Chapter **13**

Biodiversity Policy

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Executive summary

Biodiversity is a key component of a healthy planet with healthy people (*well established*)**.** Though evidence regarding the importance of biodiversity for economic output, health and security has grown significantly in the last two decades, it is certain that existing measures to conserve and sustainably manage biodiversity are inadequate {Box 13.1, Section 6.1, 13.1}.

Policy instruments working in silos are insufficient to stem biodiversity loss (*well established*). Instead, multiple approaches that embrace a diversity of instruments and scales, including platforms for encouraging behaviour change, are vital {13.1, 13.2.3}.

The cost of inaction (societal and economic) for biodiversity conservation and restoration is extremely high, as biodiversity loss is largely irreversible (*established but incomplete*) {13.1, 13.2.1, 13.2.4}.

There is an urgent need to act now and strengthen policy responses for conserving biodiversity and invest in capacity-building and institutional infrastructure to reach the Aichi targets and Sustainable Development Goals (*well established*) {13.3, 13.4.2}.

Current valuation methods are not adequate to account for the negative impacts of biodiversity loss (*well established*). Developing appropriate valuation metrics and methods to make the multiple values of biodiversity understandable to decision makers is urgently needed (e.g. natural capital accounts). Such valuation techniques should consider the full natural capital value at the national level and integrate it into their National Biodiversity Strategic Action Plans {13.2.4}.

Mainstreaming biodiversity should be promoted by all stakeholders, including governments and the private sector, across themes such as health, agriculture, social security, trade and education (*well established*) {13.2.2, 13.2.3, 13.2.4}.

There is a lack of baseline information to measure the success or failure of most biodiversity policy and governance interventions (*well established*). Investing in long-term research programmes would be useful, particularly in biodiverse developing nations, to develop effective baselines. In addition, a well-defined time frame to turn goals into actions will be very likely to be useful for effective conservation policy implementation {13.2}.

Investing in independent monitoring and cost–benefit analysis could help in measuring policy effectiveness (*well established*). Countries could integrate autonomous monitoring and evaluation in the implementation of programmes to improve effectiveness. As a start, building an evidence base of what works in conservation could be prioritized at a national level {13.2}.

Conservation problems require long-term solutions, while conservation and research funding is usually short term (*well established*). Addressing this **timescale mismatch** is urgently needed in the design phase of policy interventions {13.2.3}.

Policies and mechanisms need to be in place to support innovative measures to strengthen biodiversity protection. For example, while traditional approaches such as protected areas have been the norm to secure tenure, other forms of arrangements such as community-based protected areas (e.g. Locally Managed Marine Areas) are needed to supplement protected areas for conserving biodiversity in the long term {13.1}.

Economic development is commonly perceived as a threat to biodiversity conservation, but sustainable growth and development of the green economy (low in carbon, resource-efficient and socially inclusive) can also promote and enhance biodiversity (*well established*) {13.2.3, 13.2.5}.

In the policy design phase, adequate attention needs to be paid to equity, gender and health aspects (*well established*). To deliver desired co-benefits between enhanced biodiversity and other environmental and societal goals, there is a need for scale-up, further innovation and transformation in the approach to biodiversity management. It would also help other sectors achieve their goals through biodiversity conservation. This reflects Sustainable Development Goal (SDG) 17, which calls for the building of partnerships to achieve the SDGs. {4.2, 13.1, 13.2.4}

The astounding wealth of biodiversity that we collectively share is on loan from future generations. To create the future we want, member states, community-based organizations, non-governmental organizations and corporations are urged to create financial and social incentives that enable individuals and policymakers to make decisions that favour the protection and promotion of biodiversity {13.2.2, 13.2.3, 13.2.4}.

13.1 Introduction

Biodiversity is an integral facet for achieving a healthy planet and human well-being (Cardinale *et al.* 2012; World Health Organization [WHO] and Secretariat of the Convention on Biological Diversity [SCBD] 2015). However, the rate of biodiversity loss continues unabated, and it is well known that species extinction risks are increasing over time (see Section 6.1). The estimated annual cost to the global economy from biodiversity loss and loss of ecosystem functions is up to €14 trillion by 2050; this is equivalent to 7 per cent of projected global gross domestic product (GDP) (Braat and ten Brink (eds.) 2008). Another estimate places the global cost from the loss of ecosystem services solely from land-use change at US$4.3−20.2 trillion (in 2007 valuation) per year between 1997 and 2011 (Costanza *et al.* 2014). Though it is impossible to be precise, quantifying the costs of inaction motivates the need for policy action (Braat and ten Brink (eds.) 2008; Oliver *et al.* 2015). In addition, the importance of biodiversity to health in all its dimensions (WHO and SCBD 2015) has emerged in initiatives such as ecosystem approaches to health, Ecohealth, One Health and Planetary Health (see Section 4.2.1). There is a growing focus on interrelationships between the health of humans, domesticated and wild animals and other species in the context of complex social-ecological systems (Charron 2012; Wilcox, Aguirre and Horwitz 2012; WHO and SCBD 2015) **(Box 13.1)**.

Biodiversity loss is a complex issue (see Section 6.1), and biodiversity conservation relies on strategies involving a wide range of policy approaches such as regulatory command and control, economic incentives, supporting investment, the promotion of innovation, enabling actors, capacity-building and goal-setting, among others. The major policy and governance responses include the Convention for Biological Diversity (CBD) (CBD 1992), the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) and protected areas (see Section 6.7). While there are variations in the effectiveness and perceived legitimacy of international environmental agreements (IEAs) and multilateral environmental agreements (MEAs) (see Annex 6-1 for a list of MEAs relevant

### Box 13.1: Global recognition of the link between human health and biodiversity.

A joint work programme between CBD and WHO was formally established in 2012 (CBD 2012 (Decision XI/6)). Health was identified as a priority mainstreaming sector at the 13th CBD Conference of the Parties (CoP) in Mexico in December 2016 (CBD 2016a (Decision XIII/3)); a comprehensive decision to integrate biodiversity and health linkages in national policies was also adopted (CBD 2016b (Decision XIII/6)). The United Nations Environment Programme (UNEP) GEO-6, 'Healthy Planet, Healthy People' and the joint WHO-CBD publication 'State of Knowledge Review Connecting Global Priorities' (WHO and SCBD 2015) recognize that human health and biodiversity are inextricably linked. At the 71st World Health Assembly in 2018, biodiversity loss was recognized as a significant human health issue by many Member States. Increasingly, the medical, public health, biodiversity conservation and policy communities are forging new networks and breaking traditional silos, and One Health, Ecohealth and Planetary Health have emerged as animating approaches.

to biodiversity at the end of this document), they form the basis of global environmental governance and continue to shape governmental behaviour and expectations (Stoett 2012). Biodiversity has more MEAs in place than other environmental policy domains (see Annex 13.1).

Over the last 10 years, and particularly since the last GEO, awareness about the loss of biodiversity has risen significantly in international policy, health and economic discourse (WHO and SCBD 2015; Jabbour and Flaschsland 2017; World Economic Forum 2018). The most recent developments in the global biodiversity policy and governance landscape are described in Annex 13.2 at the end of this document.

The 196 CBD member states are required to develop National Biodiversity Strategies and Action Plans (NBSAPs) according to Article 6. To date, 190 of the 196 parties (96 per cent) have developed NBSAPs (SCBD 2018a) **(Figure 13.1)**.

Figure 13.1: Cumulative number of countries that have adopted the NBSAPs as of 2018
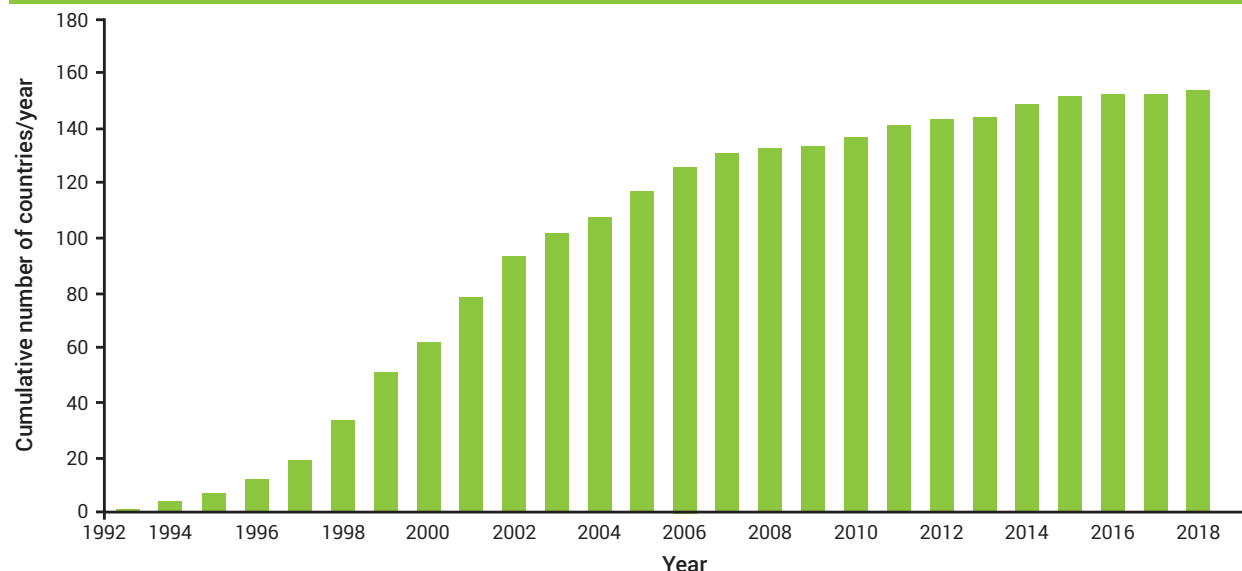
Source: SCBD (2018a)

Moreover, similar to other environmental issues, biodiversity conservation and restoration require the involvement of a range of different stakeholders with often conflicting value positions (Mukherjee *et al.* 2018). Over time, there has been greater recognition of the gender and equity dimensions of conservation policies and their implementation **(Box 13.2)**.

This chapter follows the twofold (top down and bottom up) policy effectiveness assessment framework outlined in Chapter 10.[1]

Key policies and governance approaches (top down): A set of policy clusters and five specific policy instruments pertaining to these clusters is elaborated. Five case studies are drawn as illustrative examples of these policy instruments **(Table 13.1)**. The case studies are not intended to be representative in any form. They were selected to cover the three dimensions of biodiversity (ecosystems, species and genetics), a range of approaches within the typology, geographical spread of

examples and varying degrees of success (see Section 10.6). The case studies are drawn from North America, South Asia, Europe, the Pacific and Africa.

Indicators (bottom up): The case studies are followed by a review of three policy-relevant indicators (see Section 10.7), which map the progress towards internationally agreed goals and targets, complementing the policy and governance approaches above.

13.2 Key policies and governance approaches

13.2.1 Enabling actors: Community-based conservation

Engaging local stakeholders through community-based conservation is a central feature of many biodiversity conservation and natural resource management efforts globally to make conservation more effective. Within the Drivers, Pressures, State, Impact, Response (DPSIR) framework (see Figure 1.2 Chapter 1), community-based conservation as a policy approach addresses the drivers, as it counterbalances external resource users who do not have the same cultural and historical attachment to the area.

Protected areas are a key tool for biodiversity conservation. There has been a shift over the last few decades away from exclusive protected areas, where humans were not welcome, towards more people-centred or community-based conservation (Brown 2003; Oldekop *et al.* 2015) and integrated landscape management (Food and Agriculture Organization [FAO] 2018). A nuanced understanding of governance and sociocultural context plays an important role in all types of stakeholder engagement efforts for biodiversity conservation (Bennett *et al.* 2017; Mukherjee *et al.* 2018) and makes those efforts more legitimate, salient, robust and effective (Sterling *et al.* 2017).

Communities are the major players in decision-making in indigenous peoples' and community-conserved territories and areas (ICCAs). ICCAs play a key role in conserving traditional ecological knowledge, cultures and languages, which are often inextricably linked to conservation of biodiversity (Corrigan and Hay-Edie 2013). This role helps in addressing CBD Aichi Biodiversity Target 18, which is aimed at preserving traditional knowledge, innovations and practices of indigenous peoples and local communities and integrating them into biodiversity conservation interventions (ICCA Registry 2018).

> **Box 13.2: Highlights of the gender and equity dimensions in biodiversity policies**
>
> Paragraph 13 of the CBD Preamble recognizes gender issues in conservation, and the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) mentions women's practices, knowledge and gender roles in food production (SCBD 2018b). The need for the full and active involvement of relevant stakeholders, including indigenous and local communities, youth, non-governmental organizations (NGOs), women and the business community, is underlined in the Convention.
>
> ❖ The Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization created an international framework that provides concrete measures, rules and procedures.
> ❖ Out of the 254 NBSAP reports from 174 countries, 143 reports (56 per cent of all documents) from 107 countries (61 per cent of all countries examined) contain at least one gender keyword; 145 of the 174 countries (83 per cent) identify gender equality as a guiding principle; and 12 per cent have gender equality or women's empowerment as an objective or goal (International Union for Conservation of Nature [IUCN] 2016; SCBD and IUCN 2018).

Table 13.1: Typology of policy and governance approaches described in this chapter

Policy type /governance approach	Policy instrument(s)	Case study	Spatial scale
Enabling actors	Community-based conservation	Locally managed marine areas, Fiji	National
Command and control	Policing of illegal wildlife trade	Wildlife trafficking and Project Predator, South Asia	Regional
Economic incentive	Payment for ecosystem services	Working for Water programme, South Africa	Subnational
Supporting investment	Banking of genetic material	Svalbard global seed vault, Norway	Global
Enabling actors[1]	Strategic environmental planning	Urban biodiversity in Edmonton, Canada	City

1 The policy type 'enabling actors' has been showcased through two different examples of associated policy instruments.

The case study below on Locally Managed Marine Areas (LMMAs) elaborates one such type of community-based sustainable management in the marine realm.

Case study: Locally Managed Marine Areas in Fiji
Fiji LMMAs are defined as "areas of nearshore waters and coastal resources that are primarily managed at a local level by the coastal communities, land-owning groups, partner organizations, and/or collaborative government representatives who reside or are based in the immediate area" **(Figure 13.2)**. They cover 145 traditionally defined fishing areas (79 per cent of Fiji's inshore fishing areas); the remaining areas permit comparison of the effectiveness of the approach. The LMMA approach is signified by empowered local actors acting at a community scale to sustainably manage inshore resources for mutual community-wide benefit, most commonly through periodically harvested closures (Jupiter *et al*. 2017). After gaining traction in Fiji, the approach was extended further to Melanesia and Polynesia and into Asia through the LMMA network.

Community-based approaches have garnered support because of their adaptability to different contexts and focus on locally identified objectives, negotiated and implemented by stakeholders. Rather than promoting new and alternative visions for serving short-term human needs, community-based approaches such as the LMMA approach are built on refreshing and revitalizing long-standing traditional systems. The non-prescriptive nature of the approach, however, leads to multiple objectives that confound simple measurement of natural resource and biodiversity outcomes (Jupiter *et al.* 2014). Further benefits of the approach could extend to human health through improved food and nutrition security and community integrity, though this has not been documented to date.

The organic expansion of alternative approaches is a positive indication of their effectiveness. Some management tools used with the LMMA approach, such as periodically harvested

Figure 13.2: Inshore fishing is an important source of food in Fiji, and many of these inshore areas are under traditional tenure by local communities

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closures, are not consistently effective for fish biomass and biodiversity outcomes (Jupiter *et al*. 2017). While the approach has spatially expanded dramatically in the absence of any alternative and is currently heavily relied on to achieve conservation and fisheries management outcomes in Fiji, there is no unequivocal evidence at present that it has been completely effective in terms of site-based biological outcomes. The approach has transformative potential, through promoting benefits based on a long-established community system strengthened by coherent resource management approaches.

As the costs of both inaction and action are predominately borne by the local community, the incentive for progressive transformation is apparent. Attention needs to be paid to the causality between community-based governance arrangements and the effectiveness of conservation efforts (Eklund and Cabeza 2017). Existing analyses of policy effectiveness, such as the 'Protected Planet' report (Bertzky *et al*. 2012; Juffe-Bignoli *et al*. 2014; United Nations Environment Programme World Conservation Monitoring Centre [UNEP-WCMC] and IUCN 2016), could be consulted to identify gaps between policy intent and governance effectiveness.

13.2.2 Command and control policies: Policing of the illegal wildlife trade

Command and control policies (CCPs) are characterized by centralized, often hierarchical and bureaucratic, decision-making structures that have defined jurisdictional authority and less flexibility in implementation compared to economic incentive policies (Cox 2016). CCPs are the most traditional form of regulatory instruments seeking to 'control' activities that could negatively affect biodiversity through penalties, prohibitive rules, enforcement and compliance checks. Typically, national or subnational governments are the decision-making authorities which create the rules and decide how, when and by whom the rules will be implemented (Holling and Meffe 1996). Due to their centralized structure and institutional support, it is easier to evaluate the policy effectiveness of CCPs, especially when the policies have clearly stated objectives and time frames (Gunningham and Young 1997). Therefore, they may be well suited to complex, non-linear issues such as biodiversity loss (e.g. due to ecological tipping points). However, top-down approaches can also present issues of legitimacy, equity and sustainability for local communities (Redpath *et al*. 2017).

Integrating the views of local stakeholders in the decision-making and implementation phases is often key to the success of CCPs (Mukherjee *et al*. 2018). For example, though the European Union (EU)-wide Birds Directive 79/409/EEC (European Council 1979) and the Habitats Directive 92/43/EEC (European Council 1992) engaged several actors in the policy design phase, they are often implemented in an inflexible way at the national level in EU member states (Primmer *et al*. 2014). In Greece, local communities were rarely engaged in the effective implementation and enforcement of EU directives; this led to limited representation of species endemic to Greece in Natura 2000 appendices and inadequate responses (Apostolopoulou and Pantis 2009), conflicts and a lack of trust (Primmer *et al*. 2014). Furthermore, the effectiveness of CCPs (e.g. protected areas) is directly proportional to the capacity and resources available to manage them (Geldmann *et al*. 2018).

Table 13.2: Summary of assessment criteria: Locally Managed Marine Areas in Fiji case study

Criterion	Description	References
Success or failure	The Fiji LMMA approach can increase fish and invertebrate size and abundance. Three of the eight LMMAs studied had fish biomass benefits, and one had biodiversity benefits. This improves the potential for the sustainable use of coastal fisheries resources and, therefore, supports national policy agendas (e.g. Roadmap for Democracy and Sustainable Socio-economic Development and Green Growth Framework) as well as international obligations such as UNCLOS and CBD.	Jupiter *et al.* 2017
Independence of evaluation	Expert-based assessments involved several organizations, including: UN Environment World Conservation Monitoring Centre (UNEP-WCMC), the Centre for Sustainable Development and Environment (CENESTA), the International Union for Conservation of Nature (IUCN), the United Nations Development Programme (UNDP), the Secretariat of the Pacific Regional Environment Programme (SPREP), the South Pacific Community (SPC), the World Wide Fund for Nature (WWF), WorldFish and Reefbase.	Govan 2009; Jupiter *et al.* 2014; Jupiter *et al.* 2017,
Key actors	There is external input from the NGO and community-based organization (CBO) sector guided by local norms. The Government plays no direct role in management approaches and has a passive administrative role such as collection of dues for fisheries permits from non-customary (non-community) fisheries, which are then returned to the community.	
Baseline	No baseline data were collected at the start of initiatives. The selection of target areas was based on interest from the community, rather than any particular biological or societal status.	
Time frame	No time frame was established for the initiative. LMMAs emerged in the 1980s, coupled with a realization of the ineffectiveness of Western approaches to conservation in countries with local tenure and with little ability to enforce conservation measures. Fiji's LMMAs expanded through the 1990s and 2000s to their present coverage of 145 traditional fishing areas covering 79 per cent of Fiji's inshore fishing area.	
Constraining factors	While the community may be able to manage local resources, strategies must be implemented that improve management of threats operating at larger scales and across boundaries (e.g. provincial scale, land–sea interactions, climate change).	
Enabling factors	The openness of the Fiji LMMA network allowed a wide range of entities to participate in the expansion, including NGOs, universities and CBOs, and facilitated the associated financial support. Working within existing sociocultural norms allowed this inclusive and integrated approach linking communities to natural resources to flourish.	
Cost-effectiveness	No cost-effectiveness assessment has been conducted.	
Equity	Equity gains from the approach include: increased fish and invertebrate size and abundance, which improve diet and also improvement of the potential for the sustainable use of coastal fisheries resources when under LMMA management. However, these biological gains are not guaranteed, and other co-benefits may be more important, such as reinforcing customs and asserting access and tenure rights. This is assumed to be relatively equitable in the way the gains are spread across the communities involved; however, there are sections of the population who are not bestowed with traditional customary rights.	Jupiter *et al.* 2014; Jupiter *et al.* 2017
Co-benefits	The extension to other Pacific countries and Asian countries was not an intended consequence at the start but can be perceived as a co-benefit, additional to those identified at the community level.	
Transboundary issues	There are no intra- or international transboundary issues.	
Possible improvements	There is a need for increased engagement and alignment with government. Government 'ratification' and sustainable financing of support for customary systems delivering natural resource management would help stabilize the approach. Increased clarity in the costs of such approaches and improved monitoring to assess resource management and biodiversity outcomes would be useful.	

The case study below examines the effectiveness of CCPs in the context of addressing the global illegal wildlife trade. The estimated value of illegal wildlife trade ranges between US$50 billion and US$150 billion per year (illegal fisheries are estimated at between US$10 billion and US$23.5 billion, and illegal logging at between US$30 billion and US$100 billion (Nellemann and International Criminal Police Organization [INTERPOL] Environmental Crime eds. 2012; Higgins and White 2016). The corrupt engagement of some government officials, including customs officials and local police, in addition to a chronic lack of resources, make effective monitoring and enforcement difficult. Even in countries with relatively advanced technological and criminological infrastructures, wildlife crime lags behind other aspects of law enforcement (Wellsmith 2011). Violence is not uncommon either, as poaching involves weapons, and anti-poaching efforts can be lethal; armed rebel groups also use the trade to finance their military campaigns.

Within the DPSIR framework (see Section 1.6), this policy approach is mostly aimed at the pressure of overexploitation, by tackling related biodiversity loss or by protecting endemic species and traditional human practices (see Section 6.4.4). However, the development of effective CCPs to constrain undesirable human activities demands significant capacity-building efforts.

Case study: Project Predator and policing the global illegal wildlife trade
Project Predator was launched in 2011, at the 80th INTERPOL General Assembly in Hanoi, Viet Nam, and is focused on building law enforcement capacity for the conservation of Asian big cats, most notably the tiger. Wild tiger populations are falling at a precipitous rate, down from over 100,000 at the start of the 20th century to less than 4,000 today (Goodrich *et al.* 2015). The main threat to big cats is habitat destruction, but poaching remains a major problem throughout their range. As reported by the IUCN Red List, the largest market is for tiger bone used in Asian traditional medicines, but other illegal markets for tiger products, especially skins, teeth and claws (particularly in Sumatra), contribute to poaching pressure. Tigers killed by farmers or villagers who believe their livestock or human inhabitants are at risk of tiger attacks can also feed into the illegal trade.

The specific objectives of Project Predator include:

i. encouragement of the creation of National Environmental Security Taskforces **(Figure 13.3)** and strengthening the South Asia Wildlife Enforcement Network;
ii. information and intelligence management, and enhancement of investigative skills;
iii. capacity-building and international integration; and
iv. intelligence-led anti-poaching activity.

Tiger range States include Bangladesh, Bhutan, Cambodia, China, India, Indonesia, Lao PDR, Malaysia, Myanmar, Nepal, Russian Federation, Thailand and Viet Nam. The collaboration between INTERPOL, national governments and legal systems is a relatively new development in global environmental governance and supports the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and other international conventions. Similar programmes have been implemented for the ivory trade, hazardous waste, illegal logging, and illegal fishing.

Figure 13.3: National Environmental Security Taskforces are direct liaisons between national bureaucracies and the INTERPOL National Central Bureau; image showing seizure of 114kg of tiger bones

Source: https://greennews.ie/wanted-wildlife-trafficker-arrested-nepal-this-month/

Table 13.3: Summary of assessment criteria: Project Predator case study

Criterion	Description	References
Success or failure	Success refers to empirical evidence of animal parts seized. In 2015, officials organized Operation PAWS (Protection of Asian Wildlife Species) across 17 countries. This led to the arrest of more than 300 wildlife criminals and revealed the location of four wildlife crime fugitives. Officers seized 6 tiger skins and parts, more than 150 common and clouded leopard skins and parts, including 12 big-cat skins, more than 9 tonnes of ivory, 37 rhino horns, more than 2,000 turtles and reptiles, 282 pangolins, 5 tonnes of pangolin meat, and 275 kg of pangolin scales.	INTERPOL 2015
Independence of evaluation	To our knowledge, no formal evaluation of Project Predator has taken place. However, a recent study by the independent wildlife trade monitoring network TRAFFIC emphasizes the need to share intelligence among range States and the potentially helpful role of INTERPOL.	Stoner *et al.* 2016
Key actors	Project Predator's main funders include the United Kingdom of Great Britain and Northern Ireland Government, Environment Canada, the International Fund for Animal Welfare (IFAW), the Smithsonian, USAID and the Global Tiger Initiative. The latter is an umbrella organization formed in 2008 by the World Bank, the Global Environment Facility, the Smithsonian and the Save the Tiger Fund. It is related in turn to the International Tiger Coalition, which comprises some 40 NGOs in 13 tiger range countries. The CITES Secretariat is a formal partner.	United States Agency for International Development [USAID] 2016
Baseline	Wild tiger populations have fallen from over 100,000 at the start of the 20th century to less than 4,000 today.	Goodrich *et al.* 2015
Time frame	Operation Predator was established in 2011. Funding is expected to continue into the 2020s.	
Constraining factors	Corruption at all levels continues to be a problem, as does the inability to establish environmental crime as a punishable offence in many countries. The transnational environmental crime networks involved in wildlife trafficking are powerful, and their crossover illicit activities are believed to include human trafficking, drug and arms smuggling, money-laundering and extortion.	
Enabling factors	International outrage over the fate of wild tiger and snow leopard populations related to the charismatic nature of these iconic species was a motivating factor. Intelligent policing and the introduction of new tracking technology was essential. Since establishing an Environmental Crime Committee in 1992, INTERPOL has become an active agent in efforts to curb and punish transnational environmental crime.	
Cost-effectiveness	Not conducted yet	
Equity	Problematically, the low-income poacher often assumes the brunt of legal prosecution, while the enriched 'middle man' or purchaser of illicit wildlife trade escapes (including developed nations (United Kingdom of Great Britain and Northern Ireland, United States of America) which continue to trade in 'legal' wildlife when sources are often hard to identify) (Nelson 2017).	
Co-benefits	Big cats are central to ecosystem resilience and biodiversity, so their protection is beneficial to everyone who relies on related ecosystem services. The enhancement of judicial systems through National Environmental Security Taskforces is another main co-benefit.	Thinley *et al.* 2018
Transboundary issues	Wildlife trafficking involves a wide variety of international actors, and INTERPOL is unable to monitor them all. Ultimately, the success of anti-poaching efforts will depend on the capacity of national governments to monitor their own borders in a corruption-free context, and to impose serious punishment on offenders.	
Possible improvements	More information is needed on the impact of INTERPOL's interventions and National Environmental Security Taskforces. More accurate tracking of big cat populations would be helpful across the range States. More local community involvement is needed.	

Command and control strategies have historically dominated efforts to promote environmental protection. However, they face difficulties in terms of a lack of human resources and local participation (Harrington, Morgenstern and Sterner 2004; Laitos and Wolongevicz 2014). Though CCPs have their fair share of demerits, they may be highly pertinent in situations where critically endangered species and habitats are at stake and their loss is imminent (see Section 6.4.4). For instance, the relaxation of land clearing regulations and

enforcement has led to increased forest loss, particularly in remnant forests (Marcos-Martinez *et al.* 2018). The challenge lies in greater integration of local communities in both the design and implementation phases (Paavola, Gouldson and Kluvánková-Oravská 2009). Adequate, power-neutral consultation of different stakeholders during policy design, and regular monitoring and adaptation could help improve the effectiveness of CCPs for biodiversity conservation. In the United Kingdom of Great Britain and Northern Ireland,

UN Environment Assembly Resolution 2/14 asked for a review of "best practices in engaging rural communities in wildlife management" (Cooney *et al.* 2018), focused specifically on engaging indigenous peoples and local communities (IPLCs) in combating the illegal trade in wildlife. The report prepared by IUCN and the International Institute for Environment and Development (IIED) concludes that local communities must be central actors in stemming illegal trade and be viewed as stakeholders and not just passive victims or witnesses. Though policing activities are important, they can also be seen as militarized responses that alienate the local communities that have the most to gain from enhanced biodiversity conservation. As the report states, partly as a "result of an increased militarization of poaching, the response [has included] the resurgence of a top-down protectionist approach emphasizing fences and fines, guns and boots. However, unless accompanied by strengthened accountability measures, this can lead to—and has led to—human rights abuses, restricted livelihood options, and hardship for IPLCs [and can drive] disenfranchisement, resentment and anger" (Cooney *et al.* 2018, p. 5).

Community-based approaches demand patience, as local stakeholders need to organize and build their own capacity. Building robust opportunities for IPLCs to be heard and to exercise their rights at all levels is critical in promoting more effective and equitable wildlife conservation strategies.

implementation of the Natura 2000 sites was carried out in an integrated manner, leading to wider acceptance (Primmer *et al.* 2014). If the INTERPOL approaches described above prove successful, they could serve as models for further initiatives aimed at stemming international crime and environmental destruction. In addition, setting up randomized control trials and regularly measuring and reporting on the success or failure of conservation interventions can help monitor effectiveness (Schwartz *et al.* 2017).

13.2.3 Economic incentive policies: Payment for ecosystem services

Economic incentive policies (EIPs) and market-based instruments are arguably more flexible than CCPs and regulatory policies, allowing the development of innovative approaches that reframe the relationship between people and the environment. EIPs are generally a response measure in the DPSIR framework (see Section 1.6) and are based on the assumption that economic incentives can account for market externalities by facilitating pro-conservation behaviour and disincentivizing negative behaviour. Such economic tools can also be used to compensate stakeholders who are negatively affected by biodiversity conservation.

EIPs are, therefore, able to address scale mismatches in biodiversity conservation—for example, where the benefits of conservation are felt at a regional or national scale, while the cost is borne by local communities at a smaller scale. Examples of EIPs include schemes related to REDD+; species enhancement; eco-certification; setting aside agricultural

land; or purchasing public or grant-aided land. Others include conservation easements, incentive payments for organic farming, fiscal/taxation measures and payment for ecosystem services (PES) (UNDP 2017). For instance, municipalities located in the core area of a national park in France now receive an 'ecological allocation' for the protection of these areas (General Code for Local Authorities, article L2,334-7). There is also a 20 per cent reduction in the property tax rate for all wetlands in the country (Primmer *et al.* 2014).

PES captures many of the important elements of EIPs. As a policy instrument, PES was first widely implemented on a national scale in Costa Rica (Porras *et al.* 2013), where it has been operative since 1996, but has since spread to many countries in different forms. Typically, PES rewards local stewards of an ecosystem so that they maintain the natural resources on which they (and often downstream users) depend. Farmers on steep slopes, for example, can be incentivized to return their land to forest cover, so that an important water supply can be protected. In one well-documented example, the city of New York paid landholders in the Catskill Mountains to protect the landscape and thus avoid the greater cost of a new water treatment plant (Appleton 2013). By providing economic incentives to encourage better stewardship of the land, PES enables new actors in biodiversity conservation and simultaneously promotes a more sustainable relationship between people and nature by emphasizing the value of the ecosystem services that biodiversity supports.

However, the effectiveness of PES schemes is an area of current debate, as there are few randomized control studies to evaluate its success (Börner *et al.* 2017). A recent analysis of 38 peer-reviewed articles found that evidence of effectiveness was weak (Gaworecki 2017). Most studies had not compared areas where PES had been implemented with a relevant non-PES control area (Gaworecki 2017), and the more rigorously designed studies showed reductions in deforestation of just a few percentage points. Payments were often too low compared to the opportunity costs of other land uses – for instance, agricultural development – although this does not take into account potential co-benefits. The following case study explores an example of a PES scheme that had dual goals of reducing invasive species (one of the major pressures on biodiversity) and generating employment.

Case study: Working for Water programme, South Africa
In South Africa, a major pressure on water resources is imposed by non-native plants, both terrestrial (e.g. *Pinus*, *Acacia* and *Eucalyptus* species that have escaped from commercial cultivation) and aquatic (e.g. water hyacinth [*Eichhornia crassipes*], also a threat to the African Great Lakes) biomes (Chamier *et al.* 2012). In 1995, the South African Government established the Working for Water (WfW) programme to clear invasive species from environmentally degraded water catchments and address social equity issues and unemployment among low-skilled people. WfW focussed mainly on rural women, youth and people with disabilities, by providing them with employment opportunities associated with the removal and control of invasive plants (McQueen, Noemdoe and Jezile 2001). WfW provides one of the longest-running examples of the PES approach linked to employment generation.

Table 13.4: Summary of assessment criteria: Working for Water case study

Criterion	Description	References
Success or failure	The aims of the WfW programme were to enhance water security, improve ecological integrity and restore the productive potential of land, promote sustainable use of natural resources and invest in the most marginalized sectors of South African society. Today, over 3 million hectares have been cleared of alien species (30 per cent of the total affected area in South Africa), showing some success and promise for the future of the policy. Stream flows were increased, although benefits decline over time as vegetation regrows.	Barnes *et al*. 2007; Bonnardeaux 2012; Jarmain and Meijninger 2012; Le Maitre, Gush and Dzikiti 2015; Scott-Shaw, Everson and Clulow 2017
Independence of evaluation	Extensively evaluated in the peer-reviewed scientific literature	Hobbs 2004; Turpie, Marais and Blignaut 2008; Buch and Dixon 2009; Meijninger and Jarmain 2014
Key actors	WfW's framework comprises the following: ❖ Inter-ministerial Board (Cabinet ministers chaired by the Minister of Water Affairs and Forestry) ❖ Inter-departmental Steering Committee ❖ Provincial Steering Committees and Project Steering Committees of relevant stakeholders at local level	McQueen, Noemdoe and Jezile 2001
Baseline	The report 'Water for Growth and Development in South Africa, Version 6' was the baseline. It reported that 10.1 million hectares (6.8 per cent) of South Africa and Lesotho were invaded by alien plants in 1997, reducing mean annual water flow by 3.3 billion m^3 and resulting in wastage of about 7 per cent of South Africa's water annually.	Barnes *et al*. 2007
Time frame	WfW has been operational for over two decades. Measurable ecosystem gains were reported in the few years immediately following implementation.	
Constraining factors	The short-term employment and low wage provided by WfW has been suggested as providing only a temporary solution to the chronic problems of unemployment and the skills gap in South Africa.	Buch and Dixon 2009
Enabling factors	Effective legislation used in the programme includes the Agricultural Pests Act, Conservation of Agricultural Resources Act, National Environmental Management Act, Environment Conservation Act, National Water Act, and National Veld and Forest Fire Act. WfW maintains a research unit as part of its commitment to the management of invasive alien plants.	Venter 2005
Cost-effectiveness	There have been several cost–benefit analyses, with differing results, but overall leaning towards this being a cost-effective policy. An important aspect is the high cost of doing nothing. In 1998, the South African Department of Environmental Affairs estimated the cost of controlling invasive plants at R600 million (US$100 million) a year over 20 years but indicated that this could double within 15 years if appropriate action is not taken.	South African National Biodiversity Institute 2008; Turpie, Marais and Blignaut 2008; South Africa, Department of Environmental Affairs 2010; South Africa, Department of Water Affairs [DWAF] 2010a; DWAF 2010b; McConnachie *et al*. 2012; van Wilgen *et al*. 2012
Equity	Landowners clearing invasive species through the WfW programme were eligible for tax breaks. The employees clearing invasive species from the landscape (mostly women and disadvantaged people) benefit the most.	Turpie, Marais and Blignaut 2008; Buch and Dixon 2009
Co-benefits	WfW provides more than 20,000 temporary jobs each year for the most marginalized people who might not have access to any other employment (52 per cent of beneficiaries are women), educates and trains unskilled labourers and assists in community development programmes (http://www.dwaf.gov.za/wfw/). With a particular emphasis on HIV/AIDS, WfW aimed to provide support for those with a positive diagnosis, and education and training to reduce the risk of transmission.	Magadlela and Mdzeke 2004
Transboundary issues	Not applicable	
Possible improvements	Recommendations include: a) robust ecological indicators to evaluate: (i) the extent of the area treated; (ii) the reduction in the degree of invasion; (iii) the impact on water resources; and (iv) the rate of ecosystem recovery (Levendal *et al*. 2008); and b) further integration of social development more fully with the programme's environmental goals.	Levendal *et al*. 2008

When implemented well, EIPs allow cross-sector integration (e.g. facilitating women's empowerment by controlling invasive species, as shown in the WfW case study), greater stakeholder engagement and multi-level governance. However, a drawback of EIPs stems from the assumption that financial incentives alone will influence the actors to change their behaviour towards a pro-conservation stance. This assumption may lead to further questions on the sustainability of such policies when funding is exhausted. Finding the correct financial tipping point to prevent biodiversity loss and improve human well-being (e.g. correct level of compensation) by matching projected opportunity costs may be challenging. Cost-effectiveness analysis can help find the optimal solution when multiple conservation interventions are possible (Bryan 2010). A further gap in the implementation of EIPs lies in the treatment of landowners as independent and individual decision makers (e.g. in the Finnish 'Nature Values Trading' PES experiment) (Paloniemi and Vilja 2009). However, landowners may be influenced by professional advisers and a range of group-based factors in their decision-making (Mukherjee *et al.* 2016). In addition, the focus should remain on biodiversity conservation rather than simply the benefits derived from it.

Considerable progress has been made in the last couple of years towards mainstreaming the value of nature (e.g. IPBES 2016). A cautionary note though would be to retain the focus on biodiversity. The essence of biodiversity conservation should not be lost in the enthusiasm to value its benefits and services since biodiversity underpins all the services (see **Figure 13.4** below from Kusmanoff 2017, which shows that while the use of economic language has risen, the use of the term 'biodiversity' has declined in Australia).

Figure 13.4: Usage of the terms containing 'biodiversity', 'econo' and 'ecosystem services' over time in Australian Government environment portfolio media releases (n= 3,553). Error bars indicate 95 per cent confidence intervals based on the ecosystem services framing subsample (n = 516)
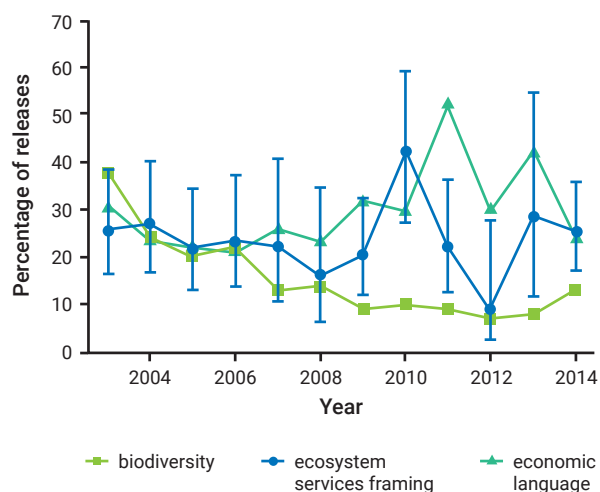
Source: Kusmanoff (2017)

13.2.4 Supporting investment: Banking of genetic material

Currently only a tiny fraction (~0.002 per cent) of global GDP is invested in the conservation of biodiversity (Sumaila *et al.* 2017). Yet sustaining natural capital by meeting the 2020 Aichi Biodiversity Targets would provide monetary and non-monetary gains that far outweigh the costs of achieving these goals (Sumaila *et al.* 2017).

Though progress is slow, some governments are warming to the cause. For example, the New South Wales Government in Australia has set up a Biodiversity Conservation Trust to deliver a comprehensive conservation programme on private land in its 2017-2037 strategy (New South Wales, Office for Environment and Heritage 2017). Government investment of A\$240 million over five years, with A\$70 million in ongoing annual funding, has been earmarked for this project targeting private landholders.

The EU has estimated that the cost of managing the Natura 2000 sites, its protected area network, would amount to €5.8 billion annually, while the benefits range from €200 billion to €300 billion annually and could create 180,000 jobs (Bourguignon 2015). EU LIFE funding (the Financial Instrument for the Environment), launched in 1992, and its successor LIFE+ have co-financed site management, capacity-building, and species action plans. Between 2014 and 2020, €2.6 billion has been earmarked under LIFE for environmental protection, half of which is for nature and biodiversity conservation (Bourguignon 2015). The United Kingdom of Great Britain and Northern Ireland Government recently announced that it would set up a Green Business Council to support environmental entrepreneurialism in its 25-year Environment Plan (United Kingdom [UK], Department for Environment, Food and Rural Affairs 2018, p. 150). The United Kingdom of Great Britain and Northern Ireland also plans to create a Natural Environment Impact Fund to issue a variety of loans and grants at submarket rates that could be repaid on a long-term basis. This is aimed at addressing potential market failures that might have limited the uptake of return-generating natural environment projects in the past (UK Department for Environment, Food and Rural Affairs 2018, p. 149).

Sources of financing for investment in biodiversity can come from multiple sources (SCBD 2012), including core national biodiversity funding sources, national government financing, international flows of Official Development Assistance and multilateral funding. In addition, tax breaks for green infrastructure, conservation agreements, carbon offsets, green fiscal policies and green bonds, as well as private- and third-sector investment are also in the toolkit available to policymakers to support investment in biodiversity conservation.

The Green Bond principles of 2016 explicitly recognize biodiversity conservation as one of the categories eligible for funding (GreenInvest 2017). Green Bonds are one of the fastest growing fixed-income market segments, with US\$81 billion in 2016. These Green Bonds could be used strategically by governments and corporations to tap international capital to support investment in biodiversity conservation (GreenInvest 2017). Green Bonds could also provide a platform for interactions between financial and investment policymaking,

which are often institutionally separate in some countries (GreenInvest 2017, p. 40).

An innovative example of supporting investment is the Svalbard Global Seed Vault (SGSV), which is a gene bank representing the largest collection of crop diversity in the world. Within the DPSIR framework (see Section 1.6), this serves as a policy response focused on *ex situ* conservation of seeds to improve the status of plant species important for food and agriculture.

Case study: Svalbard Global Seed Vault
FAO estimates that 75 per cent of plant genetic diversity was lost in the last century (FAO 2010). A primary form of conservation for plant genetic material is *ex situ* in the form of gene banks (currently over 1,750 worldwide, collectively maintaining an estimated 7.4 million accessions) (FAO 2010).

The SGSV **(Figure 13.5)** was established in 2008 with the primary goal of providing a backup for plant genetic resources for food and agriculture. The priority is on preserving intraspecific diversity of crop species and crop wild relatives. The risks from natural disaster, war and the mismanagement of some national gene banks demand backup storage for globally important crops (Fowler 2008).

The construction was funded by the Norwegian Government at a cost of US$8.8 million (Hopkin 2008), and the operating costs for the SGSV are around US$300,000 annually, shared by the Norwegian Government and Global Crop Diversity Trust. The latter provides long-term grants from an endowment fund built by public and private donations.

Figure 13.5: The SGSV is located 100m inside a mountain on a remote island in the Svalbard archipelago, midway between mainland Norway and the North Pole, and the samples are stored at -18°C

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Supporting investment policies are urgently needed to complement CCPs, EIPs and enabling actors in stemming rates of biodiversity loss (see Section 6.5). Similar to EIPs, the supporting investment policies are also more flexible and adaptable in their approach. They also allow for unique and innovative solutions as shown in the SGSV case study. Foreign direct investment to developing tropical countries could be directed for biodiversity conservation through supporting investment policies, such as Green Bonds (GreenInvest 2017). Initiatives such as the SGSV are in line with Sustainable Development Goal (SDG) 16, as the outputs of such investments are accountable, transparent and inclusive. One concern, however, is the power structure inherent in the decision-making and implementation of supporting investment policies. Who invests and who benefits in the long term are key questions to be asked in *ex ante* analysis of such policies.

In terms of wider biodiversity conservation, the SGSV is a backup, and it does not seek to maintain the traditional knowledge for harvesting crops that could be lost as agriculture evolves, whereas *in situ* conservation could sustain these skills and also allow species to adapt to changes in their environment. *Ex situ* conservation also faces the issue of genetic erosion (van de Wouw *et al.* 2010), whereby the seeds being conserved may not be viable in perpetuity. Protection of genetic resources requires a range of actors to be involved, as there are political, ethical and technical challenges to be overcome in the conservation of crop genetic resources (Esquinas-Alcázar 2005).

In addition, the contribution of biodiversity to food security needs to be mainstreamed. The Ecosystem Based Adaptation for Food Security (EBAFOSA) initiative was launched in 2015. It aims to reconcile the sustainable management of ecosystems (including the conservation of biodiversity) with adaptations to climate change to ensure food security in Africa.[2]

13.2.5 Enabling actors: Strategic environmental planning

The enhancement of the quality of urban environments for ecological and social benefits is becoming widely accepted as a critical component of urban planning. The United Nations General Assembly (A/71/266 of 1 August 2016) has discussed the 'Mother Earth' concept under 'harmony with Nature', seeking to inspire citizens and societies and change the way they interact with the natural world. This links closely to the concept of green infrastructure, green spaces and the recognition of the vital connections between the ecosystem services and biodiversity. These include benefits linked to water quality, flood attenuation, improved air quality, physical and mental health and noise reduction, all of which are important in reducing problems posed by urban living (Carrus *et al.* 2015; Ürge-Vorsatz *et al.* 2018) and in contributing to climate change mitigation and adaptation (Rosenzweig *et al.* 2018). Biodiversity's role in cities has also been recognized by other international forums, such as the Intergovernmental Panel on Climate Change (IPCC) cities conference in March 2018; experiencing biodiversity has been proven to improve life quality, human health and environmental consciousness in urban areas (WHO and SCBD 2015; Ürge-Vorsatz *et al.* 2018).

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2 https://www.ebafosa.org

Table 13.5: Summary of assessment criteria: Svalbard Global Seed Vault case study

Criterion	Description	References
Success or failure	The target is to hold 4.5 million varieties of crops, with each variety having 500 seeds on average (a total of 2.5 billion seeds). In the first five years of operation, 53 of the world's gene banks had deposited a substantial part of their collections, and the vault currently contains over 960,000 samples.	Westengen, Jeppson and Guarino 2013; Asdal 2018
Independence of evaluation	The formal assessment was published in a peer-reviewed journal.	Westengen, Jeppson and Guarino 2013; Asdal 2018
Key actors	Actors include the FAO Commission on Plant Genetic Resources, the Norwegian Government, the Nordic Genetic Resource Centre, the Global Crop Diversity Trust and the International Advisory Council (technical and policy experts representing FAO, national gene banks, the Consultative Group on International Agricultural Research and the International Treaty on Plant Genetic Resources for Food and Agriculture).	Westengen, Jeppson and Guarino 2013; Asdal 2018
Baseline	Five benchmarks assessed the duplication covered by the collection in the SGSV. This assessment aimed to quantify how far the SGSV is away from its target of duplicating all the distinct accessions (unique sample of seeds) of plant genetic resources for food and agriculture conserved as orthodox seeds (those that can survive drying or freezing) globally.	Westengen, Jeppson and Guarino 2013; Asdal 2018
Time frame	The vault theoretically has a permanent lifetime. Currently, there are a third of globally distinct accessions of 156 crop genera.	Westengen, Jeppson and Guarino 2013; Asdal 2018
Constraining factors	The willingness of countries to sign up (e.g. China and Japan) was identified as a constraint, although new seed samples were deposited from countries including India, Peru and Kenya in 2018. Changes in climate could be seen as a future constraint to the facility.	
Enabling factors	Signing of the International Treaty on Plant Genetic Resources for Food and Agriculture; permafrost offers natural freezing in case the cooling equipment breaks down; geopolitical stability and a supportive local government (military activity is prohibited under the International Treaty of Svalbard)	
Cost-effectiveness	None conducted so far	
Equity	Currently, plants for traditional use and their cultivation practices are not prioritized, and they might also be vulnerable to loss. The Global Crop Diversity Trust provides funding for developing countries to assist in the logistics of transporting accessions to the SGSV.	Eastwood et al. 2015
Co-benefits	The SGSV has helped raise public awareness (particularly promoted by the media) of the importance of conserving genetic diversity—especially plants—for future food security.	Friel and Ford 2015; Westengen, Jeppson and Guarino 2013
Transboundary issues	The SGSV's Standard Deposit Agreement ensures that the legal ownership of accessions cannot be transferred and that accessions can only be returned to the gene banks that originally supplied them.	Westengen, Jeppson and Guarino 2013
Possible improvements	1) Gaps in accessions from other gene banks which have no backup collection. 2) The importance of in situ conservation to complement ex situ approaches has also been highlighted, as stored genetic material is evolutionarily static and cannot adapt to changes in climate and habitat. 3) Another form of ex situ conservation—DNA banks—could be a complementary approach to plant genetic conservation.	Dulloo 2015; Hopkin 2008; Hodkinson et al. 2007

Engaging communities in effective land use and management of natural ecosystems in urban areas can be beneficial to both residents and biodiversity and promote inclusive city governance. The involvement of different stakeholders at different scales and partnerships between experts from various disciplines (e.g. ecologists, urban designers, landscape architects) is also considered important for biodiversity conservation (Felson and Pickett 2005; Colding 2007). Progress is measurable: for example, the City Biodiversity Index, which "provides a monitoring tool to assist local authorities to evaluate their progress in urban biodiversity conservation, which can be further included in national reports" (CBD 2014).

Various institutional arrangements and approaches take into account the importance of biodiversity in green areas. For example, in Italy health and well-being aspects (Carrus *et al.* 2015), in Brazil restoring Atlantic Forest in urban areas through municipal plans (Sansevero *et al.* 2017), and in Finland preservation of ecosystem services (Niemelä *et al.* 2010) are considered. Mainstreaming biodiversity requires the integration of biodiversity and environmental components and norms into sectoral policies, enabling stakeholders' involvement. Within the DPSIR framework (Section 1.6), mainstreaming is a response made by a group of actors to address pressures and drivers such as habitat loss and fragmentation and human population pressure (Section 2.2). The Edmonton Natural Area System Policy shows how to engage local actors to mainstream biodiversity into the urban environment.

Case study: Edmonton Natural Area Systems Policy

The City of Edmonton has made biodiversity protection a priority by integrating biodiversity considerations into urban planning. In 2006 it approved its Environmental Policy to promote the development of environmentally sustainable communities. In 2007, the city approved its Natural Area

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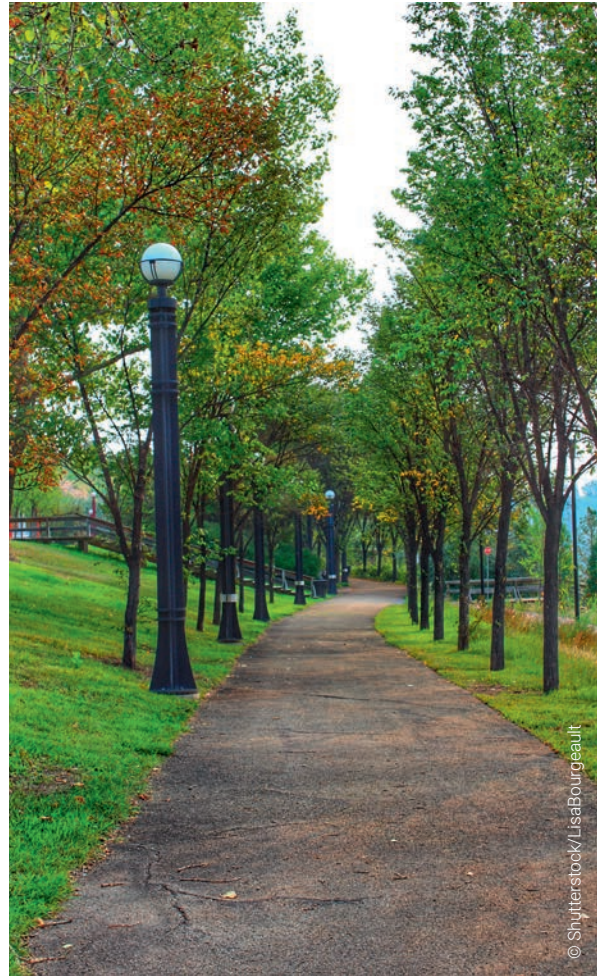
Figure 13.6: The City of Edmonton: the River Valley park system along the North Saskatchewan River as seen from downtown Edmonton

© Carol Zastavniouk

Systems Policy with a clear goal to "conserve, protect, and restore Edmonton's biodiversity, and to balance ecological and environmental considerations with economic and social considerations in its decision-making". As an outcome of this policy, a strategic plan emerged for the conservation and restoration of Edmonton's natural systems and the biodiversity they contain **(Figure 13.6).**

Enabling actors and institutional arrangements in local and urban biodiversity conservation has been proven in certain cases to be successful when governments collaborate across different levels to enhance the quality of urban environments for ecological and social benefits. Extensive stakeholder participation on environmental management "may seem very risky, but there is growing evidence that if well designed, these perceived risks may be well worth taking" (Reed 2008). However, fiscal and budget prioritization remain serious challenges for the public administration.

The Edmonton case study illustrates a successful implementation of the Protected Areas System Policy, securing 110ha/year of priority natural areas. Although Edmonton's Ecological Footprint has decreased, it is still 7.45ha per capita, far above the global average of 2.71ha per capita, and 4.5ha per capita higher than the sustainability indicator of global capacity; this is largely driven by consumption of resources from outside city boundaries.

Criterion	Description	References
Success or failure	The Edmonton 'Report on the Environment 2015' includes several ecological indicators, including naturalization of turf, priority natural areas secured, land secured for natural areas and wetland expansion, and the number of trees managed and cared for by the City Council. Time series data indicate that most indices show positive trends, with increases in the number of trees maintained by the city, land secured for natural areas and reconstructed wetland.	
Independence of evaluation	Policy success has been self-assessed with oversight from a City Environmental Management Steering Committee.	
Key actors	Key actors include the Edmonton City Council and the departments responsible for initiating best practices for biodiversity protection. The Office of Natural Areas coordinates the city's corporate strategic efforts to protect the network. Local communities participate in programmes such as the Master Naturalist, which exchanges knowledge and education for volunteering for stewardship of the natural areas within the city, monitoring of invasive species via citizen science, and participation in governance of a not-for-profit land trust.	
Baseline	The findings of the City of Edmonton's 2006 'State of Natural Areas' report revealed that its business-as-usual land use would result, over time, in the loss of more than half the area of existing natural systems in Edmonton's tablelands.	City of Edmonton 2009
Time frame	'The Way We Green Vision: 2040' set out the City of Edmonton's 30-year environmental strategic plan, with an emphasis on resilience and sustainability, and defined 12 goals that need to be reached for Edmonton to achieve a sustainable and resilient future.	
Constraining factors	The city continues to experience significant losses of natural areas as new residents move to Edmonton in unprecedented numbers. Responses to this have been the purchase by the city of valuable lands to protect them from development pressures (see below).	City of Edmonton 2009
Enabling factors	Leadership within the City Council seems to be strong and sustained in driving through both policy and implementation. Edmonton's City Council authorized a Can$20 million fund allocation and permit borrowing land trust for the acquisition of forests and wetlands in new neighbourhoods and, as part of a separate initiative, a Can$1 million per year agreement to purchase wetlands. A strong international profile and reputation may also help in continuing to focus attention on sustaining successes.	City of Edmonton, 2009; Local Governments for Sustainability 2013
Cost-effectiveness	The City of Edmonton evaluated the environmental effects, value and structure of Edmonton's urban forest, considering three ecosystem services: cleansing the air; sequestering carbon; and reducing storm water. The average benefit per tree in Edmonton's urban forest was US$74.73, whereas the cost of caring for each tree is US$18.38.	City of Edmonton 2009
Equity	The project has contributed to the social integration of immigrants into the life of the city. Land developers have to comply with environmental regulations, and new suburban areas are designed with new green spaces, natural areas and parks for the benefit of communities. However, the increase in the value of land means that buying land for conservation purposes is prohibitively costly for the City trust, especially because landowners are more reluctant to sell.	
Co-benefits	Increasing green spaces in urban settings provides additional benefits, including reducing stress, crime and violence and increasing neighbourhood social cohesion. They support a range of benefits associated with psychological, cognitive and physiological health (WHO and SCBD 2015). There are some indications of increased opportunities for renewable energy businesses (Alberta Canada 2017).	Maas *et al.* 2009; Garvin, Cannuscio and Branas 2013; Roe *et al.* 2013
Transboundary issues	None identified or recorded in reviewing the progress reports	
Possible improvements	Some long-term tracking of a wider range of social as well as environmental benefits would be useful, as would a more formal evaluation by independent peers. There is also a need to incorporate the trade-offs, such as increased land costs, and conflicts between priorities in a city with a population that has increased over the last 25 years.	

13.3 Indicators: Biodiversity policy

Policy-sensitive indicators provide an interesting way to understand policy implementation (see Chapter 10). Both IPBES and CBD have produced global assessments using a wide variety of indicators; for example, Global Biodiversity Outlook-4 used 55 biodiversity indicators (SCBD 2014; Tittensor *et al*. 2014). For the purposes of the sixth Global Environment Outlook (GEO-6), three global indicators were selected based on their linkages with the SDGs, national disaggregation and continuity with previous GEOs **(see Table 13.7).**

Currently, there is a lack of indicators which can adequately capture the links between biodiversity and human health, though ways to improve biodiversity health indicators have been described previously (Huynen, Martens and De Groot 2004; Hough 2014; Sandifer, Sutton-Grier and Ward 2015).

Table 13.7: Policy-sensitive indicators

Indicator	Rationale for selection	Addressed in Part A	Addressed in the case studies	Connection with the SDGs or MEAs	Data sources
1) Proportion of countries adopting relevant national legislation and adequately resourcing the prevention or control of invasive alien species	Links to the Convention on Biological Diversity as an indicator for Aichi Biodiversity Target 9. Indicator is policy-responsive and relevant and was designed as a response indicator. It was used in the fifth Global Environment Outlook (GEO-5) and is a confirmed SDG indicator.	**Yes:** invasive species are dealt with as one of the five main pressures on biodiversity (Section 6.4.2).	**Yes:** invasives are the subject of the WfW case study from South Africa (Section 13.2.3), which uses PES as a means of tackling invasives.	**Aichi Biodiversity Target 9.** This is also the indicator for SDG Target 15.8.	IUCN, IUCN SSC, IUCN ISSG, Monash University; bipindicators.net for factsheets, graphs, meta-data
2) Red List Index (impacts of utilization)	Links to CBD as an indicator for Aichi Biodiversity Target 4. This is a response indicator. It was used in GEO-5 and is relevant to the SDGs. It has global coverage, can be disaggregated, is a quantitative measure based on scientific assessment and has a long data series. Red List (impacts of utilization) was also chosen to demonstrate the degree to which species of direct relevance to human livelihoods and culture are responding to measures to ensure their sustainable use over time.	**Yes:** subsets of the Red List are used throughout Chapter 6, particularly in Section 6.5 in species section. The Red List Index is the leading global source on species extinction status.	No	**Aichi Biodiversity Target 4**. Also related to Aichi Targets 3, 6, 7 and 12. Relates to SDGs 8.4, 12.2, 14 and 15.	IUCN Red List Index bipindicators.net for factsheets, graphs, meta-data
3) Global Ecological Footprint	Links to CBD as an indicator for Aichi Biodiversity Target 4. The indicator tracks pressures. It was used in GEO-5 and is relevant to the SDGs. It is global, based on a long data series and can be disaggregated. This indicator was chosen because an increase in a nation's Ecological Footprint would mean an increase in its population's pressure on biodiversity and an increased risk of biodiversity loss.	**Yes:** in Section 6.4.1, as a leading driver of biodiversity loss.	**Yes**: the Ecological Footprint of Edmonton is quoted in the policy effectiveness assessment Section 13.2.5.	**Aichi Biodiversity Target 4**. Related to SDG targets 8.4 and 12.2.	Global Footprint Network bipindicators.net for factsheets, graphs, meta-data

13.3.1 Indicator 1: Proportion of countries adopting relevant national legislation and adequately resourcing the prevention or control of invasive alien species (SDG Indicator 15.8.1)

Invasive alien species (IAS) may threaten local biodiversity through direct and indirect competition, predation and habitat degradation, and as disease agents and vectors (Pejchar and Mooney 2009; Strayer 2010). They are considered the second greatest threat to biodiversity after land-use change and habitat loss (Section 6.4.2) (Wilcove *et al.* 1998; Bellard, Cassey and Blackburn 2016).

This indicator evaluates the "trends in policy responses, legislation and management plans to control and prevent spread of invasive alien species" (species that have been introduced to an area and have spread beyond the area of introduction) and the "proportion of countries adopting relevant national legislation and adequately resourcing the prevention or control of invasive alien species" (see methodology in Biodiversity Indicators Partnership 2018a) (**Figure 13.7** and **Figure 13.8)**.

Policy relevance
This indicator directly tracks progress towards global multilateral environmental agreements, and in particular Target 9 of the Aichi Biodiversity Targets. It is also relevant to Aichi Targets 5, 11, 12 and 17 and Goal 15 (Target 15.8) of the SDGs ('Life on Land') (UNEP 2015).

Figure 13.7: Trends in national legislation relevant to the prevention or control of invasive alien species (IAS) for 196 countries reporting to the Convention on Biological Diversity (1967–2016), showing specifically the percentage of countries having a combination of: (i) IAS legislation; (ii) NBSAP targets on IAS; and (iii) IAS targets aligned with Aichi Target 9
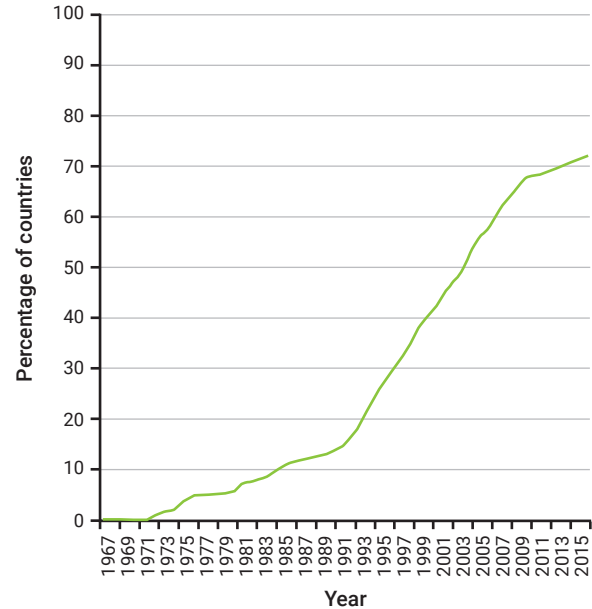
Source: Biodiversity Indicators Partnership (2018a). Partners: IUCN, IUCN Species Survival Commission and IUCN Invasive Species Specialist Group, Monash University

Figure 13.8: Percentage of countries whose institutions have a clear mandate and/or legal authority to manage IAS (a positive result is given by a Yes and is included in the overall percentage)
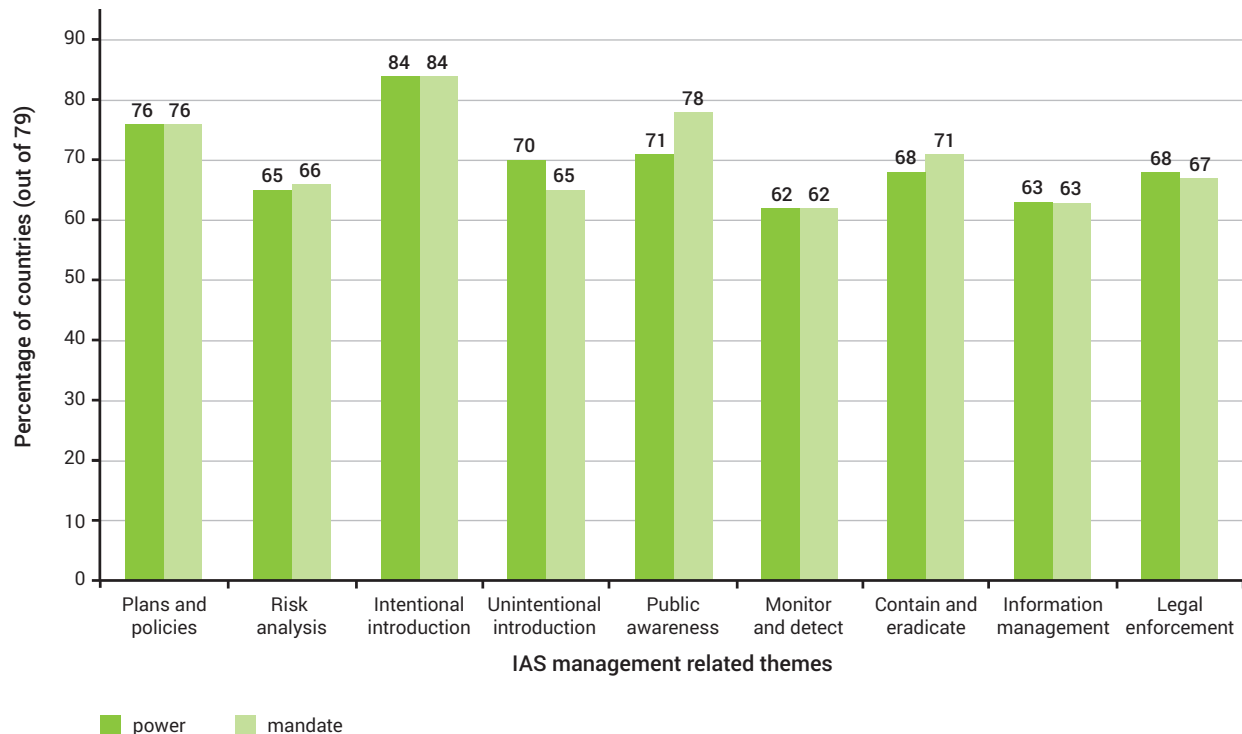
Source: Biodiversity Indicators Partnership (2018a). Partners: IUCN, IUCN Species Survival Commission and IUCN Invasive Species Specialist Group, Monash University

Causal relations

As more multilateral international agreements relevant to IAS are introduced (such as the Cartagena Protocol, the International Plant Protection Convention and the Agreement on Sanitary and Phytosanitary Measures of the World Trade Organization), the level of national commitment to related policies increases. This, in turn, reflects a greater global commitment to controlling IAS (Biodiversity Indicators Partnership 2018a). Those countries that are party to the CBD have agreed to Aichi Target 17, and policies related to the control of IAS should be addressed in their NBSAPs. This is an example of an international policy trigger and a top-down approach leading to the creation of national IAS regulations. A bottom-up causal relation (the creation of an IAS policy due to an increase in IAS within a country) is more difficult to demonstrate.

Within national IAS-relevant policies, governments may use several policy instruments to reduce IAS. These responses can be quite varied and specific. The WfW programme in South Africa (Section 13.2.3) uses PES to encourage the removal of IAS from waterways by giving monetary incentives to local communities (Buch and Dixon 2009). Other nations may use CCPs, such as the United Kingdom of Great Britain and Northern Ireland plant health policy that imposes strict regulations on and certifications for the import and moving of certain plants, seeds, organic matter and plant products to prevent the introduction and spread of harmful plant pathogens (UK Department for Environmental and Rural Affairs 2014), as well as Australia's well-developed strategic plan (Australia, Invasive Species Council 2015). In addition, island nations may have stronger IAS policies, reflecting a higher presence of endemic species, and ports can be subjected to stronger regulation, such as the recent international Ships Ballast Water and Sediments policy (International Maritime Organization 2017).

Other international and national policies may influence this indicator, especially trade policies. As globalization progresses and international commerce creates new trade routes and markets, new opportunities are created for alien species to establish themselves in new areas (Meyerson and Mooney 2007; Seebens et al. 2015). A direct positive link has been shown between the degree of international trade by a nation and the number of IAS (Westphal et al. 2008; Hulme 2009; Liebhold et al. 2012; Brockerhoff et al. 2014).

Other factors

Climate change, especially in colder regions, poses an IAS risk, as it may lower the barrier to establishment by creating new niche space (Wolkovich et al. 2013; Duffy et al. 2017). Emerging economies with increasing economic development in tourism, the exotic pet trade and infrastructure projects are also at greater risk of IAS (Hulme 2015).

13.3.2 Indicator 2: Red List Index (impacts of utilization)

Humans depend on biodiversity and the use of wildlife in a range of different ways (e.g. hunting, trapping and collecting wild birds for food, sport or feathers). The Red List Index (RLI) (impacts of utilization) shows trends in the status of mammals, amphibians and birds driven by two factors: the negative impacts of utilization (i.e. the use of wildlife leading to a decrease in status) or the positive impacts of measures taken (i.e. controlling or managing the utilization of wildlife

Figure 13.9: The Red List Index (RLI) for 1980−2017 for mammals, birds and amphibians, showing the trends driven only by utilization (by only including utilized species)
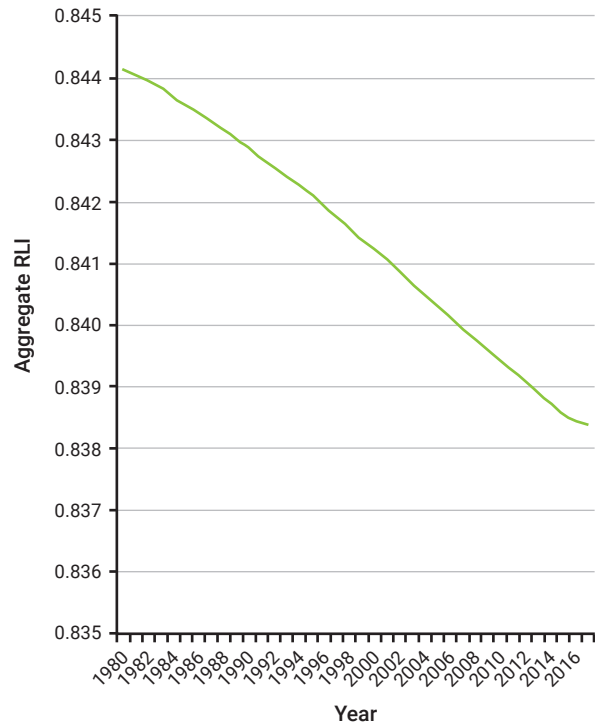
Source: Biodiversity Indicators Partnership (2018b). Partners: Birdlife International, Kew Gardens, ZSL, IUCN

towards sustainability) (Biodiversity Indicators Partnership 2018b, see Section 6.5.2). **Figure 13.9** shows the RLI (impacts of utilization) for birds, mammals and amphibians from 1980 to 2017.

Scope and measurement

The indicator is determined from species-level data which may be analysed on several scales (country, region and/or global). The IUCN Red List assigns species to seven categories of relative extinction risk (Extinct to Least Concern, or 'Data Deficient' for poorly known species). This is done using quantitative criteria for species based on population size, area of distribution and rate of decline (Bubb et al. 2009). In the 2012 update, the IUCN Red List included assessments for 63,837 species, of which 19,817 were threatened with extinction (SCBD and IUCN 2018). An RLI of 1 means all species in that group are categorized as Least Concern, while an RLI of 0 means that all species in the group are Extinct (Bubb et al. 2009). Currently, an RLI can be calculated for birds, mammals, amphibians, corals and gymnosperms. To assess taxonomic groups that are poorly known and/or have a very large number of species, a sampling approach was developed in which 1,500 species are randomly chosen and assumed to represent the larger group (Baillie et al. 2008).

For the RLI (impacts of utilization), only species that are utilized by humans (as pets, for food, medicine, materials or other uses) are included. Utilization categories are defined by the IUCN Use and Trade Classification Scheme (version 3.2) (IUCN

2006; Almond *et al.* 2013). The resulting trend can be used to indicate the degree to which consumption is sustainable and the impact of natural resource use is within safe ecological limits. A declining trend indicates that current utilization is unsustainable (negative impact of utilization), while an upward trend means that human use of this group of species is sustainable (positive impact of utilization through measures to control or manage sustainably) (Birdlife International 2012).

Policy relevance

The RLI (impacts of utilization) is directly related to Target 4 of the Aichi Biodiversity Targets. It is also directly related to several targets within SDGs 8, 12, 14 and 15 (Biodiversity Indicators Partnership 2018b; UNEP 2015).

Causal relations

Policies that limit the utilization or promote sustainable management of species have the potential to directly impact this indicator, though there is little to no published literature demonstrating policy effectiveness. The lack of evidence for policy impact may be partly because the average time for species status to improve by one Red List category is 16 years (Young *et al.* 2014). However, this indicator should be sensitive to economic changes or policies that increase or decrease the price of a species-derived product. For example, a higher market price creates an incentive for greater use of a species by the manufacturer or hunter and, therefore, can put that group of species at greater risk of extinction, reflected in a lower RLI (Ayling 2013). It has been shown that CCPs, such as CITES international trade bans and regulations on poaching products from endangered species, can fail when there are strong economic incentives to continue poaching (Rivalan *et al.* 2007; Conrad 2012). Policies that instead focus on incentivizing and building capacity within communities to sustainably manage wildlife (e.g. as showcased in the Project Predator case study, Section 13.2.2) can decrease the long-term use of and demand for species (Challender and MacMillan 2014), effectively increasing the RLI (impact of utilization). Similarly, modelling has shown that more effective management of protected areas (i.e. design of protected areas, adequacy and appropriateness of management, delivery of objectives; SCBD 2018c) can have a greater positive impact on the RLI than only expanding protected areas (Costelloe *et al.* 2016).

Other factors

Other factors include cultural and marketplace trends, such as people not buying items of clothing made using animals (fur, leather, feather down) and the increase in vegetarian/vegan diets in Western countries (Newport 2012; Saner 2016). Both these trends can result in a decrease in the use of species, and an increase in the RLI. Advocacy groups and consumer policies that push for decreases in the use of threatened species play a large role in marketplace trends; for example, consumer awareness campaigns, an increase in the number of organizations certifying environmental sustainability, and government restrictions have combined to dramatically reduce the consumption of shark fins in China in recent years (Fabinyi 2016).

Caveats

Empirical data supporting policy effectiveness remain scarce. One study showed that the efforts of a local conservation trust resulted in improving the status of a small set of 17 threatened vertebrate species in Brazil, India, Madagascar, Mauritius and

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Spain (Young *et al.* 2014). However, other studies have shown that the RLI has the potential to exhibit a shifting baseline over the long term. This is because the Red List measures declines in abundance over species-specific time frames, so if populations stabilize, a species may return to a low-risk category despite being at very low population levels (Costelloe *et al.* 2016; Nicholson, Fulton and Collen 2017).

13.3.3 Indicator 3: Ecological footprint

The Ecological Footprint, or Ecological Footprint Accounting, "compares human demand on nature against biocapacity, or nature's supply" and capacity to regenerate (Rees and Wackernagel 1996). "Demand is measured by the biologically productive area a human population uses for producing the natural resources it consumes and absorbing its waste." Biocapacity is measured in surface area (Biodiversity Indicators Partnership 2018c). The Ecological Footprint is measured "by taking the amount of biologically productive land and water area, or biocapacity that is required to produce the food, fibre and renewable raw materials an individual, population or activity consumes". It also takes into account the materials needed to absorb carbon dioxide emissions generated (Global Footprint Network 2018). The Ecological Footprint uses an area-equivalent unit called global hectares (gha); 1 gha represents a biologically productive hectare with world average productivity (Galli 2015). The Ecological Footprint encompasses production and consumption, and each of these comprises the cropland, grazing, forest product, carbon and fish footprints, as well as built-up land (Global Footprint Network 2018). As a population's pressure on biodiversity grows, so does its Ecological Footprint (see Section 13.2.5 Edmonton case study). The world Ecological

Footprint by component (land type) between 1961 and 2013 is shown in **Figure 13.10**.

Policy relevance

The Ecological Footprint indicator is directly relevant to Target 4 of the Aichi Biodiversity Targets and to several targets within SDG 8 (8.4) and SDG 12 (12.2).

Causal relations

There have been many studies on Ecological Footprint Accounting and how it can guide policy creation (e.g. the global Ecological Footprint aiding in the recent adoption of a National Strategy for Sustainable Development in Montenegro (Galli 2015; Galli et al. 2018), but few empirical examples of how policy changes have affected the global or national Ecological Footprint. Any policies that reduce or promote sustainable management of resource consumption, land use or carbon emissions will lower the Ecological Footprint, while those policies that directly or indirectly promote increases in these parameters raise it. One study has found that economic globalization drives the Ecological Footprint of consumption, production, imports and exports, while social globalization increases the Ecological Footprint of imports and exports but lowers the Ecological Footprint of consumption and production (Rudolph and Figuree 2017).

Other factors

Other factors that can influence the Ecological Footprint are environmental events that change the biocapacity of a region (e.g. climate change causing a previously unproductive area to become productive or vice versa), technological advancements that increase the biocapacity of a region (e.g. heat-resistant genetically modified crops that increase the productivity of an area) or cultural consumer choices that increase or decrease resource consumption (e.g. opting for public transit, walking or biking instead of using motor vehicles).

Caveats

Although the Ecological Footprint has been widely embraced due to its clear depiction for policymakers of the overuse of ecosystem services (Galli 2015), it has also been criticized because it fails to track human-induced depletion of natural capital stocks. However, the methodology is actively being improved by the Global Footprint Network (Mancini et al. 2017).

13.4 Conclusions

It is well established that biodiversity is in a crisis and that existing policy and governance measures to conserve biodiversity have not been adequate (see Chapter 6, Executive Summary). This may be because policy responses may be insufficient to counteract the growth of drivers of loss (SCBD 2014).

Evidence suggests that inadequate economic incentives and investments in ensuring effective compliance and enforcement of legal instruments at the national level could lead to ineffective policies and governance (Ambalam 2014). A qualitative study assessing the United Nations Convention to Combat Desertification in Africa identified additional challenges, including a lack of adequate baseline data on desertification, poor monitoring mechanisms and ill-defined

Figure 13.10: The world Ecological Footprint by component (land type) between 1961 and 2013, measured by number of Earths
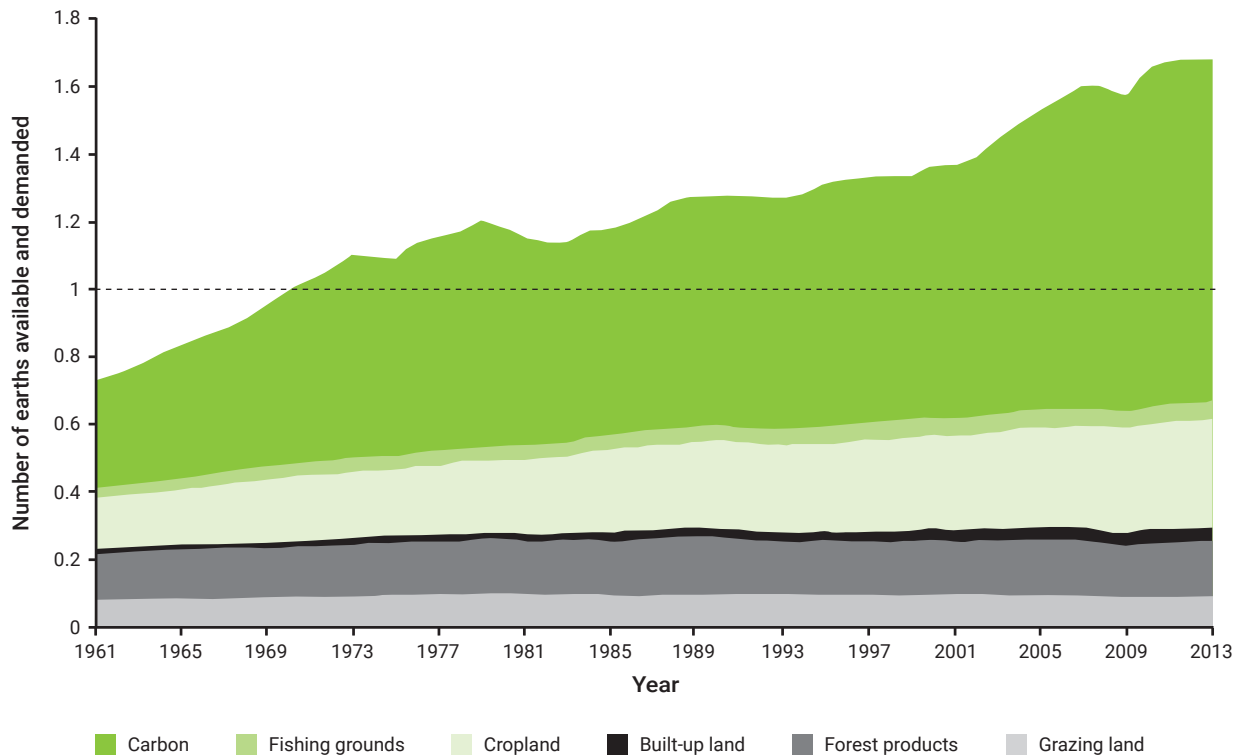
Source: Global Footprint Network (2018).

policy objectives, which hindered compliance (Ambalam 2014). An analysis of the Finnish NBSAP revealed how a range of different forms of responsibility (liability, accountability, responsiveness and care) in different policy sectors could be constructed by introducing new knowledge, providing better process design and building institutional networks (Sarkki *et al.* 2016). However, there remained a lack of intersectoral dialogue despite pro-biodiversity outcomes in other targeted policy sectors, and the responsibilities did not percolate from the environmental administration to other policy sectors. Addressing this cross-sectoral 'responsibility gap' remains a major challenge for effective environmental policies (Mukherjee *et al.* 2015; Sarkki *et al.* 2016). In addition, International Environmental Agreements, in particular, seldom go beyond business-as-usual outcomes

(Kellenberg and Levinson 2014). Diffuse language and the lack of quantitative or measurable goals in many International Environmental Agreements leave signatory countries' actions open to interpretation and prevent rigorous appraisal of their performance in improving the quality of ecosystems.

Biodiversity conservation policy is inherently multifaceted, and it is more vital than ever that a 'big picture' perspective emerges among practitioners and governments. Integrating climate, health and equity issues into efforts to mainstream biodiversity, and developing awareness across sectors of policy commitments, are key to the overall success of the SDGs. Many of the policy initiatives discussed in this chapter can serve as models for scaling up efforts to the global level with appropriate and sustained support from governments.

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