Part

I

Introduction

1 Introduction

1.1 Context

The conservation and sustainable use of plant genetic diversity is the basis of human well-being and food security. Today we face a stark challenge – either we learn to conserve biological diversity and practice sustainable use of its components or we ourselves are likely to face extinction. Thus, as biologists our specific challenge is to classify existing biological diversity and halt ecosystem, habitat, species and genetic diversity loss, while feeding the ever-increasing human population. Further as scientists we would be failing if we did not also warn society about the excessive consumption rates of a relatively small proportion of humankind, and the resulting gross inequality and poverty. World population is projected to grow from 6.1 billion in 2000 to 9.8 billion in 2050, an increase of 38% (Figure 1.1). Future population growth is highly dependent on the path that future fertility takes. The average annual population growth rate over this half-century will be 0.77%, substantially lower than the 1.76% average growth rate from 1950 to 2000. Future population growth is highly dependent on the path that future fertility takes. If fertility levels continue to decline, the world population is expected to reach 10.1 billion in 2100, increasing by about 35 million persons each year, according to the medium variant (United Nations, 2011). Even if human population levels do begin to level off, it can be argued that the planet is already beyond its human carrying capacity as evidenced by the current over-exploitation of our natural resources and the dominance of unsustainable environmental management practices.

The exponential loss of plant diversity that is currently occurring has been well documented: habitats, species, gene combinations and alleles are being lost. The State of the World's Plants 2016 report (RBG Kew, 2016) estimates that 21% of global plant species fall into the threatened IUCN Red list criteria, and they conclude in their 2017 report (RBG Kew, 2017) that 'Despite ongoing efforts to increase the rate at which plants are evaluated for their extinction risk, there is widespread recognition that many plants may become extinct before they have been recognized as being at risk, and perhaps even before they have been discovered'. It is perhaps easiest to undertake threat assessment at the plant species level because species are relatively discrete, and, in many cases, the necessary data sets are available. Conversely, loss of genetic diversity may be characterized as a 'silent risk', because unlike habitats and species the loss of genetic diversity is difficult to observe and quantify and often passes unnoticed. Yet loss of genetic diversity will always be greater than habitat and species loss because genetic diversity will be entirely lost from extinct habitat and species but there will also be genetic diversity loss from the habitats and species that remain extant (Maxted *et al.*, 1997a). However, the conservation of plant genetic diversity is of critical importance to the survival of humanity itself due to the pivotal role plants play in the functioning of all natural ecosystems and the direct benefits to humanity that can arise from their sustainable exploitation of plant diversity (Frankel *et al.*, 1995). Humankind has since the earliest times exploited plant diversity in numerous ways, such as the development of new agricultural and horticultural crops, and medicinal drugs, as well as the numerous other ways humans use plants (Lewington, 1990). In contrast to the economic, political and social benefits of active plant conservation linked to sustainable exploitation, the consequences of our careless disregard for loss of diversity or unsustainable exploitation, combined with population growth, will be catastrophic for the planet, our fellow creatures and humanity itself.

The importance of biological diversity conservation, its sustainable utilization and the link to human development were central to the United

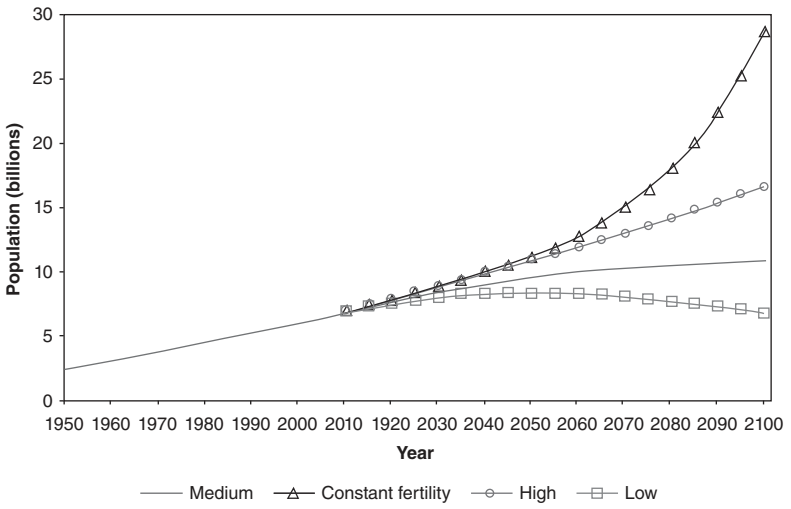


Figure 1.1 Human population 1950–2100.
(United Nations, 2011)

Nations Conference on the Environment and Development (UNCED) held in Rio de Janeiro, Brazil, in 1992. The Conference saw the adoption of the Convention on Biological Diversity (CBD, 1992), whose three key objectives, stated in Article 1, remain a cornerstone of plant genetic conservation today:

> The objectives of this convention . . . are the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources. . .

Subsequent to signing and ratification of the Convention, steps were taken toward conserving microbial, animal and plant species and genetic diversity, as well as the habitats and ecosystems in which they live. In April 2002, the CBD Conference of the Parties (COP) made a commitment to achieve by 2010 a 'significant reduction of the current rate of biodiversity loss at the global, regional and national level as a contribution to poverty alleviation and to the benefit of all life on Earth' (CBD, 2002). However, it must be admitted that this target was not or even nearly met. In response to this failure, in October 2010, the CBD COP adopted a revised and updated Strategic Plan for Biodiversity, including the Aichi Biodiversity Targets, for the 2011–2020 period (CBD, 2010b). The vision was that humankind should be 'Living in Harmony with Nature' and 'By 2050, biodiversity is valued, conserved, restored and wisely used, maintaining ecosystem services, sustaining a healthy planet and delivering benefits essential for all people'. The rationale for the new plan was that biological diversity underpins ecosystem functioning and these ecosystem services are essential for human well-being. Furthermore, it provides for food security, human health, and the provision of clean air and water, and is essential for the achievement of the Sustainable Development Goals, including poverty reduction. Target 13 of the Aichi Biodiversity Targets specifically addresses genetic conservation:

> Target 13: By 2020, the genetic diversity of cultivated plants and farmed and domesticated animals and of wild relatives, including other socio-economically as well as culturally valuable species, is maintained, and strategies have been developed and implemented for minimizing genetic erosion and safeguarding their genetic diversity.

Intermediate progress was assessed in the Global Biodiversity Outlook 4 (CBD, 2014) (Table 1.1).

In parallel to the recent development of the new Strategic Plan, the CBD has also developed the Global Strategy for Plant Conservation 2011–2020 (CBD, 2010a), which aims to achieve the three objectives of the Convention particularly for plant diversity. It should be implemented within the broader framework

Table 1.1. **Target 'dashboard'—a summary of progress towards the Aichi Biodiversity Targets, broken down into their**
Note The assessment uses a five-point scale and the assessment of level of confidence is indicated by stars (★★★).

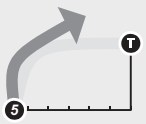
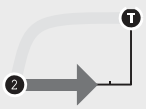
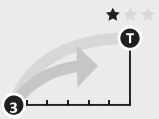
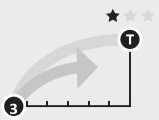
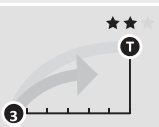
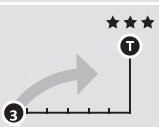
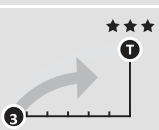
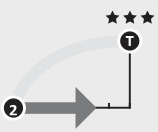
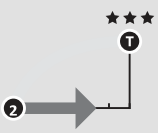
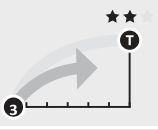
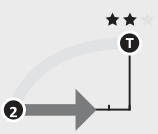
 On track to exceed target (we expect to achieve Target by deadline)	 On track to achieve target (if we continue on our current trajectory, (we expect to achieve target by 2020)	 Progress towards target but at an insufficient rate (unless we increase efforts target will not be met by deadline)	 No significant overall progress (overall, we are neither moving towards nor away from target)	
		TARGET ELEMENT	STATUS	COMMENT
	Target 1	People are aware of the values of biodiversity		Limited geographical covera regional differences
		People are aware of the steps they can take to conserve and sustainably use biodiversity		Evidence suggests a growing available, but limited und have positive impacts
	Target 2	Biodiversity values integrated into national and local development and poverty reduction strategies		Differences between regions. poverty reduction strategi
		Biodiversity values integrated into national and local planning processes		The evidence shows regional clear if biodiversity is actu consideration
		Biodiversity values incorporated into national accounting, as appropriate		Initiatives such as WAVES s towards such incorporatio
		Biodiversity values incorporated into reporting systems		Improved accounting implies

Table 1.1. (*cont.*)

	Target 3	Incentives, including subsidies, harmful to biodiversity, eliminated, phased out or reformed in order to minimize or avoid negative impacts		No significant overall progre some backward movement harmful subsidies but littl
		Positive incentives for conservation and sustainable use of biodiversity developed and applied		Good progress but better tar and still outweighed by po
	Target 4	Governments, business and stakeholders at all levels have taken steps to achieve, or have implemented, plans for sustainable production and consumption . . .		Many plans for sustainable p consumption are in place, scale
		. . . and have kept the impacts of use of natural resources well within safe ecological limits		All measures show an increa
	Target 5	The rate of loss of forests is at least halved and where feasible brought close to zero		Deforestation significantly s areas, although still great
		The loss of all habitats is at least halved and where feasible brought close to zero		Varies among habitat types, biomes
		Degradation and fragmentation are significantly reduced		Habitats of all types, includi wetlands and river system fragmented and degraded.

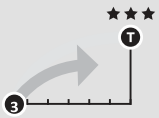
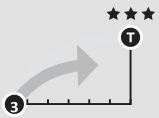
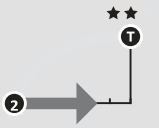
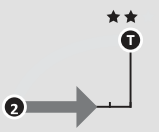
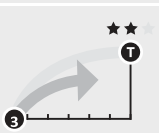
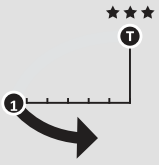
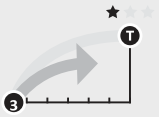
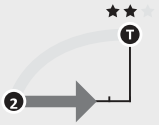
6	Target 6	All fish and invertebrate stocks and aquatic plants are managed and harvested sustainably, legally and applying ecosystem based approaches		Great regional variation, pos but data limited for many
		Recovery plans and measures are in place for all depleted species		Variable, progress in some re
		Fisheries have no significant adverse impacts on threatened species and vulnerable ecosystems		Some progress e.g. on long-l fisheries, but practices still ecosystems
		The impacts of fisheries on stocks, species and ecosystems are within safe ecological limits, i.e. overfishing avoided		Overexploitation remains an regional variation
7	Target 7	Areas under agriculture are managed sustainably, ensuring conservation of biodiversity		Increasing area under sustain on organic certification ar agriculture. Nutrient use fl techniques expanding
		Areas under aquaculture are managed sustainably, ensuring conservation of biodiversity		Progress with sustainability s introduced, but in the con expansion. Questions abou expansion of freshwater a
		Areas under forestry are managed sustainably, ensuring conservation of biodiversity		Increasing forest certificatio Certified forestry mostly in slower in tropical countrie

Table 1.1. ***(cont.)***

	Target 8	Pollutants (of all types) have been brought to levels that are not detrimental to ecosystem function and biodiversity	*No clear evaluation*	Highly variable between poll
		Pollution from excess nutrients has been brought to levels that are not detrimental to ecosystem function and biodiversity		Nutrient use levelling off in and North America, but at detrimental to biodiversity regions. Very high regiona
	Target 9	Invasive alien species identified and prioritized		Measures taken in many cou invasive alien species
		Pathways identified and prioritized		Major pathways are identifie controlled at a global scal
		Priority species controlled or eradicated		Some control and eradicatio
		Introduction and establishment of IAS prevented		Some measures in place, but continuing large increase
	Target 10	Multiple anthropogenic pressures on coral reefs are minimized, so as to maintain their integrity and functioning		Pressures such as land-based tourism still increasing, al protected areas may ease regions
		Multiple anthropogenic pressures on other vulnerable ecosystems impacted by climate change or ocean acidification are minimized, to maintain their integrity and functioning	*Not evaluated*	Insufficient information was target for other vulnerable seagrass habitats, mangro

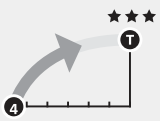
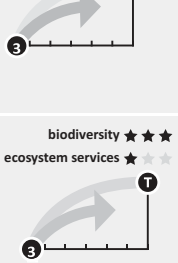
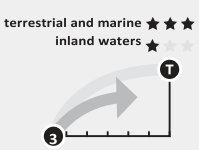
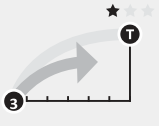
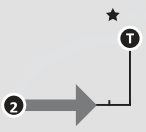
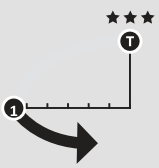
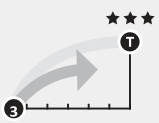
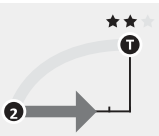
	Target 11	At least 17 per cent of terrestrial and inland water areas are conserved		Extrapolations show good pr be achieved if existing co protected areas are implem protection has distinct issu
		At least 10 per cent of coastal and marine areas are conserved		Marine protected areas are a extrapolations suggest we the target. With existing c would be met for territoria exclusive economic zones
		Areas of particular importance for biodiversity and ecosystem services conserved		Progress for protected Key B important gaps. No separa services
		Conserved areas are ecologically representative		Progress, and possible to me ecosystems if additional p representative. Progress w areas, but much further to
		Conserved areas are effectively and equitably managed		Reasonable evidence of impr small sample size. Increasi community involvement i dependent on region and
		Conserved areas are well connected and integrated into the wider landscape and seascape		Initiatives exist to develop co parks, but there is still not Freshwater protected areas

Table 1.1. ***(cont.)***

	Target 12	Extinction of known threatened species has been prevented		Further extinctions likely by and fish. For bird and mar evidence measures have p
		The conservation status of those species most in decline has been improved and sustained		Red List Index still declining, risk of extinction across gr regional differences
	Target 13	The genetic diversity of cultivated plants is maintained		*Ex situ* collections of plant g to improve, albeit with so support to ensure long ter varieties of crops in the fa agricultural practices and
		The genetic diversity of farmed and domesticated animals is maintained		There are increasing activitie their production environm including through *in-vitro* these are insufficient
		The genetic diversity of wild relatives is maintained		Gradual increase in the cons of crop plants in *ex situ* fa conservation in the wild r with few protected area m addressing wild relatives
		The genetic diversity of socio-economically as well as culturally valuable species is maintained	*Not evaluated*	Insufficient data to evaluate
		Strategies have been developed and implemented for minimizing genetic erosion and safeguarding genetic diversity		The FAO Global Plans of Act genetic resources provide development of national a and action plans