Chapter 10

Species and Population Management/Recovery Plans

For most wild species the best that we can hope for is to establish and monitor their presence in some form of protected area where, provided the area itself is not under threat, and subject to the dynamics of the system and the extent of human pressures, some degree of protection may be afforded. We are a long way from achieving even this. Moreover, the fact is that most species currently (and for the foreseeable future) occur outside currently protected areas (Heywood, 2005).

Introduction: The aims and purpose of species management or recovery plans

The actions taken to ensure the maintenance of viable populations are at the core of targeted *in situ* conservation of species and are referred to as species management, action, conservation or recovery plans, depending on the degree of intervention required, which will, in turn, reflect the conservation status of the species concerned. Many conservationists (e.g. Sutherland, 2000) regard species management as a confession of failure – that is, failure to provide appropriate habitat management or control of threats such as wild harvesting or impacts of invasive species. Indeed, as already noted in Chapter 3, if a species is not threatened or endangered, little or no management intervention may be needed; provided the habitat is secure, only monitoring of the area and of the status of the populations will normally be necessary. In such cases, a *species conservation statement* may be made, summarizing the situation (such as the species statements of the UK Biodiversity Action Plan). However, given the continuing pressure on habitats caused by human demographic growth and the consequential need to expand agriculture to feed the growing population, by industrial and building development, the growing threats from invasive species and the impacts of

accelerated climate change, it is highly likely that many species that are today regarded as safe will become threatened.

The Species Survival Commission of the International Union for Conservation of Nature (IUCN) has published a handbook on strategic planning for species conservation, primarily intended to provide guidance to IUCN/SSC specialist groups on when and how to prepare and promote species conservation strategies (SCSs). A *species conservation strategy* is defined as a blueprint for saving a species or group of species, across all or part of the species' range. A SCS should contain a status review, a vision and goals for saving the species, objectives that need to be met to achieve the goals, and actions that will accomplish those objectives (IUCN/SSC, 2008). Although largely animal-oriented, this handbook contains much of relevance to CWR conservation. In particular, it adopts a multi-stakeholder participatory approach as recommended in this manual.

As already discussed in Chapter 3, many conservationists and policy-makers would argue against a species-based approach to conservation, largely on the grounds that there are so many species requiring attention that such an approach would not be cost-effective. On the other hand, in many circumstances – and CWR are a case in point – a focus at the species/population level is both deliberate and unavoidable (Kell et al, 2008; see also Box 10.1) whether the species is threatened or not. For CWR, as discussed in Chapter 7, priority may often be given to species that are threatened; in such cases, management interventions will logically address the threats and threat management will be a major component of any management or conservation plan. Given that there is such a high number of CWR and a high probability that many of them are threatened to some degree, it might appear that there is no place for taking conservation action for species that

Box 10.1 The future of species conservation

Paradigms of ecosystem services, pro-poor conservation and rights-based approaches to conservation are taking centre stage, but these approaches all call for continued attention to the fundamental role that species play in underpinning those paradigms. In the brave new world of conservation, species approaches remain core business. We must continue to use all the tools in the species conservation toolbox, from development and implementation of species action plans to reintroduction, *ex situ* management and more.

In the coming decade, no species should knowingly be allowed to become extinct. The conservation community should continue to contribute to monitoring and assessment of status and threat trends in species, including support for indicator development and reporting. Working towards a better understanding of the parameters defining 'sustainable use' of species and encouraging managers of those species to make use of that knowledge will be vital. Similarly, the conservation world should promote all possible efforts to manage and control invasive species.

Source: McNeely and Mainka, 2009

are not threatened. On the other hand, a case can be made for ensuring the future survival of CWR, judged to be of high priority (see Chapter 7), even if the species is not currently threatened, by establishing a genetic reserve.

Species conservation or recovery plans?

The difference between species conservation/action/management plans and recovery plans is a matter of scale and degree, and reflects the extent of management intervention needed (Lleras, 1991).

For species that are not currently threatened or are estimated to have a low probability of extinction, little conservation action is likely to be needed other than to monitor their habitat and populations so that further action can be taken should the situation deteriorate. A species conservation or action plan will not normally be proposed unless the species is regarded for other reasons to be of such high priority that, for example, the setting up of a reserve for it is justified. For CWR that fall into this category that do not occur within protected areas, the setting up of a reserve or a series of reserves while the species still maintains its full range of genetic variability would be appropriate.

For species that are threatened to some extent but are not currently endangered, the removal, mitigation or containment of the factors causing the threat means that some form of intervention is necessary. In such cases a species conservation or action plan will be appropriate, including the setting up of a reserve or some off-site arrangement (see Chapter 11) if the species does not occur in a protected area.

For species that are currently endangered and have already suffered severe population loss or are in rapid decline so that partial or total extinction is likely within decades, a species recovery plan is the appropriate action.

Is the *in situ* conservation of CWR different from that of other wild species?

Another critical issue is whether the nature of CWR changes the focus and methods of *in situ* conservation, i.e. is the aim of genetic conservation of CWR different from that of other species? What is specific about it? As discussed in Chapter 2, the terms genetic conservation or genetic reserve conservation are often used in the case of CWR because of the focus on the maintenance of the genetic diversity in the target species that may be of actual or potential use in plant breeding and improvement and making it available (Maxted et al, 1997; Iriondo and De Hond, 2008). To achieve this, the following actions have been suggested by Iriondo and De Hond (2008):

- minimize the risk of genetic erosion from demographic fluctuations, environmental variation and catastrophes;
- minimize human threats to genetic diversity;
- support actions that promote genetic diversity in target populations;
- ensure access to populations for research and plant breeding;

- ensure availability of material of target populations that are exploited and/or cultivated by local people.

The concept of genetic reserve conservation (see Chapter 3; Maxted et al, 2008) is considered to be one of the major differences between species management plans for CWR and other wild plants. In practice, however, the distinction breaks down and the difference is largely one of objectives or motivation rather than practice. In all cases of *in situ* species conservation or recovery of a wild species, the aim must be to ensure the species' survival and this requires that as much genetic variation as possible be maintained; in this respect there is nothing intrinsically different about CWR conservation or about a genetic reserve. It is primarily the use that may be made of the genetic diversity of the CWR that distinguishes a genetic reserve and, in deciding on the location of areas to be set aside as genetic reserves, the set of populations that maximizes the representation of genetic diversity, both within-population and between-population, should be selected (Maxted et al, 2008). The same considerations also apply to reserves for other target species such as medicinal plants. The management plans for CWR are essentially the same as those for other wild species although actions may be included that are directed at maintaining or enhancing particular sectors of genetic variation within populations, again as would apply to conserving medicinal plant species.

Experience derived from species recovery programmes

Until recently, our experience of targeted *in situ* species conservation has, in fact, mainly been gained from the extensive programmes of recovery plans for threatened or endangered wild species undertaken by a number of European countries (including EU LIFE-Nature projects), Australia, New Zealand, and the US (Boxes 10.3 and 10.4). This has been underpinned by extensive research on conservation biology and conservation genetics (e.g. Simmons et al, 1976; Synge, 1981; Falk and Holsinger, 1991; Bowles and Whelan, 1994; Frankel et al, 1995; Falk et al, 1996; Reynolds et al, 2001).

The United States Fish and Wildlife Service Endangered Species Recovery Program[1] is the largest of these and works in partnership with federal, state and local agencies, tribal governments, conservation organizations, the business community, landowners and other concerned citizens. It has also established a national partnership with the Center for Plant Conservation, which is primarily devoted to *ex situ* conservation, although several of its member gardens are engaged in restoration and recovery actions (see Box 10.2). This programme, along with 27 other federal agencies and most state agencies, reported their expenditures for federally protected species in the 2007 fiscal year: the total expenditure reported was US$1.66 billion, of which US$1.57 billion was reported by federal agencies and US$95.3 million was reported by state agencies.

In the majority of cases, these recovery plans do not refer to species of agrobiodiversity interest, and the focus is not so much on genetic conservation as on survival and recovery of viable populations. The genetic resources sector has focused its attention mainly on *ex situ* conservation until recently, and its involve-

Box 10.2 Center for Plant Conservation (CPC)

Founded in 1984, the Center is dedicated solely to preventing the extinction of native plants in the US. It is supported by a nationwide consortium of 36 leading US botanic institutions, gardens and arboreta. With about one in every ten plant species in the US facing potential extinction, the Center is the only national organization dedicated exclusively to conserving *ex situ* material. Live plant material is collected from nature under controlled conditions and then carefully maintained as seed, rooted cuttings or mature plants. The collection contains more than 600 of America's most endangered native plants and ensures that material is available for restoration and recovery efforts for these species. Network institutions conduct horticultural research and carefully monitor these materials so that endangered plants can be grown and returned to natural habitats. Several CPC institutions are also involved in restoration projects in the field (*in situ*). Scientists are stabilizing current populations of threatened plants and reintroducing new populations in appropriate habitats.

Source: http://www.centerforplantconservation.org

ment in *in situ* conservation has been largely in the area of 'on-farm' conservation of landraces. Its limited involvement in genetic conservation of CWR has not, until very recently, taken this experience of recovery planning into account.

Likewise, the extensive experience of the forestry sector in *in situ* conservation has not been fully acknowledged. The challenge for those involved in CWR conservation is to draw on this accumulated experience and adapt it to the special requirements of genetic conservation.

A detailed global survey of *in situ* conservation of wild species (Heywood and Dulloo, 2005) revealed, not surprisingly, that very few species recovery or management plans have been prepared or implemented for tropical species, highlighting the enormous gulf that exists been actions to conserve tropical and temperate species. Some of the management plans that have been implemented in the tropics are aimed at making sustainable resource extraction economically viable, and improving the economic conditions of the local families involved, rather than at conservation as such, as in the case of a recent project in Peru's Pacaya Samiria National Reserve, involving community-based resource management of palms and aquatic resources. Management plans were created for enmoriche palms (*Mauritia flexuosa*), yarina palms (*Phytelephas macrocarpa*) and huasaí palms (*Euterpe precatoria*) and addressed deleterious harvest practices. Not only did the implementation of the management plans lead to improvements in the availability of resources, but there is strong evidence to suggest that they have helped the recovery of the species concerned (Gockel and Gray, 2009). With an increasing focus on community-based conservation and sustainable use, such examples are likely to become more common, but they do not alter the imbalance between targeted *in situ* species conservation in the tropics and temperate regions. This needs to be addressed as an urgent priority, although there are few indications that there is any political will to do so. In the particular case of CWR, many,

Box 10.3 Species recovery in New Zealand

The New Zealand Biodiversity Strategy (NZBS) 2000 funding package committed NZ$16.5 million (US$11.5 million) between 2000 and 2005 for the Department of Conservation's work on species recovery programmes and mainland islands. This work is focused on enhancing the recovery of threatened indigenous plant and animal species in coastal, land and freshwater ecosystems and will be achieved through intensive management of both threatened species and predators. This work addresses two of the main themes of the NZBS: (i) to ensure that a net gain has been made in the extent and condition of natural habitats and ecosystems important for indigenous biodiversity; and (ii) to ensure populations of all indigenous species and subspecies are sustained in natural or semi-natural habitats, and their genetic diversity is maintained.

Specific objectives

The specific objectives of the programme are to:

- expand freshwater fish, plant, invertebrate and reptile and amphibian recovery work;
- improve planning for priority species;
- provide technical support through the development of new management techniques and databases.

Source: http://www.biodiversity.govt.nz/land/nzbs/habitat/species/index.html

if not most, of them are not charismatic or flagship species and are unlikely to attract public interest or concern.

Species recovery plans

Given the extensive experience available in preparing and implementing recovery plans and because they are essentially a form of management plan, they are considered here in some detail.

Recovery is the process by which the decline of an endangered or threatened species is arrested or reversed and threats removed or reduced so that the species' long-term survival in the wild can be ensured. In terms of the conservation of CWR, Iriondo et al (2008) consider recovery as broadly referring to 'the act of assisting populations of plant species or habitats in the process of returning from a non-self-sustaining (or unstable) state to a self-sustaining (or stable) one'. The restoration or rehabilitation of habitats (also known as revegetation or reclamation) is a major and highly complex topic that is not addressed in detail in this manual as it is unlikely to be undertaken on any substantial scale as part of an *in situ* management project for CWR species.

Recovery plans may involve both habitat recovery actions and population recovery actions. For example, habitat restoration can assist in the recovery of endangered species, some of which may require restoration of degraded habitat

for their eventual recovery (Bonnie, 1999). However, these recovery actions are often challenging, costly and difficult operations that involve management actions that may need to be carried out over a number of years. They require teamwork, involving specialists from a number of disciplines as well as concerned stakeholders and the general public.

In the case of CWR genetic conservation, as Kell et al (2008) point out, the focus is on the target species with a view to conserving its variability, not on the habitat. Of course, as discussed in detail in Chapter 2, the species and habitat are intimately linked and mutually dependent. In practice, the effective conservation of any species *in situ* depends critically on identifying the habitats in which they occur and then protecting both the habitat and the species' populations through various kinds of management and/or monitoring. Thus, although *in situ* species conservation is essentially a species-driven process, it also necessarily involves habitat protection.

Consequently, the management plan of a CWR may call for some actions at the habitat level, such as ensuring its effective management (although that is essentially the responsibility of the reserve or protected area manager), weeding to remove competitors, control or removal of invasive species, control of disturbance or fencing to exclude herbivores. However, full-scale habitat or ecological restoration is not normally part of the business of CWR conservation; although, when this is carried out for other reasons, and one or more CWR are known to occur in the restored habitat, then advantage can be taken to develop an appropriate CWR species management plan, provided the conditions are appropriate and the genetic variability of the species is represented. Kell et al (2008) cite examples of habitat restoration where regeneration of the vegetation is combined with a targeted species approach. For example, in Spain on the 8-hectare island of Columbrete Grande (L'illa Grossa), the largest of the Islas Columbretes (Province of Castellón), a mixed recovery programme for habitats and rare and endangered species was started in 1994; since 1997, efforts have focused on recovery of the local endemic leguminous shrub *Medicago citrina*.

A *species recovery plan* is a document stating the research and management actions necessary to stop the decline, support the recovery and enhance the chance of long-term survival in the wild, of a stated species or community of protected wildlife. The goal is the recovery of target species to levels where protection is no longer necessary.

Species recovery plans are mainly used to:

- stabilize and halt the decline in existing populations of threatened species;
- increase, reinforce or rejuvenate existing populations through adding individuals to them (*reinforcement* or *enhancement*);
- transfer material from one part of the existing species' range to another (*translocation*);
- Reintroduce plants of endangered species to locations outside its current range, but within its historic range similar to ones where they previously existed (*reintroduction inter situs*).[2]

Reintroduction is often a controversial process because of fears that it will lead to undesired ecological or genetic consequences; it requires detailed knowledge of an ecosystem functioning on the one hand and of the biology and ecological tolerances of the species on the other. It may also face legal challenges. Reintroduction has been employed in Hawaii by the National Tropical Botanical Garden in collaboration with local landowners for the conservation of rare plant species (Burney and Burney, 2007). For a discussion of the issues, see Akeroyd and Wyse Jackson (1995) and Burney and Burney (2009). A recently proposed method of *human-assisted translocation* or *migration* as a means of responding to the problem that some species may not be able to track changing climatic conditions quickly enough is discussed in Chapter 16.

The overall objectives of a recovery plan are to prevent further loss of individuals, populations, pollinator species and habitat critical for the survival of the species; and to recover existing populations to normal reproductive capacity to ensure viability in the long term, prevent extinction, maintain genetic viability and improve conservation status. The general aim in threatened species' recovery is to establish sufficient self-sustaining healthy populations for the species to be no longer considered as threatened.

The *contents of a species recovery plan* will vary according to the circumstances but should include:

- an evaluation and description of the species' current situation, including any relevant scientific data;
- a recovery objective (for example, a target population number) and a list of criteria for indicating when the objective has been achieved;
- the detailed specific actions that will be required to secure the species;
- implementation procedures using scientific techniques;
- the organizations that will play a part in the recovery process (e.g. botanic gardens, national/regional/local conservation institutions, community bodies, etc);
- an implementation schedule, including priorities of tasks and cost estimates; arrangements for external reviews.

Of these, the first three points are essential for any species recovery plan. The assessment of the status of the CWR will have already been undertaken as part of the selection process already described in Chapter 7 and, once selected, during the ecogeographic survey (Chapter 8).

Species recovery plans vary widely in their scope and extent. Unfortunately, there are not yet any clearly established protocols for species recovery for plants and anyone planning to develop a species recovery plan for a CWR is advised to consult a range of published plans to find those most relevant to their particular species. For examples, see Box 10.4. The model used by the Australian government for recovery plans is given in Box 10.5.

A range of examples of recovery planning in Australia, where recovery plans have been used as a basis for managing a growing number of the country's threatened species since 1989, is given in Box 10.6.

Box 10.4 Examples of recovery plans

The United States Fish and Wildlife Service Threatened and Endangered Species System website lists the species for which recovery plans have been prepared: http://www.fws.gov/endangered/species/recovery-plans.html

For UK species action plans, see the UK Biodiversity Action Plan site which lists numerous examples: http://www.ukbap.org.uk/SpeciesGroup.aspx?ID=31

For the Swiss flora, summary species action/data sheets for over 140 priority species have been prepared (Fiches pratiques pour la conservation Plantes à fleurs et fougères). See: http://www.cps-skew.ch/english/data_sheets.htm; http://www.crsf.ch/index.php?page=fichespratiquesconservation

An example of a Spanish species recovery plan for *Cheirolophus duranii* (as published in the Official State Bulletin) is available at: http://www.uam.es/otros/consveg/documentos/Cheirolophus%20duranii%20Plan%20Recup.pdf

Australia: Conservation and recovery profile for *Haloragodendron lucasii*: http://www.environment.nsw.gov.au/resources/nature/tsprofileHaloragodendronLucasii.pdf

Australia: Recovery plan for the endangered vascular plant *Alectryon ramiflorus* Reynolds: http://www.derm.qld.gov.au/register/p00174aa.pdf

Species conservation management/action plans

> *Genetic conservation plans must be firmly based on the available scientific information if they are to be the basis of effective policies and practices* (Rogers, 2002).

If the species selected as targets are found to be threatened – and about one in four plant species probably is – then the critical factor at the species or population level is to control, mitigate or eliminate the threat(s) to the populations. This must be addressed in the species management plan.

Conservation management/action plans should be prepared for those species that require some form of management intervention to ensure the continued maintenance of viable populations. As already noted, they are essentially similar to species recovery plans, but the degree or intensity of management intervention is lower, reflecting the lower degree of threat to the population(s). The detailed composition of a management plan will vary from species to species, depending on the biological characteristics of the species, its population status, the location, the aim of the plan and so forth. As pointed out by Heywood and Dulloo (2005), there is no single approach for the genetic conservation of target species that is appropriate for all situations or even generally applicable. On the other hand, Maxted et al (1997) have proposed a practical model that they consider suitable

Box 10.5 Summary of content requirements for a recovery plan of the Australian government

Part A: Species/ecological community information and general requirements
Species/community name
Conservation status/taxonomy/description of community
International obligations
Affected interests
Role and interests of indigenous people
Benefits to other species/ecological communities
Social and economic impacts

Part B: Distribution and location
Distribution
Habitat critical to the survival of the species/community
Mapping of habitat critical to the survival of the species/community
Important populations

Part C: Known and potential threats
Biology and ecology relevant to threatening processes
Identification of threats
Areas under threat
Populations under threat

Part D: Objectives, criteria and actions
Recovery objectives and timelines
Performance criteria
Evaluation of success or failure
Recovery actions

Part E: Management practices

Part F: Duration of recovery plan and estimated costs
Duration and costs
Resource allocation

Source: http://www.environment.gov.au/biodiversity/threatened/recovery.html

for widespread application; the model is being tested in several projects. Common features that should be included in a species management plan are given in Box 10.7 (see also Sutherland, 2000: Box 7.1).

As in the case of recovery plans, the three essential components are: an evaluation of the current status of the species; the aims and objectives of the plan; and the actions proposed.

It is critically important to agree on and include in the management plan a statement on what the objectives are; in other words, what it is hoped that the

Box 10.6 Species recovery planning: Some Australian case studies

Community involvement in the species recovery process: Insights into successful partnerships – Stephanie Williams

Involving the general public in the recovery of threatened species and ecological communities provides discrete short-term benefits for conservation programmes as well as long-term gains in developing social responsibility for Australia's natural heritage. Guidelines for successful engagement of the community in the species recovery process, based on personal experience, are outlined. It is suggested that government agencies provide community endeavours with honesty, support, expertise and sensitivity to the community's concerns for conservation. This will help to develop effective partnerships in species recovery initiatives.

Conservation of the endangered plant* Grevillea caleyi *(Proteaceae) in urban fire-prone habitats – Tony D. Auld and Judith A. Scott

The endangered plant *Grevillea caleyi* (Proteaceae) occurs in bush land that is adjacent to urban areas in the Sydney region. Within these areas, repeated and frequent fire threatens not only the endangered flora but life and property as well. These threats were well illustrated by the impact of the fires that occurred in January 1994 in Sydney. Management of urban fire-prone areas needs to identify those fire regimes likely to drive the endangered flora to extinction, as well as identifying if any populations of endangered flora occur in locations that pose a fire hazard for the protection of life and property. Research into the population dynamics of *G. caleyi,* as part of the development of a recovery plan for the species, indicates that a regime of frequent fire will lead to local population decline and extinction. Consequently, burning on a frequent basis for hazard reduction to protect property assets in the vicinity of *G. caleyi* is inappropriate for the conservation of this plant. Instead, a minimum fire-free interval of 8 to 12 years is recommended for the conservation of *G. caleyi*. Additionally, areas not burnt for 20 to 25 years should be monitored for adult plant survival and seedling recruitment. If all or most adults have died and there is no seedling recruitment then consideration should be given to burning such sites.

Rediscovery programme for the endangered plant* Haloragodendron lucasii – *Marita Sydes, Mark Williams, Rob Blackall and Tony D. Auld

The *Haloragodendron lucasii* rediscovery team was established to try and find new locations of this plant in the wild. Prior to the initiation of the team, only three sites were known with a total of four genetically distinct individuals. Each of these individuals is effectively male sterile. Finding more locations of this endangered plant will lead to the protection of more individuals, the possibility of discovering male fertile plants, as well as assisting the planning of conservation measures. The rediscovery team involved joint coordinating efforts by New South Wales National Parks and Wildlife Service, the Australian National University and Ku-ring-gai Council. Community involvement was encouraged through the use of volunteer groups to search for *H. lucasii* in the field.

Box 10.6 *continued*

Instruction to community groups involved an evening session, where the details of the recovery of *H. lucasii* and associated genetic research were discussed, through to field days where the public were shown what the plant looks like in the wild. The value of the involvement of the community groups for the rediscovery programme is highlighted by the discovery of a new location for *H. lucasii* in late September 1995.

Threatened by discovery: research and management of the Wollemi pine Wollemia nobilis *Jones, Hill and Allen – John Benson*

The discovery of the Wollemi pine *Wollemia nobilis* in 1994 not only brought to light a new genus in the Araucariaceae and a conifer with at least a 91 million-year-old Gondwanan history, it also increased the threat to the two known wild populations of 40 adults and about 130 seedlings. Although growing in an inaccessible, warm temperate rainforest-lined gorge in a large national park, the impacts of visitation, and indeed researchers, could prove costly to the species. The main threats from people are trampling of seedlings, compaction of the ground and introduction of pathogens. Another threat is wildfire, which has the potential to destroy much of the population in one catastrophic event. A range of *in situ* ecological research and *ex situ* botanical and horticultural research is being conducted on the species to aid its conservation. A species recovery plan has also been prepared. In the short term, a key research programme aims to discover the most efficient way to propagate and cultivate the species to meet market demand for garden plants. This would remove the pressure of illegal seed collection from the fragile wild populations. Since the Wollemi pine is a relic species, 'recovery' is not the question. Management should aim to maintain the current population and genetic variation. Translocation may arise as an issue in the long run, but there would need to be sound reasons for it to be undertaken.

Source: Stephens and Maxwell, 1996

management plan will achieve and how it is intended to fulfil these aims. This will reflect the key decisions made on which populations and how many will be included in the management plan and how many individuals are needed to ensure a minimum viable population. This, in turn, will depend on the distribution pattern of the species, its demography and the distribution of genetic variation within its populations. The information on the species and its status and the ecogeographical information will be available from the ecogeographic surveys already undertaken for the target species, and the threats to the species will also have been identified (Chapter 7). The actions prescribed will vary considerably from plan to plan.

In the case of a species with a narrow or restricted distribution, the aim will normally to be to include all the population(s) within the management plan. In the case of species with a wide distribution, and in which the variation is partitioned into races or ecotypes, a choice must be made as to how many populations and

Box 10.7 Common features of a species management plan

- a description of the species, including its scientific name, essential synonyms, common names, its reproductive biology, phenology and its current conservation status (see Chapter 7);
- ecogeographical information – location of the CWR populations, their habitat, ecology, soil preferences, demography size and viability, genetic variation, population viability analysis (see Chapter 8);
- the nature of the threats affecting the conservation status of the species (see Chapter 7);
- a summary of existing conservation actions that are already being undertaken and by whom;
- the objectives of the management plan;
- the detailed actions that will be required to contain, reduce or eliminate the threats and ensure the maintenance of viable populations of the species;
- the actions that may be needed to safeguard and manage the site;
- the management objective(s) and targets (both short term and long term), and a set of criteria for indicating when the objective(s) are achieved;
- a statement on how the plan will be implemented and what scientific techniques will be adopted;
- identification of any policy or legislative actions that need to be undertaken;
- identification of the lead agency or party and a list of the organizations that will play a part in the management actions (e.g. national/regional/local conservation institutions, botanic gardens, community bodies, etc);
- arrangements for negotiation with the site authorities and other interested parties or stakeholders regarding management interventions;
- an implementation schedule, including prioritization of the various actions or tasks;
- a detailed budget with annual cost estimates for the various actions involved;
- monitoring programme and schedule;
- arrangements for external reviews;
- plans for communication and publicity.

how much of the variation is to be selected for conservation and inclusion in the management plan. For example, for the Monterey pine, *Pinus radiata*, field and laboratory studies have revealed strong genetic differentiation among the five populations studied, each having some unique features, and the implications for genetic conservation, according to Rogers (2004), are that specific conservation efforts must be directed at the population (or lower) level as there is 'no "representative subset" of populations that could effectively conserve the genetic and ecological diversity of the species' (Box 10.8). This, of course, has major implications for the amount of effort, time and costs involved.

Another complicating factor that applies in wide-ranging species is that if the total range of species, or those parts of it that are critical for effective *in situ* genetic conservation, occurs in more than one jurisdiction, there will be additional management and planning challenges in dealing with the operative laws, policies

Box 10.8 Problems of genetic conservation in Monterey pine (*Pinus radiata*)

The Monterey pine is a forest tree species that is widely commercialized outside its native range. Native forests are represented by only five fragmented populations: three along the central coast of California and two on Mexican islands off the coast of Baja California.

> *Current Monterey pine protected areas have not been selected with genetic values in mind, and thus do not necessarily contain representative genetic variation, represent sufficient habitat size or effective population size, or reflect conditions that allow ongoing regeneration and adaptation. There is little information available on within-population genetic structure, but given the steep gradient expressed in various soil and microclimatic features of coastal-to-inland environments, and some indication of within-population genetic structure … it is prudent to assume that several* in situ *reserves per population would be needed to adequately conserve genetic diversity unless (yet to be collected) evidence suggests otherwise. … Thus, current protected areas are not necessarily* in situ *genetic reserves, but some may offer the potential for including genetic values in their management. More information is required to ascertain which currently protected areas may also serve as genetic conservation areas.*

Source: Rogers, 2004

and ordinances of the different jurisdictions' planning cycles, even assuming that all parties agree on the need for coordinated conservation action (Rogers, 2004). In the case of the Monterey pine, just for the three Californian populations, the ownership and management was very diverse, 'including federal, state, county, and city governments; land trusts; universities and other nongovernmental organizations; and private owners (including home owners with some Monterey pine habitat, ranchers, forest companies, and recreation-oriented businesses)'.

A management plan may be concise and just a few pages long or extensive and up to 100 pages or more (see Box 10.4 for examples), depending on the range of activities involved. Ideally, plans should contain photographs or other illustrations of the plant and its habitat, maps and other graphic material. In some countries plans must be published officially once approved – for example, the recovery plan (Plan de Recuperación) for *Crambe sventenii*, *Salvia herbanica* and *Onopordon nogalesii* was published in the Boletín Oficial de Canarias, 5 February 2009 (Nbr. 024) by DECRETO 8/2009. They are occasionally published in journals (e.g Bañares et al, 2003) or as free-standing publications (e.g. the Recovery plan for *Silene hifacensis*, published as a booklet by the Environment Agency of the government of Valencia, Spain (Conselleria de Medi Ambient, Aigua, Urbanisme i Habitatge 2008)).

The successful implementation of a management plan may take many years to achieve and it is usual to include short-, medium- and long-term objectives.

Species management versus area management

Although this has been discussed in detail in Chapter 3, it is important to reiterate that effective *in situ* conservation of a target species is, on the one hand, dependent on the secure and effective management of the area(s) in which the species occurs and, on the other, requires management interventions at the population/species level different from those needed to maintain the area(s); these interventions may even be in conflict with the management policy of the area(s). Thus, a distinction must be made between protected area management plans and species management plans. Both are needed to achieve the successful *in situ* conservation of species or their populations. If the protected area in which a species occurs is extensive and several to many populations occur within it, management of the area and management of the species will most likely require quite different actions and management plans. If, on the other hand, the area is small with only one or two populations, the species and area management requirements will probably coincide to a considerable extent, and it should be relatively easy to make any changes to the area management plan as required, provided the area management authority agrees (see Chapter 9).

It also needs to be re-emphasized that if the target species is threatened, its presence in a protected area will not, in itself, ensure its protection unless the factors causing it to be threatened are addressed.

Single-species versus multi-species plans

One of the basic decisions that must be made in genetic conservation is whether to plan for the conservation of single species or multiple species. Genetic reserve conservation (Chapter 3), as practised so far,[3] has tended to focus more on groups of species occurring together in selected areas rather than on a single target species, largely on the grounds of cost-effectiveness, given that the number of target species is likely to exceed available resources for a species-by-species approach. This parallels the multi-species approach recently adopted for recovery programmes by Australia, Canada, the US and some European Union countries (through the EU Habitats Directive), although previously the single-species approach has been the norm.

The scientific rationale behind the use of multi-species plans is based mainly on the assumption that the target species share the same or similar threats. While the effectiveness of multi-species recovery conservation programmes for CWR has yet to be sufficiently assessed, there is evidence from surveys of multi-species plans for wild species undertaken in Australia, Canada and the US, that insufficient attention to detail is given to individual species within multi-species plans; for these plans to be effective, as much effort must be given to each species as in a series of single-species plans. One report found that nearly half of the multi-species plans failed to display threat similarity greater than that for randomly selected groups of species. The report concluded

that, as currently practised, multi-species recovery plans are less effective management tools than single-species plans (Clark and Harvey, 2002). Multi-species planning can be a very complex, time-consuming and expensive process (Canadian Wildlife Service, 2002) and the effectiveness of multi-species plans may be limited because less money and effort is spent per species (Boersma et al, 2001) and they are often poorly resourced as compared with single-species plans.

The advantages of multi-species approaches are summarized in Box 10.9. Comparisons of the strengths and weaknesses of multi-species and ecosystem-based approaches to recovery planning have been made by several authors such as Clark and Harvey (2002), Hoekstra et al (2002), Sheppard et al (2005: Table 1) and Moore and Wooller (2004: Table 3.14). As Kooyman and Rossetto (2008) note, some of the key problems in implementing multi-species plans are:

- they are less likely than single-species plans to include species-specific biological and ecological information, and adaptive management criteria;
- the lumping of species does not appear to be based on any biologically logical criteria (i.e. similarity of habitats or threats);
- multi-species plans have fewer recovery tasks implemented during the life of the plan; and
- species included in multi-species plans have been found to be four times less likely to exhibit positive status trends.

There is too little experience in the case of CWR conservation to judge the relative effectiveness of single- versus multi-species approaches but there is no reason to believe that it will differ significantly from what has been found for other examples of threatened wild species.

Box 10.9 Strengths of multi-species approaches

Multi-species approaches can:

- address common threats in a concise and focused manner (Boyes, 2001);
- streamline the public consultation process;
- reduce duplication of effort in describing the habitats of, and threats to, each species;
- provide a good format for environmental impact statements;
- promote thinking on a broader scale;
- reduce conflicts between listed species occurring in the same area;
- benefit other species not at risk;
- provide an approach that can restore, reconstruct or rehabilitate the structure, distribution, connectivity and function upon which a group of species depends.

Source: Canadian Wildlife Service, 2002

Stakeholders

The successful preparation and implementation of a management plan will involve a wide range of stakeholders. Just as in the creation of a protected area, the local population must be fully consulted and involved so that their interests and concerns are taken into account, considering that the formulation of a species management plan will affect the way in which the area is managed[4] and possibly access to populations of the target species and restrictions on their use. As already noted, the increasing focus on community-based conservation initiatives reinforces the emphasis on the requirement of the broad-scale participation of those most affected by conservation and management interventions.

Species management plans prepared by the UNEP/GEF CWR Project countries

The main source of problems faced by the countries in preparing management plans was the almost total lack of previous experience in this area. Not only had no species management plans been prepared before the initiation of the CWR Project, but knowledge of what was involved was lacking and there was a general failure to appreciate the distinction between preparing a protected area management plan and a species management or recovery plan. Such confusion is widespread and there was little available literature until very recently to give any guidance.

A fully detailed management plan for the Erebuni Reserve has, in fact, been prepared and its action plan includes both habitat and species management actions (see Chapter 9, Box 9.8).

A management plan for the selected priority cereals (*Triticum boeoticum*, *T. araraticum*, *T. urartu*, *Aegilops tauschii*) has been developed. The following state agencies participated in the development process: Ministry of Nature Protection (GEF and CBD focal point agency), Ministry of Agriculture, Institute of Botany, Yerevan State University and Armenian Agrarian University. All the main institutions involved in conservation activities in Armenia were contacted to nominate experts who could be engaged in the development process. There were a number of meeting sessions before and during the preparation process of the plan. A draft was sent for comment to the aforementioned institutions and the feedback received was discussed with project partners. The draft plan was also presented through Aarhus Convention Centres[5] in Armenia to local communities. An outline of the management plan is given in Table 10.1.

Sri Lanka has prepared a species management plan for *Cinnamomum capparu-coronde* in the Kanneliya Forest Reserve (see Chapter 9).

Uzbekistan has developed a management plan for *Amygdalus bucharica* within the protected territory of Chatkal State Biosphere Reserve. There were no problems with implementation of this plan in the protected territory. The reserve administration is cooperating as a partner and has agreed to include the

Table 10.1 *Outline content of the Management Plan for* In Situ *Conservation of* Triticum boeoticum, T. araraticum, T. urartu *and* Aegilops tauschii *in Armenia*

1	Introduction
2	Description
	2.1 Morphological characteristics of *Triticum urartu*, *T. boeoticum*, *T. araraticum*, *Aegilops tauschii*
	2.2 Taxonomy of the target species
	2.3 Current distribution (in the country, inside and outside of protected areas; distribution maps and any other relevant information)
	2.4 Habitat and ecology
	2.5 Biological characteristics (life cycle, life form), seed characteristics, phenology, pollination, dispersers, pest and diseases
	2.5 Conservation status
3	Evaluation
	3.1 Importance
	3.1.1 Cultural value of the CWR for local community
	3.1.2 Potential value of the CWR for research, breeding or other functions
	3.2 Threats
	3.2.1 For conserved population in Erebuni Reserve
	3.2.2 Outside protected areas
	3.2.2.1 Land privatization
	3.2.2.2 Uncontrolled grazing and hay harvesting
	3.2.2.3 Road construction
	3.2.2.4 Industrial and agricultural waste pollution
4	Identification of stakeholders
5	Goals/objectives
6	Management of threats
7	Strategic actions
8	Actions to ensure protection in protected area(s)
9	Actions to ensure protection outside protected areas
10	Improvement of *ex situ* collections
11	Research and monitoring
12	Public awareness and education
13	Action Plan (2009 to 2013); the management plan for wild wheats in the Erebuni State Reserve is available on the Crop Wild Relatives portal at: http://www.cropwildrelatives.org/index.php?id=3263

management plan developed in the frame of the CWR Project into the management plan of the reserve.

Management plans for walnut, pistachio and apple tree for insufficiently protected territories of the Ugam-Chatkal National Park are being developed. As they become available in English the management plans developed by each country will be made available through the CWR Global Portal at: http://www.cropwildrelatives.org/index.php?id=3263.

Conclusions

To date, few species management plans have been prepared or implemented for CWR. We have to rely mainly on the extensive experience that has been gained from the recovery plans for endangered wild species that have been prepared in a number of countries, mostly, however, in the temperate world.

Although the aim and focus of conserving CWR *in situ*, sometimes termed genetic conservation, is on maintaining the genetic diversity in the species for use in plant breeding, management or recovery plans for CWR are essentially similar to those for other wild species. Globally, very few such plans have been made for CWR and no specific, generally agreed protocols are yet available.

The level of management intervention required will depend on the status of the CWR in question, ranging from little or no intervention other than monitoring, in the case of species that are not currently at risk, to full-scale recovery, for species that are critically endangered and in rapid decline.

A critical decision that has to be made is whether to prepare single-species or multi-species plans. There is little or no evidence as to the relative effectiveness of these two approaches in the case of CWR.

The detailed composition of a species management or recovery plan will depend on the biology of the species, its conservation status, its location and other local circumstances. The essential elements are: (a) a full evaluation and description of the current status of the species; (b) a clear statement of the goals and objectives; and (c) an indication of the specific actions that are proposed.

The CWR Project countries have, in most cases, prepared a species management plan for one of their priority CWR, but none of these have been fully implemented due to the limited length of the Project.

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Notes

1. http://www.fws.gov/endangered/species/recovery-plans.html
2. Commonly (although incorrectly) referred to as *inter situ* (Burney and Burney, 2009).
3. Most genetic reserve conservation has been undertaken in Turkey and other countries in the Middle East/SW Asia. See, for example, Al-Atawneh et al (2008) and Tan and Tan (2002).
4. The terms conservation and management are used interchangeably given that conservation, in this context, normally involves essentially management interventions to a greater or lesser degree.
5. Aarhus Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters.

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