Ex-situ conservation

DEFINITION

The conservation of components of biological diversity outside their natural habitats.

Convention on Biological Diversity (CBD) 1992[1]

KEY POINTS

- Ex-situ (‘off site’) conservation is a set of conservation techniques involving the transfer of a target species away from its native habitat. It is one of two basic conservation strategies, alongside in-situ conservation.
- Ex-situ techniques include: seed storage, captive breeding, slow-growth storage, DNA storage.
- The main purposes of ex-situ collections are the rescue and preservation of threatened genetic material and the breeding of species for reintroduction in cases where a species’ continued survival in its native habitat is threatened.
- Ex-situ conservation forms the basis of Article 9 of the Convention on Biological Diversity (CBD), which highlights it should always be implemented as a complementary (and not as an alternative) approach to in-situ conservation. Ex-situ measures should preferentially be put into practice in the country of species origin.

INTRODUCTION

Ex-situ ('off site', 'out of place') conservation is a set of conservation techniques involving the transfer of a target species away from its native habitat to a place of safety, such as a zoological garden, botanical garden or seed bank. Its primary objective is to support conservation by ensuring the survival of threatened species and the maintenance of associated genetic diversity. To do so, ex-situ institutions preserve the genetic or reproductive material of a target species, or take care of the living target species for the purpose of reintroduction. In its simplified form, the concept is likened to Noah’s ark, wherein species are maintained in a place of safety until factors threatening their existence in the wild have been removed and reintroduction is likely to be successful[1].

TECHNIQUES FOR EX-SITU CONSERVATION

Ex-situ techniques target plant and animal populations. Techniques vary according to the characteristics of the species to be preserved, which dictates the type of material to be preserved (e.g. whole animals, pollen, seeds). Ex-situ collections of plants are established by storing seeds, conserving pollen and through the storage of plant shoots in conditions of slow or suspended growth (in vitro conservation) [2]. Ex-situ techniques applicable to animal populations include the storage of embryos, semen/ovule/DNA, or captive breeding through the establishment of field gene banks and livestock parks. Lively debate surrounds ex-situ techniques, with much deliberation over when ex-situ measures are appropriate and justified [4]. In particular captive breeding and reintroduction programmes have sparked controversy due to, among others, the difficulty in establishing self-sustaining captive populations [5], the high costs involved in captive breeding programmes [6], the poor success of reintroduction attempts [7] and the negative genetic effects of domestication on reproductive rates. Some species are however more susceptible to captive-breeding programs than others. For example, the global loss of amphibian species is mainly tackled through captive-breeding because the small body size, low maintenance requirements, repeated breeding and high fecundity of frogs allows a rapid build-up of captive populations [3].

EX-SITU IMPLEMENTATION

Ex-situ techniques are implemented in well-defined situations [9]:

- to safeguard populations or individuals that are in danger of physical destruction when protection in situ is not possible;
- to safeguard populations which are in danger of genetic deterioration;
- to ensure a readily available, continuous supply of reproductive material, either creating a production source or through storage;
- to allow commercial improvement of a species through breeding activities and supply of genetically improved reproductive material.

Several high-profile case studies have demonstrated that ex-situ conservation measures can play a critical role in preventing species extinction, e.g. the reintroduction of the Arabian oryx to Saudi Arabia [10]. The creation of 'assurance colonies' and 'safety-net populations' for Endangered and Critically Endangered species has therefore led ex-situ measures to be likened to an insurance policy against extinction. Such strategies are, for example, in use to tackle the global tortoise extinction crisis [11].

EX-SITU INSTITUTIONS AND THEIR CONTRIBUTION TO IN-SITU CONSERVATION

Biorepositories such as gene banks have an explicit ex-situ mandate. Other institutions such as zoos and botanical gardens are increasingly taking on roles as genetic reservoirs against extinction and captive breeding for future re-introduction programmes. Institutions make the most out of their ex-situ collections by using them in the wider spectrum of conservation activities, ie. through the production and assimilation of material for research, conservation education [12] and capacity-building [13]. The use of ex-situ conservation is recommended if in-situ conservation, the preferable conservation alternative, is not available or not functional for the near-term survival of a species. In-situ (“on site”) conservation refers to conservation techniques implemented in the same area where the conservation target (species, ecosystem, population) is encountered. Although ex-situ and in-situ conservation were historically treated as distinct conservation strategies, both methods are implemented cooperatively within regional conservation plans in order to reach biodiversity conservation goals more effectively. In-situ measures are the primary conservation approach because they provide a more holistic strategy for conservation, by allowing easier conservation of a greater number of ecological and evolutionary

processes.

KEY CONVENTIONS AND GUIDELINES

Article 9 of the Convention on Biological Diversity (CBD) states that ex-situ measures should predominantly be implemented for the purpose of complementing in-situ measures, such as a system of protected areas. Technical guidelines and strategies in the use of ex-situ techniques have been developed by leading conservation bodies such as the International Union for the Conservation of Nature (IUCN 2002, Maunder and Byers 2005), the Botanic Gardens Conservation Initiative [16], the Center for Plant Conservation [17] and the World Zoo Conservation Strategy [18]. Additional guidance is provided by Article 9 of the CBD. These guidelines aim to:

1. clarify when ex-situ initiatives are warranted to complement in-situ conservation measures; and
2. clarify the role ex-situ measures should play in the global action plan of an endangered or critically-endangered species.

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Botanical gardens are often sites of ex-situ conservation.

Palmengarten Botanical Garden, Franfurt, Germany.

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