Biodiversity and ecosystems

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What is the historical process by which goal setting in this sector has developed?

Biologists devised the word biodiversity to allow us to talk about the totality of life on Earth, encompassing everything from the level of DNA and genes, through to individuals, species, and whole ecosystems. Reducing global biodiversity loss in the face of unprecedented population extirpation and species extinction has become a fundamental goal for conservation, and the subject of an array of international, national, and regional policies and goals. The recognition that humans, in some way or other, rely on biodiversity and ecosystems for a great deal has bolstered and driven recent goal setting. The diversity of life we observe not only provides a rich and varied component of the natural world but, ironically, most is hidden in soils and seas and wantonly abused. Together, seen or unseen, they are our natural capital: the engineers and providers of the many benefits which humans accrue from an intact and fully functioning environment. In this chapter, we aim to summarise the developments in international goal setting and measurement for biodiversity and ecosystems; we focus on the past 25 years, when the majority of change has taken place.

Prior to the international conventions of the 1990s, goal setting in this sector had largely been driven by a focus on specific species or a few selected habitats. There have subsequently been two strands of the development of goals and measures of biodiversity and ecosystem change emerging internationally (Mace et al. 2005). The first is the Convention on Biological Diversity (CBD), which was signed by a large number of participant nations in 1992 (the Rio Conventions). A range of programmes integrating strategies for improved human health and protection of global biodiversity have been developed from this convention. In addition, a wide range of other related conventions were created, including the United Nations Framework Convention on Climate Change (UNFCCC) and United Nations Convention to Combat Desertification (UNCCD). The CBD took a long time to develop any protocols for evaluating change in biodiversity and ecosystem, and setting goals to aim for, but set a target for biodiversity in 2010 (to slow the rate of loss; for examples see Balmford et al. 2005; Butchart et al. 2010; Mooney & Mace 2009; Walpole et al. 2010), followed by 20 targets for 2020, known as the Aichi Biodiversity Targets (an integrated set of targets across the goals of addressing causes, reducing pressures, enhancing benefits to people, and improving implementation through participatory planning).

The second strand was the Millennium Development Goals (MDGs), which independently developed a goal for environmental sustainability (Goal 7). Whether any progress was made towards achieving this goal was never seriously tested, though some indicators for measuring biodiversity were co-opted from the CBD process.

What progress has been achieved in this sector through the Millennium Development Goals and other processes?

On a broad scale, progress has been limited. In almost every way we measure biodiversity, decline is still apparent; pressures on biodiversity are growing in extent and intensity, and the few indicators that measure metrics that relate to human benefits from biodiversity are all in decline. More thought has gone into target setting though, and there is now a growing group of indicators to track progress (Butchart et al. 2004; Collen et al. 2009; Tittensor et al. 2014).

The progress that has been achieved has made been through the following mechanisms:

- Locally inspired and driven conservation efforts, usually species- or habitat-related, have successfully arrested local declines and species extinctions. The overall impact is negligible in relation to the extent of overall landscape change and biodiversity loss, but still highly significant and resilient. For example, black and white rhino conservation in Africa has had notable success in recovering and maintaining populations of these species. However, the vast majority are in fenced, ecologically unviable systems, and genetic exchange relies on a complex system of meta-population management, auction sales, and translocation, whilst the threat of poaching remains significant (Biggs et al. 2013).
- There are a large number of internationally inspired, funded, and driven projects to protect species and manage habitats or species, sometimes with local staffing, which show short-term positive results. The long-term sustainability of such progress is frequently threatened due to lack of local adoption or political turmoil. The saiga antelope is a case in point: after the collapse of the Soviet Union, a protection-focused management system disappeared almost overnight, and nearly one million animals were slaughtered for food and/or exploitation of commercially valued male horn, whilst agricultural and supply systems failed, leading to one of the most dramatic population crashes of a large mammal ever seen.
- Government driven and funded programmes have achieved notable success, particularly in areas of good governance and relatively high wealth. One example is the population recovery of large carnivores in the Rocky Mountain range of North America. There have also been many failures, especially in lower-middle income countries where insufficient resources are available to ensure conservation success. One leading problem is the lack of incentive for local human populations to conserve, in the face of protectionist policy and no local benefits to people. This is exemplified by the disappearance of species and populations from many of the so-called protected areas in South, South East and Central Asia; and East, Central and West Africa (Craigie et al. 2010).

What is the current debate about future goal setting?

Goal setting around the topic of biodiversity has generally been conducted in the context of preventive measures, and from the beginning these goals have often been in conflict with other global goals, for example those associated with agriculture and health. Most notably, agricultural and urban expansion are in constant conflict with goals to conserve biodiversity. Of note, these inter-sectorial conflicts have not been debated in any detail. There is a lot of interest in the CBD process, particularly from governments, policy makers, conservation organisations, and scientists, especially as some of the CBD goals are very much directed

towards biodiversity conservation. Others have broad overlaps into commodity and production sectors, and into public education and health. A few questions that we believe need to be highlighted are:

- Are the 20 CBD targets all achievable simultaneously or do they conflict? The greatest gains will be made where there are mutual benefits among targets. For example, reducing habitat loss (Target 5) will be instrumental in allowing for the restoration of degraded ecosystems (Target 15) and reversing biodiversity trends (Target 12). There are also cases where target achievement appears to conflict with others, for example habitat restoration (e.g. Target 15) can come at the expense of habitat protection (Target 11) when resources allocated to conservation are limited.
- How should national and regional differences in responsibility for key biodiversity targets be addressed? For example the most threatened species are typically country endemic. For globally important ecosystems similar issues abound, such as tropical forests for carbon sequestration, open and deep ocean global commons, and the agricultural policies relating to land-sparing and land-sharing. Agriculture has by far the greatest negative influence on biodiversity and natural systems, with an estimated 38 per cent of global terrestrial land dedicated to this use. At current rates of conversion of land suited to agriculture, the areas of that agro-biotype to remain in a natural state will soon be negligible. Other impacts of, for example, water use for agriculture (currently at 95 per cent of available global freshwater supplies), will have considerable effect beyond these agro-ecological zones. The food security-agriculture-land use-aquaculture debate is largely ignored by the conservation community, which is focused on illegal killing, individual species conservation, and protectionist policies that are largely impotent in the face of agricultural development and other extractive industries.
- Are species the best indicators for biodiversity conservation? Species are considered by many to be the natural unit at which biodiversity change should be measured; however, perhaps a broader evaluation of the benefits from the land and sea that includes, but is not restricted to, species conservation might be more helpful for national decision-making (Bateman et al. 2013).
- Is 2020 the right time frame for multiple goals for biodiversity? Some of the metrics of biodiversity and ecosystems in which we are interested have very long and slow degradation and recovery times (e.g. coral reefs, tundra, and cod stocks), so it is not apparent whether targets are achievable within the time frames set. Moreover, natural population fluctuations require that datasets are sufficiently long to diagnose the difference between short-term dynamics and long-term trends.
- How should the CBD best interface with the UNFCCC and the Food and Agriculture Organization of the United Nations (FAO), which often deal with closely related issues, particularly if goals are conflicting?
- What is the role of monetary valuation and trade, and can the deleterious drivers of decline in biodiversity be turned to good effect? Examples of this are The Economics of Environment and Biodiversity (TEEB) initiative, the World Bank's Wealth Accounting and the Valuation of Ecosystem Services (WAVES) partnership, and natural capital accounting.
- Can indicators and goals be more directly related to policy, and if so how? For example, are we measuring things that can inform our environmental policy, and do we have the right

tools or indicators to tell us whether or not they have worked? The multiplicity of biodiversity measures can be a problem because it appears that there is useful information and data, but in practice many measures were designed for other purposes, and may be weak indicators of the stated goals.

- Can the continuity of the indicator-goal-policy cycle be improved? The indicator-goal-policy cycle should ideally be iterative but there is a tendency to move from one set of goals to the next, with no real connexion between the two. Designing the goals and indicators coherently would streamline the process and increase the chances of achieving stated goals (Collen & Nicholson 2014).

Considerable attention has been paid to the use of the world's biodiversity for developing new high-value products (e.g. medicinal and engineering products), sustainable use of natural capital, and to the sharing of equitable benefits that stem from those products. Governance of the use of natural resources has historically been extremely weak, and only relatively recently have rights to biological property and their use been accepted at an international level, although they are rarely enforced. For example, the global agricultural industry based on the oil palm tree (the principal source of palm oil), an endemic of Guinea Conakry, accrued no benefits to its country of origin, which remains trapped in poverty, whilst global investors have continued to support and benefit from extractive industries.

Considerable attention has focused on developing new drug leads for use in globalised markets; primarily this is focused on more developed economies, the classical user-countries of such knowledge and materials. A good example of the benefits of mimicry of nature is the current research in Germany into novel antimicrobials, generated by insects (Hull et al. 2012; Steckbeck et al. 2014). This is critical research in the face of increasing antimicrobial resistance, now considered by the industrialised nations as the eighth most important threat to the economies of the world.

An aspect of biodiversity rarely accounted for is its buffering effect, along with ecosystem integrity, on emerging infectious diseases. This is a growing debate given the increasing rate of emergence of old and new infectious diseases. The hypothesis is based on the idea that development in, and fragmentation of forested systems in particular, may equate to a desterilising force allowing the spill-over of novel pathogens into amplifying host systems of domestic animals and people; the severe acute respiratory syndrome (SARS) virus, the Nipah virus, and the Ebola virus emergence are all examples of this potential. Finally, the value of harvesting systems, be it marine or terrestrial, remains high, and the capacity for renewal is remarkable despite global overexploitation. There exists no more sustainable system, but again the failure in governance of these resources, effectively considered a common good, has forced communities into increased reliance on agriculture and aquaculture. The net effect is global loss of biodiversity and habitat and less efficient production of food and goods. In general, it is a key goal of CBD targets to contribute to biodiversity conservation and economic development, both at an international and local level.

Biodiversity is traditionally associated with rural areas, but its importance in growing urban areas is increasingly recognised. Urban greening and urban biodiversity is an element of the Sustainable Development Goals (SDGs; the successors to the MDGs) that could help reconnect the vast majority of people to the concerns of biodiversity conservation, and provide real gains in health in urban environments. Maintenance of biodiversity underpins the achievement of many of the proposed

SDGs, given its role in maintaining genetic diversity of food crops, supporting human health, providing future options for adaptation, and in providing supporting and provisioning services from ecosystems (Mace et al. 2014). There are several areas in which a consistent focus on biodiversity could be beneficial, but seriously tackling the social and economic context for future biodiversity conservation requires a shift in thinking and action for the whole of society.

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