follows:

- *Vehicle supplies* - *e.g.* spare parts and accessories
- *Camping equipment* - *e.g.* tents, sleeping bags, cooking equipment, water containers, lamps etc.
- *Medical Supplies* - *e.g.* bandages, plasters, water purifying tablets, rehydration salts, pain killers, anti-malarial tablets, snake-bite serum etc.

Permits and Legal Requirements

- Collecting Permit
- Import Permits
- Letters of Introduction



Collecting can only take place with the approval and involvement of national authorities and this should be sought *well in advance* of the proposed collecting mission.

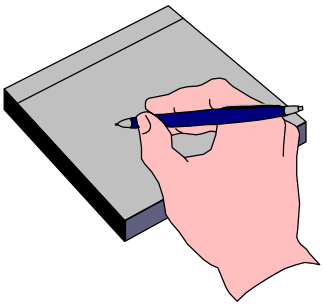
- *Collecting Permit* - as described in the FAO International Code of Conduct for Plant Germplasm Collecting and Transfer, the collecting permit is a formal authorization for the collecting mission. It lists the categories and quantities of germplasm that may or may not be collected, states the restrictions on the distribution and use of the germplasm, lists any restrictions on travel, defines any financial obligations and provides further pertinent information.

- *Import Permits* - these should be obtained from the country or countries to which the collected germplasm will be sent. The permit details the regulations governing plant introductions and vary from country to country.

- *Letters of introduction* or other documentation may be required for travelling in certain areas.

The Collecting Proposal

- Why collect the material
- What to collect
- How to collect it
- When to collect it
- Who will collect it
- How much it will cost



A collecting mission will usually require funding from institute carrying out the collecting or from an outside source such as regional organizations or bilateral and multilateral development agencies. In order to secure funding, a justification has to be made in the form of a written collecting proposal which summarizes much of the work already done in the planning process. It will cover the following points:

- ***Why*** the material should be collected from the target region *e.g.* genetic erosion, further use etc.
- ***What*** will be collected - a prioritized list of target species, type of material to be collected (seed, vegetative etc.); the proposed distribution of collected material to base collections and any follow-up activities *e.g.* characterization & evaluation;
- ***How*** it will be collected - a description of the sampling strategy and a map of the collecting region;
- ***When*** it will be collected - a detailed itinerary including times, dates and mode of travel;
- ***Who*** will collect it - the people and organizations involved and their roles;
- **The Budget** - with approximate costings.