

# Brief 6: How to monitor a species recovery project



This brief was summarised by Fabienne Van Rossum (Meise Botanic Garden) and Yvette Harvey-Brown (BGCI) from Chapter 7 of BGCI's and IABG's Species Recovery Manual



## Introduction

**Monitoring is a vital component of any species recovery project. Recovering a species should be an iterative process, with the project adapting to successes and failures.**

**Monitoring is an opportunity to measure the success of a project's recovery actions and provides evidence for management decisions. In this brief, we provide advice on developing a monitoring plan and the different components that should be considered.**





## Species and population monitoring

Species and population monitoring means recording changes to a species and its populations or to individuals in a population within a designated area. It includes both genetic and demographic monitoring.

**Individual:** The smallest unit that can be monitored. As many plant species propagate vegetatively, the individual must be defined as either a genetic or a functional entity.

**Population:** A group of individuals in a particular place and time.

## Before you start

Monitoring primarily consists of collecting data in the field to be able to determine how your target species and ecosystem are changing before, during and after species recovery actions.

A monitoring plan should include:

- **Objectives**
- **Data collection methodology for factors being measured**
- **Sampling strategy**
- **Review of resources and equipment needed and legal considerations (e.g. licenses)**
- **System and methodology for recording and storing data**
- **Process of data analysis and interpretation**
- **Timetable for the implementation of these steps.**

To be able to evaluate the impact of your recovery actions it is necessary to collect baseline data on the species, population, habitat and any other factor, process or action that you will be monitoring. See Species Recovery Brief 1 for guidance on how to conduct an eco-geographical survey.

### TOP TIP

*The objectives of your monitoring plan will determine what data you will need to collect. Do not try to monitor everything. The more difficult and expensive monitoring is - the more likely it will not be sustained!*

## Genetic monitoring

Genetic monitoring can determine whether genetic diversity and evolutionary potential have been restored and plant fitness increased in the populations under recovery.

## Why is it important to measure?

There are several benefits to undertaking genetic monitoring:

- **Estimation of gene flow (pollen and seed dispersal distances) and inbreeding**
- **Identification of whether the new recruits result from sexual reproduction / clonal propagation and from crosses between different seed sources**
- **Detection of inbreeding and outbreeding depression, genetic rescue, heterosis and local adaptation**
- **When repeated: estimation of effective population size and population viability analysis.**



## What to measure?

Genetic data are obtained using molecular data and fitness-related quantitative characters.

### Population variables

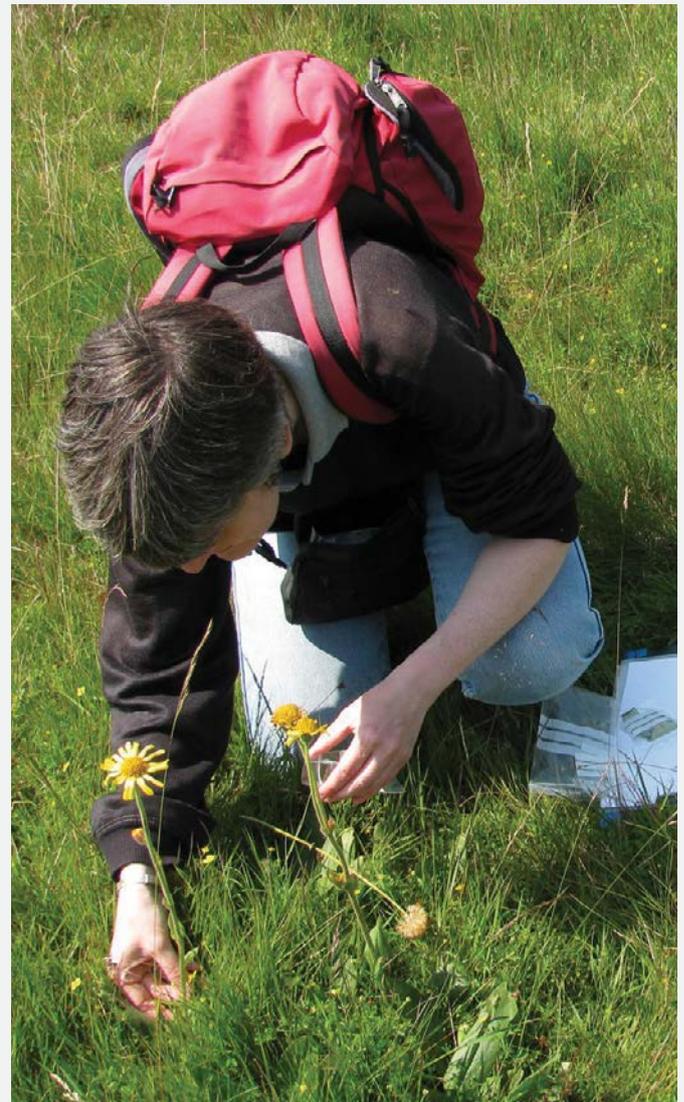
	How to proceed
<b>Genetic variation and structure</b>	Allelic richness, genetic diversity, genetic differentiation statistics, Bayesian methods and multivariate analyses can be calculated. A statistically sound subsample can be used.
<b>Inbreeding</b>	Can be estimated using Wright's inbreeding coefficient, and selfing rates.
<b>Contemporary gene flow</b>	Can be estimated using spatial genetic structure, paternity and parentage analyses, and methods using powdered dyes as analogues for pollen.  Mapping the individuals is necessary. For paternity/parentage analyses, ideally all plants in flower should be sampled.

### Individual variables

	How to proceed
<b>Individual genotypic data</b>	Allows you to distinguish clones from seed recruits.
<b>Admixture between seed sources</b>	Bayesian methods, hybrid index and parentage analyses can be calculated.
<b>Plant fitness</b>	Measurements in standardised environments, on several generations, in relation to molecular, population and environmental data.

#### TOP TIP

*If any of the terms used in this brief are unfamiliar to you or you need more guidance on how to carry out genetic monitoring please refer to BGCI and IABG's Species Recovery Manual ([www.bgci.org/files/ERABG/Species%20Recovery%20Manual/SpeciesRecoveryLowRes.pdf](http://www.bgci.org/files/ERABG/Species%20Recovery%20Manual/SpeciesRecoveryLowRes.pdf))*



## Demographic monitoring

Demographic monitoring consists of assessing changes in population size, dynamics and fitness.

## Why is it important to measure?

There are several benefits to undertaking genetic monitoring:

- Improved understanding of the species biology, functioning and life cycle
- Information on the population conservation status
- Identifying the causes of population demographic decline or expansion
- Identifying possible evidence-based management measures.

## What to measure?

	How to proceed
<b>Census population size (all individuals of a population)</b>	A thorough survey to count all individuals of a population, requires no specialist equipment and allows you to determine whether a population is stable, expanding or declining. However, in some cases it can be a long and difficult process to determine what is an individual in the field.
<b>Demographic structure (number of individuals by plant life stage: seedling/ juvenile/ vegetative, flowering or senescent adult)</b>	Allows you to track the evolution of the total population. As long as a rigorous sampling strategy is used, it is not necessary to survey the whole population.
<b>Recruitment (juveniles and seedlings)</b>	When the number of recruits is low, an exhaustive count may be considered. When recruitment is high, use small quadrats and extrapolate the results for the whole population.
<b>Spatial extent (area occupied by a population)</b>	Survey the area surrounding the target population and identify the position of any new individuals (flowering or vegetative) using a GPS. The population area can be calculated and the spatial extent of the population can be visualised on a map using GIS.



## Individual plant fitness variables

The monitoring of plant fitness should be realised on a sample of individuals representative of the population, covering several generations, and high enough to allow statistical analyses and long-term studies.

	How to proceed
<b>Survival rate</b>	The proportion of individuals surviving over a given period. As survival may vary over time, it is recommended to record survival for at least 10 years.
<b>Vegetative plant health</b>	It is useful to distinguish between individuals that look healthy and those that do not (e.g. showing signs of chlorosis, wilting and infestation).
<b>Size and growth of individual plants</b>	Several variables can be used to measure plant size, depending on the species' growth habit, such as rosette diameter, leaf area, plant height, number of leaves, volume and trunk diameter (for trees). Growth rates can be calculated if measurements are repeated over time.

### TOP TIP

*Simultaneous monitoring of natural and restored populations is essential for you to determine the key factors driving variability between natural and restored populations.*

### Reproductive success (plant flowering)

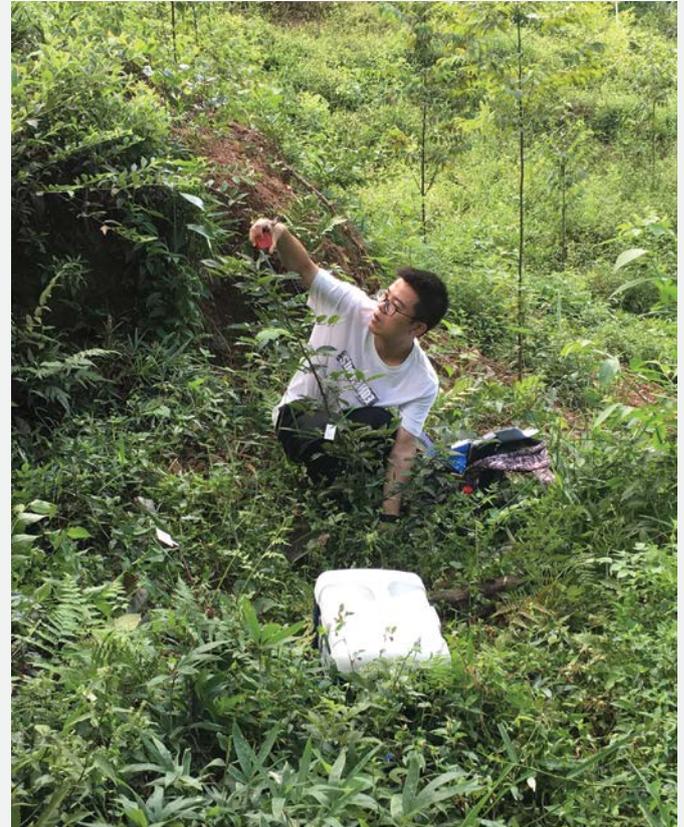
The following variables should be considered:

- Age of individuals at the time of first flowering
- Number of flowers per stem (can be replaced for complex flower structures by a count and measure of the diameter of flower heads or clusters)
- Number of stems per plant.

### Reproductive success (plant fruiting)

The ability of plants to produce seeds and therefore offspring is one of the most important criteria for determining the sustainability of restored populations. The following variables should be considered:

- Number of fruits (and flowers) to calculate the proportion of flowers that are developing into fruits (fruit set)
- On ripe closed fruits (before seed dispersal):
  - Number of unfertilised ovules
  - Number of viable and aborted seeds (to calculate viable/aborted seed sets)
  - In controlled conditions, germination ability of a subsample of seeds
  - Seed weight can sometimes be used as a proxy for germination capacity.



## Ecological and habitat monitoring

Ecological and habitat monitoring can determine whether the recovery project has restored the environmental conditions required by the target species.

### Why is it important to measure?

It is particularly important to verify that the restored habitat is suitable for the target species (taking ecological requirements at adult and recruit life stages into account), especially for species that require continuous species-specific habitat management.

### What to measure?

Engaging the community during survey work carried out prior to commencing the species recovery actions can help to develop a relationship with the local community, who may be able to provide useful information on the target species, become involved in recovery actions and ensure the longer-term sustainability of the recovery programme. See Species Recovery Brief 4 for more detailed guidance on engaging with local communities.

**TOP TIP** *You must make sure that the same individuals are easily identified year after year. Use permanent labels or precise plant mapping using a GPS.*



## What to measure?

### Biotic variables

	How to proceed
<b>Vegetative composition</b>	Composition of the plant communities and the abundance of specialist species are essential for evaluating the success of the recovery project. Variables to consider include species richness, diversity, frequency, density and cover abundance.
<b>Pollinators</b>	For plant species that rely on animal pollinators, it is essential to determine whether plant-pollinator interactions have been restored. Abundance and quality of pollinators can be estimated by an inventory of flower visitors and visitation rates per species or taxonomic group.
<b>Disturbance</b>	Disturbances to the site, e.g. management regime, floods, wildfires, grazing pressure, should be recorded with the date and period of occurrence.

### Abiotic variables

	How to proceed
<b>Soil</b>	Choosing which soil factors to measure depends on the target habitat. Variables to consider include trophic level, pH level and fluctuation of the water table. In some cases, visualisation and computer-assisted interpretation of satellite images can be applied (e.g. soil moisture assessment using radar images).
<b>Microclimate</b>	Some plant species are very sensitive to climatic variations. It is practical and cheap to use data loggers placed in the target sites to record air temperature and relative humidity, over a period of time.

## Timing and frequency

The accuracy of all types of monitoring is largely dependent on the timing and frequency of data collection, which may depend on the target species life cycle, phenology, growth form (annual, short-lived or long-lived perennial) and the season at which it is best suited to collect measurements. It has been shown that the duration of monitoring under a species recovery project is often too short, which means that recovery success and long-term population viability are not properly evaluated.



**TOP TIP** *The more threatened a population is - the more frequently you should monitor its status.*

## Implementation and reporting

Reporting is an integral part of monitoring. It allows for communication with partners and stakeholders on what has been done, summarises recovery progress, demonstrates the impact of a recovery plan and highlights lessons learned.

Before analysing the data, you must consider how to meet reporting needs of the audience. Several questions should be asked:

- **What should be included in the report?**
- **What is the level of detail required (e.g. summary or full technical report)?**
- **What is the frequency of reporting?**
- **In which format(s) should information be communicated (e.g. written report or workshop)?**

Reporting times can be a constraint in monitoring. A report on recovery progress is often required at an early stage of the monitoring process to guide funding or management. In such cases, it will be necessary to deliver preliminary results, providing evidence that these are important but also highlighting that this does not yet assess the long-term success of the recovery plan.



**Botanic Gardens  
Conservation International  
BGCI – Plants for the Planet**  
Descanso House, 199 Kew Road,  
Richmond, Surrey, TW9 3BW, U.K.

Tel: +44 (0)20 8332 5953  
Fax: +44 (0)20 8332 5956  
E-mail: [info@bgci.org](mailto:info@bgci.org)

**Visit: [www.bgci.org](http://www.bgci.org)**



**BOTANIC  
GARDENS**  
CONSERVATION  
INTERNATIONAL