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Review Article

Endangered Plant Species Recovery

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Abstract

Plants are essential for all life on earth, the uptake of carbon dioxide, one of the principle greenhouse gases, during photosynthesis is the major pathway by which carbon is removed from the atmosphere and made available to humans and animals for growth and development. Plant diversity provide the basic life-support systems on which all life depends and wild plants are also vitally important in supporting livelihoods for millions of people around the world.

A group of plants that have been excessively collected from its habitats and become endangered due to different contributory factors: extensive denudation of the forest floor, caused by cattle grazing and collection of leaf litter, and removal from the wilderness which is highly used by the human being.

Seed is only the means of propagating of the majority of the plants, but some time seeds have reduced probability of germination when adult plants are already growing in the area, thus reducing species dissemination. Various *ex situ* and *in situ* measures have been adopted for conservation of threatened and endangered plants species; however, these have been limited due to various discrepancies associated with them. This report provides a review of progress towards new knowledge's on endangered plants.

INTRODUCTION

The major habitats for threatened species have been refined to vegetation types as described in different conservation studies [1]. It is now possible to get a list of threatened species associated with each vegetation type, simply by typing the name of the vegetation type in the searching box.

Threatened species tend to be strongly associated with habitats that are extensively degraded or have been lost to other land uses such as agriculture, urban development or mining.

The following reports focuses in endangered, rare and plants included in different Endangered and Threatened Wildlife lists in the World, as most in need for conservation. Several themes are address concerning this thematic.

Critical habitat

Climate change is expected to bring substantially warmer atmospheric temperatures and increased aridity to the Earth's arid regions over the next century [1]. These temperature increases have the potential to exert strong selection pressures on plants to the extent that many species will undergo considerable shifts in their biogeography, population structure, and physiology. Populations occurring in the warmest and driest extremes of current species ranges are most vulnerable to climate change, particularly where populations are adapted to a relatively narrow range of temperature regimes.

It is estimated that there are 40,000-53,000 tree species in the tropics and 96% of all the tree species on Earth have similar numbers (19,000-25,000) in Asia, the Pacific and the Neotropics, but far fewer (4500-6000) in Africa. Although plant diversities are lower on individual islands, endemism is high and around 50,000 species of vascular plants are island endemics [2].

The major threats to plant diversity are habitat loss, fragmentation, and degradation, overexploitation, invasive species, pollution, and anthropogenic climate change. Conservation of plant diversity is a massive task if viewed globally, but the combination of a well-designed and well-managed protected area system and *ex situ* gap-filling and back-up should work anywhere. The most urgent needs are for the completion of the global botanical inventory and an assessment of the conservation status of plant species. Both in and *ex situ* conservation can target critical habitats, i.e. specific geographical areas, which is essential for the conservation of a threatened or endangered species. Such an approach may require special management considerations. However, state governments can only act on privately owned lands if the owners are receiving state funding or permits.

Endangered species refers to those species that are in danger of extinction throughout all or a significant portion of their range. A threatened species is one that is likely to become endangered in the near future throughout all or a significant portion of its range. Inadequate habitat is a term used in the context of the survival and recovery of species listed as "threatened" or "endangered" (ESA). A habitat includes all the components for a species' survival, including basic elements like minerals, or other nutritional or physiological requirements, water, air, light, space for individual and population growth and for normal behavior, cover or shelter, it will contain sites for breeding, reproduction, or rearing offspring, germination, or seed dispersal. Among habitats that need to be protected from disturbance are those that are representative of the historic, geographical and ecological distribution of a species.

Conservation

The geographical distribution of genetic lineages is studied by phylogeography, which has helped to identify cryptic species, and areas of endemism. Speciation and genomics will add a new dimension to phylogeography, involving the study of genes that are pertinent to recent and ongoing differentiation.

Under the IUCN Red List criteria, 94% of land plant species have not yet been globally evaluated. Clearly, biologists need to make this a higher priority than at present. Regional and national assessments using IUCN Red List criteria can provide a basis for targeting conservation work [2,3]. Various *ex situ* and *in situ* measures have been adopted for the conservation of threatened and endangered plants [4,5].

In situ techniques prevent the total loss of the species and provide new plants for habitat restoration or population reestablishment.

The numbers of plant species that are endangered are increasing, and their conservation now includes *ex situ* protocols. *Ex situ* methods for maintenance of species are carried out by botanical gardens using the system of Botanic Gardens Conservation International [6,7].

Seed banks can be maintained through desiccation or by cryopreservation (storage of material at −196°C) [8,9]. The Royal Botanic Gardens of Kew is host to the world's largest *ex situ* collection of seeds from wild flowering plants. Kew's Millennium Seed Bank Partnership (MSBP) is a network of botanical organizations working in more than 80 countries, coordinated by Kew scientists. Seed is only the means of propagating *Clinopodium odorum*, but seeds have reduced probability of germination when adult plants are already growing in the area, thus reducing species dissemination [6]. The species that cannot be conserved through conventional seed banking, are now referred to as exceptional because needs other treatment as dormancy of rupture [7]. The numbers of plant species that are endangered are increasing, and their conservation now includes *ex situ* protocols like natural reserves [6].

Nevertheless, seed storage is not possible for some plants because the seed production is very low. Therefore, strategies to induce physiological and mechanical seed dormancy rupture must have carried out, which caused a positive reaction on the seed germination response [8].

The geographic distribution of genetic lineages is studied by Phylogeography, it has helped to identify cryptic species, and areas of endemism.

The habitat heterogeneity promotes by biogeography study Speciation and Genomics will add a new dimension to phylogeography, allowing the study of genes that are pertinent to recent and ongoing differentiation.

Thus, both in and *ex situ* conservation can be considered efficient. Clearly, biologists need to make this a higher priority than what it is at present.

Regional and national assessments using IUCN Red List criteria include many species that have no global assessment yet, and can provide a basis for targeting conservation work in these areas [2]. Various *ex situ* and *in situ* measures have been adopted for conservation of threatened and endangered plants [10,11].

Aside from the maintenance of plants in botanical gardens or arboreta, micropropagation is the only viable option for *ex situ* conservation for these plant species that cannot be conserved through conventional seed banking are now referred to as exceptional [6]. Micropropagation is a method of producing certain plants in much larger numbers than you could by natural methods. This method ultimately results in a large number of clones of the original plant material, which can be used to cryopreserve or reestablish the plant population [8,9]. Characterization and control of micropropagation problems has been one of the priorities of plant tissue culture research due to the enormous contribution of this discipline for plant production, improvement and conservation. The prevalence and severity of these tissue culture problems varies widely among plant species [10].

The term for transferring the soft bits of blobby plant tissue, which looked like plump green buttons, from the gel-like media. However, it is not easy foresee a use for "microprop" in general horticulture [11,12]. How wrong I was. Today it is widely used. If you've bought a double primrose, an agapanthus, a lavender, a lupin, a heuchera or a hosta recently, the chances are that it started life in a glass flask under light and heat [13,14].

A Biobanking store is a library of the organisms that has become an important resource in research genomics and other studies [15-17]. They are a wide array of biospecimens maintained in biobanks that can be described and characterized. The list of specimens or catalogue used by genetic and other traits, such as age, gender and ethnicity are also categorized according to environmental factors, such as whether, radiation, or if are affected by some substances. Biobanks are necessary when the people need some specimen for their research studies. A renewable source of genomic DNA assists the conservation of plants genetic resources including expression studies, modulation of expression/variable phenotype, and regulation to protect biodiversity. These studies can be carried out through new methods: plant cell tissue, microplants, as model of plant biotechnology. Tissue culture is one of the technique, which involves growing small pieces of plant tissue or individual cells in culture, that provide a fast and efficient way of taking numerous cuttings from a single plant. In many cases, entire plants can be regenerated from a single cell because each cell contains all the necessary genetic information [15]. After selecting a disease-free cutting, for example, scientists can mass-produce copies that are genetically identical (ISBER, 2012). This is the basis of plant cloning, or plants micropropagation. In gene banks, tissue culture is now used routinely to preserve the genetic information of plants which have seeds that do not store well, are sterile or have poor germination rates.

Inaccessible biodiversity

Altering vegetation composition produces unviable cover which is lost or degraded in useful soil. Gough and other inaccessible Islands are two extraordinary uninhabited examples of making inaccessible plants.

In fact, plants cannot grow there because of the soil chemistry, salinity, water flow, or other physical factors that are suboptimal physiological conditions. There is exceptional habitat like islands with lava, which contain soil and older lava rock (in which minerals have plugged up the holes) is much better at trapping water and minerals. The biota is having by long distance dispersal; thus it is a means of transportation that is the main factor influencing the number of species. Discounting man's influence, species can only arrive by water or air. On the other hand is important to know that oceanic islands have remained relatively undisturbed, and are therefore of special conservation significance in many tropical coastal, marine, and small island ecosystems have suffered and continue to suffer substantial environmental damage (Hanoi Statement World (Heritage Marine Biodiversity Workshop, Hanoi, Wietnam, 2002 and (Conference of the Parties, adopted the Updated Global Strategy for Plant Conservation 2011-2020, (2010). Gough Island is one of the largest cool-temperate oceanic islands in the world that remains close to species exchange, having been spared of invasive species introductions that have decimated unique island biodiversity elsewhere. While the other Inaccessible Island is smaller, it is of no lesser significance, housing a number of species endemic to this tiny speck in the South Atlantic Ocean.

Phylogeography and conservation

Phylogeography has helped identify the geographic distribution of genetic lineages, cryptic species, and areas of endemism [14].

The habitat heterogeneity promoted by biogeography study Speciation and Genomics of the plants will add a new dimension to phylogeography allowing the study of phylogenetic variation.

If species extinction persists at such a tremendous speed, the future generation will occupy a planet with significantly reduced biodiversity, diminished ecosystem services, reduced evolutionary potential, and ultimately higher extinction rate and collapse ecosystem.

Managing threats for listed species

Plants are essential constituents of ecosystems and a key to the Earth's environmental equilibrium and stability. A recent paper estimated the total number of angiosperm species in the world at around 450,000, of which 10 to 20% are still unknown to science [15].

The Millennium Ecosystem Assessment (2005), has estimated that the extinction rate is now 100 to 1000 fold higher than in the recent geologic past [16]. The International Union for Conservation of Nature (IUCN), founded in 1963, has a comprehensive list of the threatened species worldwide (IUCN Standards and Petitions Subcommittee 2010). The IUCN categorizes organisms by level of extinction threat, with the most threatened being "critically endangered," followed by "endangered." The "data deficient" category indicates that further research is necessary, not discarding the possibility that the species will turn out to be threatened [16-18]. The IUCN Red List of Threatened Species (Red Book), created in 1963, is the most comprehensive inventory of the state of conservation of animal and plant species worldwide. Many governments and organizations are creating their own regional Red Lists based generally on the IUCN, to classify species at risk in their region. According to the IUCN, the extinction rate is up to 10,000 higher than expected [19].

As of 2012, 1,821 plant species are critically endangered, while another 2,655 are endangered (IUCN 2012). The two main causes of plant species endangerment are habitat fragmentation and habitat loss (BGCI n.d.). As the human population grows, habitats will continually be lost; therefore, the number of endangered plant species will only increase.

The Global Strategy for Plant Conservation (GSPC) is a program of the UN's Convention on Biological Diversity founded in 1999 and addressing the growing number of endangered plant species (https://www.cbd.int/gspc).

Earth's Endangered Creatures (EEC) lists endangered plants and animals of the world that are threatened with extinction (http://earthsendangered.com/index.asp).

US Fish & Wildlife List of Endangered Species (US FWS) is split into 11 parts, seven of which are the seven continents of our planet, and also an Oceanic, Middle East, and Central America category. Hawaii is the endangered species capital of the world and has been individually categorized by the USFWS-National Organizational Chart (Fws. gov. 2013).

The varied geography and climate of Europe provides a vast range of habitats supporting over 12,500 vascular plants, flowering plants, conifers and ferns. Some 21% of Europe's vascular plant species (flowering plants, conifers and ferns) are classified as threatened according to the IUCN. The LIFE network, a European commission, is a financial instrument for the environment that makes plant conservation efforts (http://www.eea.europa.eu/about-us/address.html.)

The Conservation and Demand Management (EDA) Framework Project is the main protected species project in the USA. Critical habitat refers to specific geographic areas that are essential for the conservation of a threatened or endangered species and that may require special management considerations.

The aim of these networks is to solve conservation problems, as well as to help the international community to reduce extinction. They use a set of criteria to assess the risk of extinction of thousands of species and subspecies, which are applicable to practically all taxa on the planet.

Threatened species to super-abundance

Native plant diversity can coexist with invasive or alien species. A recent study has shown that more than 13,000 species (3.9%) of the world's vascular plant flora have become naturalized somewhere outside their native range as a result of human activity. Tropical regions generally have fewer naturalized species than temperate regions, but they are increasing as direct trade between tropical countries overcomes the geographical barriers. Nevertheless, even on oceanic islands, where local impacts tend to be much greater than on the mainland, non-native plants generally add to the total plant diversity, rather than replacing native species, and in continental areas there is little evidence that invasive plant species currently threaten any native species with extinction. It is possible that competitive exclusion of native species is simply very slow, but current evidence suggests that, despite often large local impacts, the extinction risk from invasive plants is low [19,20].

Effect of habitat fragmentation

The effects of habitat fragmentation on biodiversity is very diverse, since the approach to measuring fragmentation varies among different reports, which inevitably leads to different conclusions regarding its magnitude and effects. Empirical studies of habitat fragmentation are often difficult to interpret because many researchers do not distinguish between habitat loss and habitat fragmentation. It is usually defined as a landscape-scale. At the patch measure of results of fragmentation and this empirical studies of habitat fragmentation are often difficult to interpret because many researchers do not distinguish between habitat loss and habitat fragmentation [32].

Habitat fragmentation has much weaker effects on biodiversity, and may be positive as well as negative. Therefore, to correctly interpret the influence of habitat fragmentation on biodiversity, the effects of these two components of fragmentation must be measured independently.

Habitat fragmentation usually occurs because of human activities such as new roads, parking lots and housing developments. Organisms need their specific habitat for survival, and fragmentation is a leading threat to many plants when they are separated from their original habitat. Habitat fragmentation from human activities is not limited to urban areas. Logging is a major cause of habitat fragmentation in forests and creates clear-cut, open ground areas that were once protected by the cover of trees. Logging roads that are built for the logging trucks to travel on can also be cut through forests, disrupting the habitat [21-23].

Exposure of threatened plant species

Plants cover virtually all terrestrial regions of the earth with the exception of ice-covered regions and extremely arid lands. Plant species diversity represents millions of years of evolution and provides an important visible expression of biodiversity, giving character to ecosystems and shaping genetic diversity [24].

Conservation efforts are essential to evaluate the suitability of standing legislation for the protection of threatened plant species. The risks to species are defined by the immediacy of the threats, whether current or projected in the short-term or long-term. Finally, they are conditioned by the severity of the threat, whether resulting in population extirpation, or temporary or permanent decline.

Critically endangered species

The total value of biodiversity is infinite, so attempts to estimate the total value of nature is pointless, since human life would be impossible without it. Many plant species are in danger of extinction and need urgent monitoring. It is also necessary to focus on the relationships between plant species and human communities and cultures, since the threats are often human-induced factors, such as climate change, habitat loss and transformation, overexploitation, alien or invasive species, pollution, clearing for agriculture and other developments [12]. If this loss is not stemmed, countless opportunities to develop new solutions to pressing economic, social, health and industrial problems will also be lost. Various species receive special protection under legislation such as the European Union Habitats Directive 1992. Some of these plants are associated with derelict buildings in urban areas deemed suitable for redevelopment.

Mitochondrial marker for detection

Nowadays, it is easier to investigate the population structure, genetic variations, and recent demographic events in threatened species using population genomic approaches.

A genomic approach can provide detailed information about the present and past demographic parameters, phylogenetic issues, and the molecular basis for inbreeding. It can also help to understand genetic diseases, and detect hybridization/introgression in organisms and provide information on the mechanisms that relate low fitness with low genetic variation. Genetic and environmental methodologies are being integrated into conservation biology and used to design state of the art, fast monitoring equipment [20].

Examination of the spatial patterns of intraspecific gene flow can also lead to the discovery of cryptic but genetically distinct populations. Contemporary patterns of population based on molecular phylogeographies can be used to obtain a temporal context for major population subdivisions and to understand the historical forces that have produced them. Phylogeographic analyses based on molecular markers are now widely used in conservation studies to identify unique evolutionary lineages. These analyses can clarify the evolutionary context of organism diversification especially when combined with various geological and climatic events [16].

Determining the distinctiveness and age of populations, especially in highly threatened habitats, is essential so that managers and policy makers can identify the population units most in need of conservation [24,25,26]. Genetically identifying unique, persistent lineages of plants can also address the impact that the loss of particular populations would have on overall biodiversity. Mitochondria have provided an endless reservoir of unconventional genomes. From the enormous, multi-chromosomal mtDNAs of various land plants to the miniature, fragmented mtDNAs of certain alveolates [27,28], to the baffling chainmail-like mtDNAs of kinetoplastids, mitochondrial genomes are anything but ordinary. They have redefined well-established rules in genetics given rise to leading hypotheses on evolution [29-31], and initiated intense debates about the roles of adaptive versus non-adaptive processes in shaping organismal and genomic complexity. It is hard to imagine the field of molecular evolution as it stands today without the contributions from mitochondrial studies.

Disappearance of endangered species

Today, endangered species recovery efforts fall into different categories. A low percentage of listed species do not have a recovery plan, perhaps because they are newly listed. Without a plan, however, the species lacks a roadmap for recovery, which raises the question of why it was listed in the first place. Moreover, recovery is a long and contentious process, even when a species' status is improving [31].

Generation length

Generation length is the average age of parents of the current cohort (i.e. newborn individuals in the population). Generation length therefore reflects the turnover rate of breeding individuals in a population. Generation length is greater than the age at first breeding and less than the age of the oldest breeding individual, except in taxa that breed only once. Where generation length varies under threat, the more natural (i.e. pre-disturbance) generation length should be used [24].

When using Time to the Most Recent Common Ancestor tables, genetic genealogists need to know which is the most suitable generation length for multiplying the number of elapsed generations by an average generation length to derive the elapsed time. There is a lack of consensus for this application, or even on whether the appropriate average generation length should be based on recent historical data, or on assumptions of shorter genealogical lengths associated with pre-historic times. The mutation rates themselves may also have been derived based on an assumed generation length, in circumstances where it would be incorrect to use any other generation length to convert the product of generations and generation rates back into elapsed time [9].

Historical range and extirpation

Due to human activities, many plant species have become threatened or extinct during the last centuries. In recent years, with substantial conservation investment from states and international conservation bodies, the outlook for species has improved. However, some populations have suffered mass mortality events.

Projects to monitor biodiversity will benefit from a direct linkage to long-term ecological research and a commitment to test hypotheses relevant to biodiversity conservation. A general guideline is to proceed from the top down, beginning with a coarse-scale inventory of landscape pattern, vegetation, habitat structure, and species distributions, then overlaying data on stress levels to identify biologically significant areas at high risk of impoverishment. Intensive research and monitoring can be directed to high-risk ecosystems and elements of biodiversity, while less intensive monitoring is directed to the total landscape [32]. In any monitoring program, particular attention should be paid to specifying the questions that is intended to answer and validating the relationships between indicators and the components of biodiversity they represent [25].

Historical gene flow

In speciation biology, the role of gene flow in species formation is a major unresolved issue. Progress in this area requires information on the long term patterns of gene flow between diverging species. A single nucleotide polymorphism derived from transcriptome resequencing is used thousands of times and a method modeling the joint frequency spectrum of these polymorphisms can reconstruct patterns of historical gene flow. The post-divergence gene flow resulted in two directional introgression, which affected the genomes of both species.

Interestingly, we found evidence for genomic heterogeneity of interspecific gene flow. This study demonstrates the complexity of long-term gene flow between distinct but incompletely reproductively isolated taxa which divergence was initiated millions of years ago [26,27].

However, in a history of divergence, ranges of incipient species often change, and thus, populations may experience periods of allopathy as well as recurrent contact resulting in gene exchange as long as reproductive isolation is not complete.

Reconstructing such historical processes spanning hundreds of thousands or millions of years constitutes a considerable challenge, complicated by the usual lack of a reliable record of range changes. It is not sufficiently understood how integrity of species is maintained in the face of gene flow, which is expected to homogenize diverging populations.

Functional morphology

A fundamental concept in evolutionary biology is that divergent selective regimes often generate and maintain phenotypic diversification [25,26].

Three primary attributes of biodiversity, composition, structure, and function, can be organized into a hierarchy that incorporates elements of each attribute at four levels: regional landscape, community-ecosystem, population-species, and genetics.

It is possible to analyze intraspecific morphological diversification between plant species that grow in different habitats in which selective pressures were created, resulting in morphological divergence between nonspecific populations. Spatial distance between habitats, presumably reflecting rates of population mixing, appears to have constrained diversification. Morphological divergence between species increases with distance between habitats.

Perspectives

Plant biotechnology, with its current technological advances, permits the maintenance and propagation of endangered species. Additionally, it allows high added value compounds to be obtained in a sustainable and ecological way in plant cell and organ cultures without the need to harvest plants under pressure in their native habitat. There are so many ways to help endangered plant species conservation. So, if you want to protect plant species and stop plant declination, get involved today in protection projects. The people who are dedicated to conservation need financial support.

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