In Situ Conservation Genetic Reserve Management

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SADC Crop Wild Relatives Regional training workshop
'*In situ* conservation of CWR including diversity assessment techniques'
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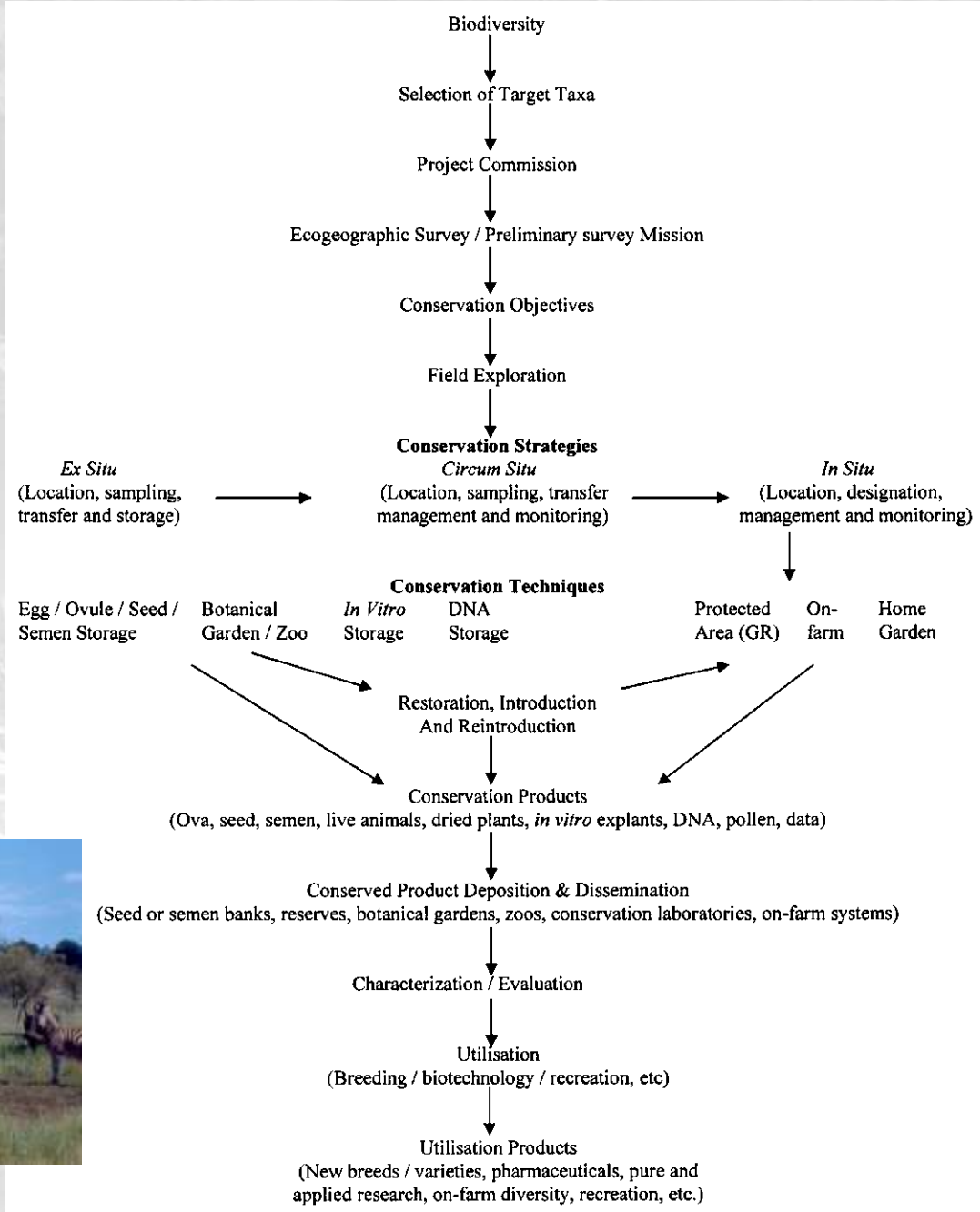
Introduction

- Publications
  - Groom, Meffe & Carroll (2006) Chp 14
  - Iriondo, Maxted and Dulloo (2008) Conserving Plant Genetic Diversity in Protected Areas Chps 3/4
  - Pullen (2002) Chp 9

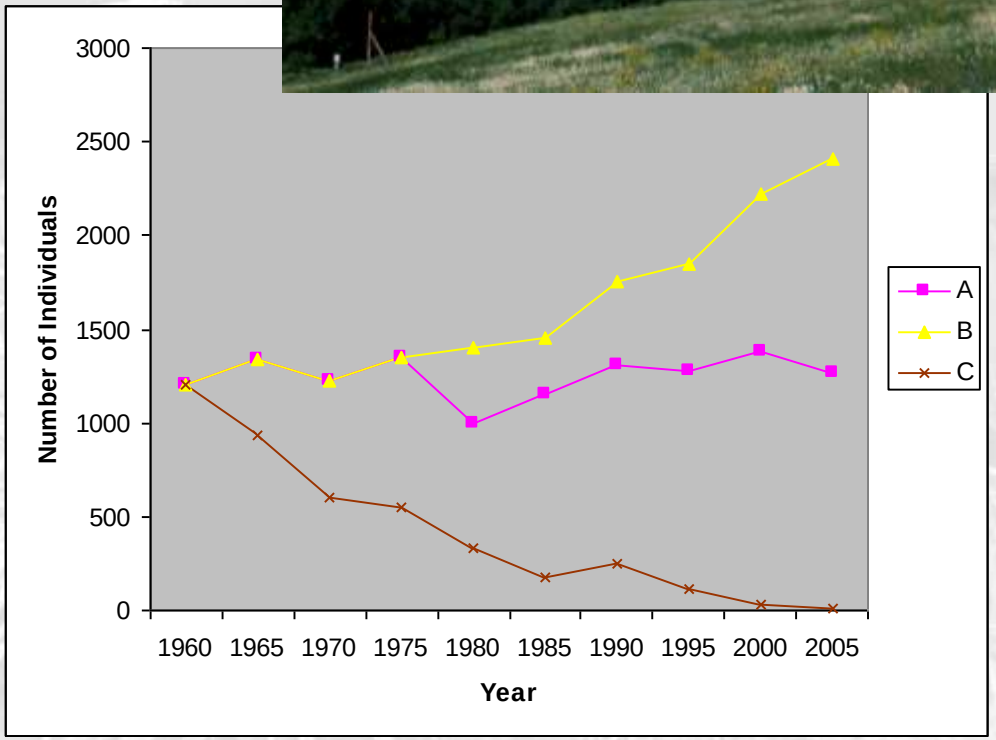
Introduction

Must fit within overall model of genetic conservation



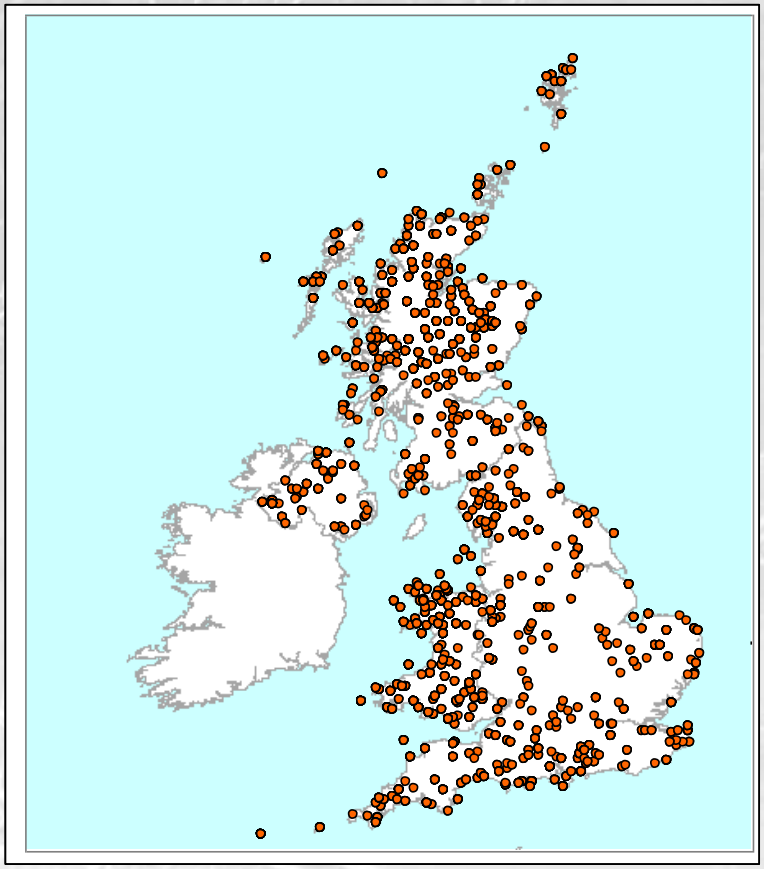
Introduction

- To manage the reserve must understand:
  - Autecology / target taxon's 'niche'
  - Synecology / community relationships
- Evidence-based conservation
- Formulate some form of management plan (with interventions)
- Monitor target populations to ensure management working



Extent of Protection

- Globally 102,102 protected areas covering 18.8M km^2
- 11.5% of the world surface
- UK generally small



Protected Area Type	Total Area (ha)	Total Number	Mean Area (ha)	Proportion of land area
SSSI	1,985,148	6,045	328	8.1%
NNR	189,540	304	623	0.8%

Evidence-based Conservation

- Conservation action is based on scientific evidence not anecdote or history!

- "Practical conservation is not well supported by background knowledge and is largely based on anecdotal evidence. This inhibits the development of scientific management and effective project planning" Sutherland (2000)

- Management often a continuation of traditional practices

Endangered Right Whales
Get Marine Protected Area off Alaska!

Evidence-based Conservation

- Extension from medical practice
- Cochrane quote:

  “What I decided was I could not continue doing was making decisions about intervening when I had no idea whether I was doing more harm than good”

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Evidence-based Conservation

- Rationale
  - Decision quality reflects the ratio between the information that the decision maker has at hand and the sum total of relevant information that is potentially available
  - More information (evidence) = better decision

- Evidence-based framework
  - Systematic framework that aims to inform decision makers about likely outcome of alternative actions
  - Links conservation research to conservation practitioners

Evidence-based Conservation

Features of evidence based system:

1. Systematic reviews and evaluation
2. Explicit assessment of effectiveness
3. Web delivery to practitioners

Advantages of evidence based system

- Efficient, unbiased, systematic, scientific
- Formalised method to identify areas where evidence is lacking
- Clear statement of best practice
- Needs-led research agenda

Evidence-based Conservation

- Example: control of invasive *Spartina* spp.
  - bio-control (*Prokelisia marginata* - a planthopper) was found to be highly effective (92.5%) against *S. anglica*, but less effective for *S. alterniflora* (18.4%)
  - Imazapyr and glyphosate were by far the most commonly used management, but Imazapyr achieved 85.1% density reductions of *S. alterniflora* while not assessed against *S. anglica*, and glyphosate achieved 57.9% density reductions against *S. alterniflora* and 42.8% against *S. anglica*
  - Cutting alone is not an effective control intervention of *S. anglica*, produced an overall increase in stem density of 42.8%

- http://www.environmentalevidence.org/

Goals of Conservation Management

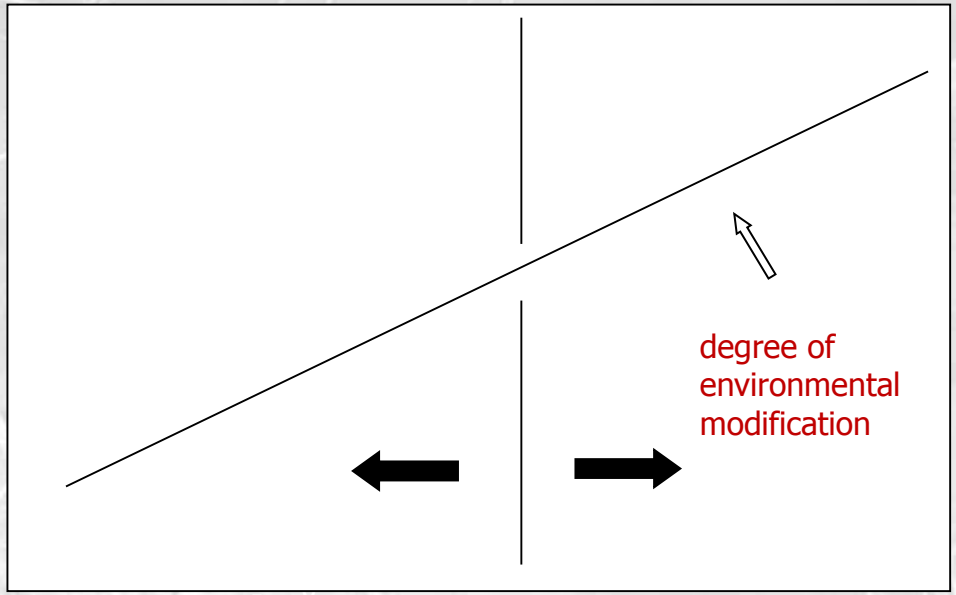
- To maintain maximum biological (habitat, species and genetic) diversity of the target taxon along with key associated species within the reserve.
- To promote general conservation of biodiversity.
- To maintain local ecological and evolutionary processes.
- To minimise external threats to biodiversity.
- To implement appropriate but minimally intrusive site management (= cost and changes of mistakes).
- To promote public awareness for the need of genetic and protected area conservation.
- To ensure diversity is available for actual or potential utilisation.

Protected Area / Genetic Reserve

- Protected area – “an area of land and/or sea especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed through legal or other effective means” IUCN (2008)
  - Ecosystem, habitat, species
- Genetic reserve – “an area of land and/or sea especially dedicated to the protection and maintenance of genetic diversity in natural wild populations within a defined areas designated for active, long-term conservation” Iriondo *et al.* (2008)
  - Intra-specific genetic diversity

IUCN Protected Area Categories

- Category Ia: Strict nature reserve / wilderness area
- Category Ib: Wilderness area
- Category II: National park
- Category III: Natural monument
- Category IV: Habitat / species management area
- Category V: Protected landscape / seascape
- Category VI: Protected Area with sustainable use of natural resources



Increasingly conservationists looking at in situ conservation outside of PAs

Management Plans

Functions of the management plan (Hirons *et al*., 1995):

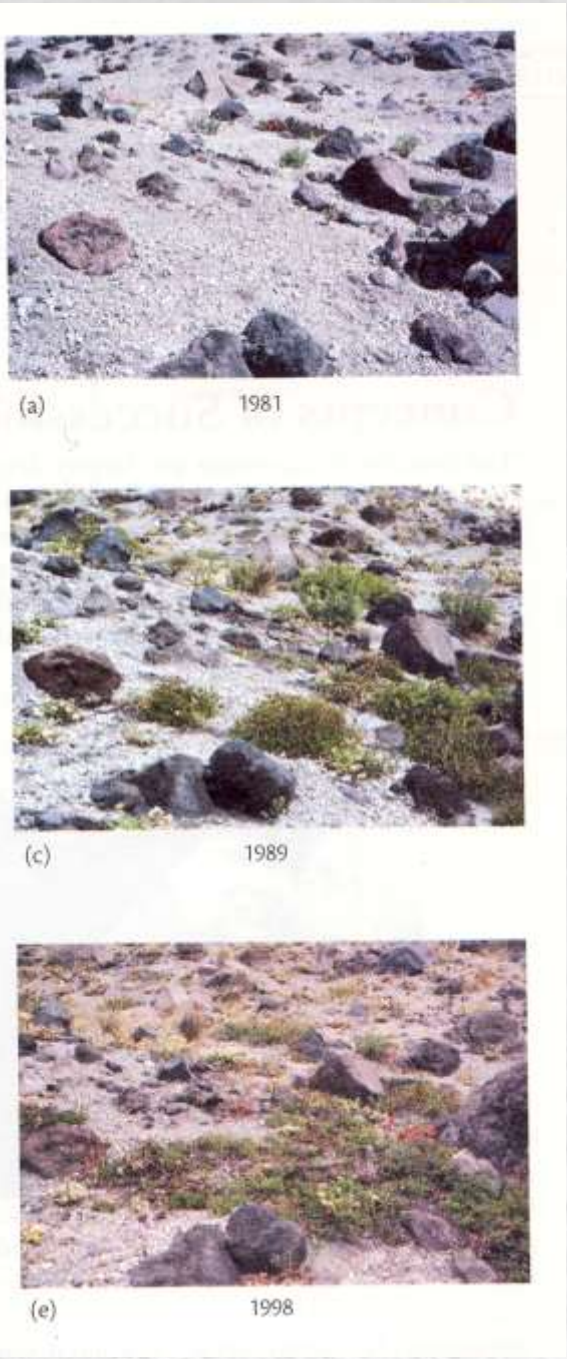
1. Describe the physical and biological environment of the reserve
2. Articulate the objectives and purpose of the reserve
3. Anticipate any conflict or problems associated with managing the reserve
4. Describe the management practices required to achieve the objectives
5. Monitor community dynamics within the reserve to assess management effectiveness
6. Organise human and financial resources
7. Act as a training guide for new staff
8. Ensure consistency between the reserve and national and regional conservation plans
9. Ensure site management objectives and management practices reflect the policies of parent organisations
10. Facilitate communication and collaboration among *in situ* and conservation agencies

Change is Natural!

- Communities are intrinsically dynamic and change is 'natural'

- Three forms of natural change
  - Stochastic - drought, floods, fire, cyclones, hurricanes and epidemics (external)
  - Successional - directional, halted by management intervention (e.g. Mount St Helens post 1980)
  - Cyclical - density-dependent interactions

- Dramatic but their effects do not persist, there is little or no genetic drift)



Anthropogenic Change

- Although change is natural changes due to human activity are usually more dramatic, having permanent effects
  - e.g. In Mauritius 200 of 685 species of native plants are endangered (IUCN and WWF, 1994), 53 of most threatened plants are known from <10 individuals, 13 of these are down to a single individual
- Human activity may create habitats, e.g. agriculture land, roadsides is the favoured habitat of the relatives of several important crops.
- Jain (1975) no major food crops or their progenitors are associated with climax vegetation

Why manage a site?

Because natural processes do not occur

- Management areas frequently too small to support all of species present in past, intervention management is necessary to maintain populations at viable levels
- Protected areas are often too small to contain levels of disturbance that generate resource diversity. Management frequently must simulate those disturbances
- Protected areas are often so fragmented and isolated that natural migration is unable to balance local extinctions. Under these conditions, managers may have to translocate individuals between management areas or assisted breeding
- Protected areas are often surrounded by hostile anthropogenic environments that produce invasive species (weeds, diseases and generalist predators) and degrading processes (siltation and pollution). Management must minimise or remove such influences
- Protected areas may be under pressure for development, for release of their natural resources for human use, or for use as agricultural lands to feed rapidly increasing and desperately poor human populations

Genetic Reserve Management Plan

1. *Preamble*: conservation objectives, site ownership and management responsibility, reasons for location of reserve, evaluation of populations of the target taxon, reserve sustainability, factors influencing management (legal, constraints of tenure and access).

2. *Conservation context:* place reserve within broader national conservation strategy for the responsible conservation agency and target taxon, externalities (e.g. climate change, political considerations), obligations to local people (e.g. allowing sustainable harvesting), present conservation activities (*ex situ* and *in situ*), general threat of genetic erosion.

3. *Site abiotic description*: location (latitude, longitude, altitude), map coverage, photographs (including aerial), detailed physical description (geology, geomorphology, climate, hydrology, soils).

4. *Site biotic description*: general biotic description of the vegetation, flora, fauna of the site, focusing on the species that directly interact with the target taxa (keystone species, pollinators, seed dispersers, herbivores, symbionts, predators, diseases, etc.).

Genetic Reserve Management Plan

5. *Site anthropogenic description*: affects of local human population (both within reserve and around it), land use and land tenure (and history of both), cultural significance, public interest (including educational and recreational potential), bibliography and register of scientific research.

6. *General target taxon description*: taxonomy (classification, delimitation, description, iconography, identification aids), wider distribution, habitat preferences, phenology, breeding system, means of reproduction (sexual or vegetative) and regeneration ecology, genotypic and phenotypic variation, local name(s) and uses.

7. *Site specific target taxon description*: taxa included, distribution, abundance, demography, habitat preference, breeding system, minimum viable population size, and genetic structure and diversity of the target taxon within the site, autecology within the reserve, synecology with associated fauna and flora (particularly pollinators and dispersal agents), specific threats to population(s) e.g. (potential for gene flow between CWR and domesticate).

Genetic Reserve Management Plan

8. *Site management policy (non prescriptive)*: site objectives, control of human intervention, allowable sustainable harvesting / hunting by local people and general genetic resource exploitation, educational use, application of material transfer agreements.

9. *Taxon and site population research recommendations*: taxon and reserve description, auto- and synecology, genetic diversity analysis, breeding system, pollination, characterisation and evaluation.

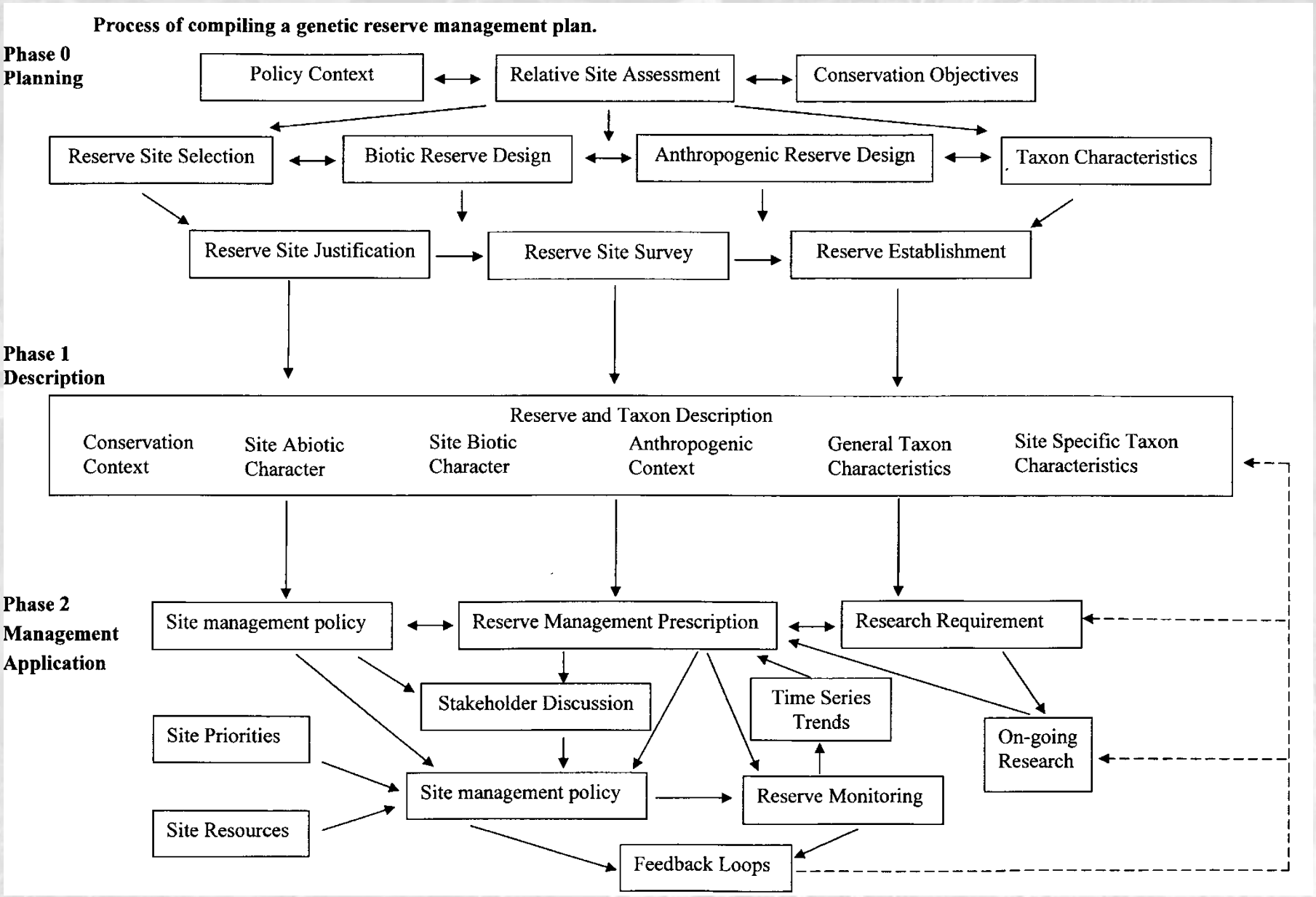
10. *Prescription (management interventions)*: details (timing, frequency, duration etc) of management interventions for target taxon, population mapping, impact assessment of target taxon prescriptions on other taxa at the site. Staffing requirements and budget, project register.

11. *Monitoring and Feedback (evaluation of interventions)* : demographic, ecological and genetic monitoring plan (including methodology, schedule, etc.), monitoring data analysis and trend recognition. Feedback loops resulting from management and monitoring of the site in the context of site itself and the regional, national and international context.

Management Interventions

- Grazing Control
- Burning
- Erosion Control
- Invasive species control
- Nutrient Control
- Disturbance
- Assisted Propagation / breeding
- Habitat Restoration
- Cultural Change
- Research and training

Writing a Management Plan



Management Orientated Monitoring System (MOMS)

System for collecting, analysing, storing and reporting information (Botswana, Zambia, Mozambique, Namibia and Cambodia)

MOMS: Operational principles

- People responsible for management decide on what needs to be monitored;
- Technical support team assist the resource managers to develop their monitoring system;
- Data collection, analysis and archiving is undertaken locally by staff as records of their normal day to day activities – i.e. monitoring should not be an additional burden;
- Reporting uses highly visual aids in the form of simple, locally generated graphs, maps or tables, colour coded to differentiate between short- and long-term trends;
- Entire system is based on pen and paper sustainable for field;
- Easily amenable to digital capture and sophisticated analysis including the use of GIS; and
- External reporting (e.g. to government/donors/shareholders) should this be required.
- Adaptive Management assumes need for intervention!

Genetic Management Outside Protected Areas

- Suitable for plants found outside of climax communities
- E.G. roadsides, field margins, orchards and even fields managed using traditional agro-silvicultural practices
- Increased threat: road widening, scrubbing out of hedgerows, introduction of herbicides / pesticides
- Require management agreement with land owners/ legislation