There are many concepts that emerge with the potential to change the way we think about environmental problems, helping to re-frame both the nature of the problem and possible solutions. Although in theory many of these ideas are sound and logical, translation into governance systems and management practices is slow and contested. As one of the many contested concepts in the Anthropocene, novel ecosystems offer an example of this problem of transferring theory into practice. And yet, it is in the very contested nature of novel ecosystems that a path towards reconciling this problem can be found. Much of what is contested in the novel ecosystem debates is actually about how we confront the drivers of transformation in social and ecological systems, and whether we need incremental or radical reform of governance to do so. Adaptation is an inherently political process, and struggles related to subjectivity, knowledge, and authority can open up or close down space for changing governance (Eriksen et al. 2015). This chapter builds on the previous discussion of expert perceptions and knowledge governance to explore how contested knowledge and ideas can influence adaptive capacity, paving the way for change (Domain 5). It uses the idea of ‘framing contests’ (Domain 1) to understand some of the new ways of framing both problems and
solutions—a process which can either be used to relabel old ideas and reinforce existing orthodoxies or be leveraged as an opportunity for transformation.

It is important to remember that adaptation can encompass both incremental and transformative changes, and it is worth briefly revisiting these concepts here. There is a large body of literature on how to leverage transformative change and foster transformative adaptation in governance and SESs (Chaffin et al. 2016; Wyborn et al. 2016a; Abson et al. 2017; Colloff et al. 2017, 2017; Andrachuk et al. 2018; Edmondson and Levy 2019; Plummer et al. 2020). Much of this literature is theoretical in origins. Although much of this theory has been built from empirical case studies, it is difficult to draw any firm conclusions about what these case studies have in common in terms of intentional efforts to reform governance, and whether transformation emerged from radical or a series of incremental reforms. We are also a long way from being able to tease out the effect of contextual conditions (e.g. favourable political climate) and the effect of intentional reform efforts. Still, as noted in Chap. 2, incremental change, if directed at aspects most in need of reform, can provide the scaffolding towards more transformative changes (Clement et al. 2015) or, to use another metaphor, provide the building blocks for transformation (Andrachuk et al. 2018). This may not be enough, however, so questions about the capacities needed for transformation when it is required need to be raised. It is certainly the case that incremental change is favoured in many cases because transformation is too difficult, and by the time it is clear that more radical change is required, it is often too late (Colloff et al. 2017). Researchers have used a number of metaphors, heuristics, and frameworks to help explain transformative change, including ideas about deep leverage points (Abson et al. 2017) and adaptation pathways (Colloff et al. 2017; McDonald et al. 2019). Yet even if we agree that transformation of governance—or at least of decision contexts—is what we need to deal with transformation of ecosystems, how to get there is still unclear.

Many of the most important levers for change have been identified, but these are big levers, for example, paradigms, norms, values, world-views, and the fundamental social and economic systems that shape our choices (Chaffin et al. 2016; Abson et al. 2017), and practical insights
into ways to push those levers are scant (Chap. 2). The previous chapters have examined, in various ways, the sets of values, rules, and knowledge that shape how decisions are made, which are thought to be central to either limiting or enabling transformation in governance (Gorddard et al. 2016; Wyborn et al. 2016b; Colloff et al. 2017). Focusing on values, rules, and knowledge can help diagnose constraints to adaptation by revealing the societal structures that influence decision processes, which then can be used to develop strategies and agency to overcome these impediments (Gorddard et al. 2016).

The previous chapters touched on ideas about how novel ecosystems and other non-traditional ideas about what counts as conservation can be controversial or dismissed if they conflict with prevailing rules, knowledge, and values. Many of the conflicts and tensions discussed so far are also about knowledge governance (Chap. 6). Experts often focus on the importance of managing knowledge, for example, the need for robust data, the challenges of uncertainty, and the wealth of as yet unknown scientific details. Institutional and policy impediments are also considered to be important, but separate. The concept of knowledge governance addresses how the broader social, cultural, and political aspects affect what knowledge is used, whose knowledge is used, and how that knowledge is adopted. It can be seen as the link between Domain 5 and the other domains, as it the layer between capacity and knowledge, and broader institutional rules and norms (Van Kerkhoff 2014). While the previous chapter explored individual expert preferences, this chapter explores how such preferences play out in the governance of knowledge, using two very different examples. The first focuses on the governance of wildfires to understand how debates between experts and competing frames intensify when ecological transformation is imminent. The second explores whether a relatively new concept, nature-based solutions, lives up to its promise that it can transform the way we solve environmental challenges, in part by placing ‘co-production’ and ‘co-design’ of knowledge front and centre.
Framing Contests and Transforming Ecosystems

There is fairly widespread agreement on the need for new objectives, metrics of success, and approaches to more effectively conserve biodiversity and meet the challenge of ecosystem transformation. For any of this to be achieved, there is a need to reach beyond experts and incorporate the diverse values, rules, and knowledge framings of multiple stakeholders (Colloff et al. 2017). We return, then, to the power of framing and reframing. Frames are not just communicative tools, but also central to organising thoughts and the ways in which we interpret facts, values, and meanings (Goffman 1974). Frames refer to the structures of meaning that can be found in any culture, but framing refers to the active social process of using frames to shape public debates (Hertog and McLeod 2001). In this sense, there are stable frames that shape the way we approach biodiversity conservation, but the active debates about novel ecosystems, cultural landscapes, climate adaptation, and so forth involve framing messages in a particular way to advocate for either change or the status quo. Earlier chapters talked about framing as a rhetorical tool that can be used to elevate certain aspects of a narrative (Chap. 1). The ways in which we frame problems and their resolutions reflect how we think and what we believe now, but there is also evidence that framing can be a powerful tool for reshaping the way we think about problems, solutions, and the dynamic social and ecological contexts in which decisions are made (Chap. 3). Changes in individual framings can also lead to collective changes to frames and narratives, but this must also be met with broader changes in governance if it is to be successful (Chap. 4).

The previous chapter raised questions about whether experts have conservative ways of approaching biodiversity conservation and a conservative approach to conservation. It is notable, however, that individual expert preferences exist within environments where they cannot always be expressed, and, in fact, may be actively suppressed (Clement et al. 2016). Even when they are not suppressed, they are still shaped by the organisational environments and contexts in which they work. Many experts are embedded in conservation organisations that have their own
ways of framing conservation, how it ‘should’ be practised, and what does (and does not) need to change. An expert who works in an organisation with a conservative culture of decision-making may express different preferences than they would in another decision-making context. Under conditions of uncertainty, actors within these organisations may engage in ‘framing contests’ which can either reinforce existing practice or be leveraged for change (Kaplan 2008). This is a useful model for understanding much of what is presented in this chapter as well as the important role that frames play as both constraints and resources for change (Domain 1). This idea of ‘framing contests’ reminds us that frames cannot just be deployed at will to ‘sell’ a particular perspective or action, but can come to dominate an organisation, and individuals who work in them often try to transform their own cognitive frames into one that is consistent with the operating environment in which they work (Kaplan 2008). This is why experts, policymakers, and others engaged in conservation may appear to operate using ‘groupthink’, but it is more complicated than that:

Where frames about a decision are not congruent, actors engage in framing practices in an attempt to make their frame resonate and mobilize action in their favour. These practices embody more or less skilful efforts to establish the legitimacy of their frames and of themselves as claimsmakers or to realign frames to influence how others see issues. These framing practices define what is at stake and thus are a means of transforming actors’ interests. If framing activities are successful, one particular frame will come to predominate as a guide to actors’ positions regarding a strategic choice. If these efforts are not successful, frame divergence can defer decisions. How these contests play out shapes the degree of continuity or change created through the strategy-making process. (Kaplan 2008, p. 730)

In other words, the ways in which preferred problems, solutions, and many other aspects of understanding environmental challenges are framed is a political process, even within expert communities and conservation organisations. Bear these dynamics in mind in reading the sections that follow, as it is clear that there are a great many framing contests at play, driven in part by the realities of climate change that are becoming increasingly difficult to ignore.
Fire and Transformation

Fire is an enduring aspect of the Earth, having been prominent as a natural driver of disturbance long before humans ever existed. Wildfire has shaped ecosystems over hundreds of millions of years, influencing both biological evolution and global biogeochemical cycles in the process (Bond and Keeley 2005; Bowman et al. 2011). Humans have also used fire as a deliberate land management tool for thousands of years and continue to do so, for example, to clear land for agriculture, to manage for particular species, and for hunting. It is difficult to overstate the important role of fire in shaping the landscape. One study suggested that if it were possible to ‘switch off fire’, then the world would be almost unrecognisable, with half the world covered in forest because many of the world’s grasslands and savannas would transform (Bond et al. 2005). Although it is challenging to calculate the global extent of fire, current estimates suggest around 400 million hectares (4 million square kilometres) of global land area burns every year, which is about the size of India and Pakistan combined. Most of this area is savannas and their transition zones to tropical rainforests, Mediterranean forest, central Asian grasslands, and boreal forests in Asia and North America (Chuvieco et al. 2019). Fire regimes\(^1\) not only shape the way landscapes look and are used, but they also play important roles in maintaining the health of some ecosystems, impacting nutrient cycling as well as the structure and function of vegetation, although this is highly variable across ecosystem types depending on the fire regime to which they are adapted. Fire is also a potential driver of ecosystem transformation over the longer term, especially as it interacts with other drivers of degradation and potentially due to the ways in which we manage landscapes for fire.

\(^1\)A fire regime refers to frequency, season, type, severity, and extent of fires in a landscape. It can also include fuel consumption and spread patterns (Bond and Keeley 2005).
Humans, Wildfire, and Biodiversity

As with many other environmental problems in the Anthropocene, not all of the fire that occurs each year is ‘natural’, and the frequency, intensity, extent, and pattern of wildfires are changing. There are many anthropogenic changes to landscapes—and management decisions—that have made them more flammable. The impacts of climate change are thought to be important, with weather and vegetation conditions that make landscapes more prone to fire, whether the source of ignition is natural (e.g. lightning) or a deliberate or accidental human source. Among the consequences of climate change are warmer temperatures and changes in rainfall patterns, including increased frequency of droughts, which are projected to significantly increase fire risk (IPCC 2014; Abatzoglou et al. 2019). Even before the Anthropocene, modelling of past fire regimes suggests that high temperatures and prolonged periods of low precipitation are thought to be the most influential drivers of wildfire extent (Bradshaw and Sykes 2014). It is difficult to tease out the effect of climate change from other drivers of wildfire risk, but it certainly establishes many of the conditions that increase fire risk—conditions that will all be exacerbated by climate change. It is perhaps no surprise, then, that we can expect more large, intense fires; longer fire seasons; and fire in areas not previously vulnerable to them as the climate gets warmer and drier in many areas of the world (Bowman et al. 2011; IPCC 2012). This is already happening. Fire risk is high in most inhabited parts of the world (World Bank n.d.), and there are signs we have already seen intensifications in the scale and destructive capacity of fire in these areas in the last few decades (c.f. Morton et al. 2013). Fire is also estimated to emit 8 billion tonnes of CO₂ a year (Van Der Werf et al. 2017). This has ripple effects for the biosphere and the atmosphere, although there are complicated feedbacks between fire and the climate systems that are as yet not entirely understood (IPCC 2012). There is some debate about how much fire contributes to greenhouse gas emissions because carbon can be sequestered when the vegetation grows back again (Van Der Werf et al. 2017). This is influenced by a number of variables, however, including the type of ecosystem and the time scale you are looking at, as recovery times vary across
ecosystems. Repeated intense, large-scale fires combined with other stressors can make recovery increasingly precarious (c.f. Hansen et al. 2018), and further climate and land use change means that what replaces a fire-affected ecosystem may not have the same carbon-sequestering potential.

Questions around the impact of fire on biodiversity values are just as complex. Climate change adds a further stressor to already stressed species and ecosystems (Chap. 6), which could make them less resilient and capable of recovering after a fire. While wildfire can provide beneficial biodiversity outcomes in some ecosystems, this is highly dependent on the fire regimes with which these systems co-evolved. Suppression can be problematic in some ecosystems, whilst it is necessary in other ecosystems. In simple terms, fire needs to be able to play its ‘natural’ role in an ecosystem so as not to threaten biodiversity values (Shlisky et al. 2007). Yet fire regimes are degraded in many areas across the world, due not just to climate but also other human factors. Changes in vegetation, flora and fauna dynamics, grazing regimes, human settlement patterns, and policy changes may all also exacerbate maladaptive fire regimes, potentially triggering transformative changes (Pausas and Keeley 2014). Urban development, agriculture, resource extraction, climate change, and inappropriate fire management practices (including too much or too little fire) are among the major threats to biodiversity from changing fire regimes (Shlisky et al. 2007).

To reduce wildfire risk, the received wisdom among many land management organisations in many places across the world is that you need to ‘take out the stuff that burns’ (Keenan 2020). This is usually realised through the use of prescribed burning and mechanical methods of controlling fuel load, with the assumption that existing practices will present hazards to communities and, if done correctly, promote higher biodiversity value. However, the scientific evidence is mixed and geographically variable for both risk reduction and biodiversity management, and can have opposite effects depending on the ecosystem (c.f. Pastro et al. 2011; Stephens et al. 2012; Zylstra 2018; Clarke et al. 2020). It is worth noting that there is a link here to cultural landscapes (Chap. 5), as abandonment of the land can dramatically change fire management—sometimes for the better, and sometimes for the worse. The loss of Aboriginal fire regimes in
Australia and replacement with European-style fire regimes is one very prominent example, where it has been argued that the transplantation of European ideas about burning into the Australian landscape has made it more flammable (Bowman 1998a, b; Bowman et al. 2004), demonstrating the very real impacts of cultural severance for both people and nature. The tensions between biodiversity conservation and risk-reduction practices have become increasingly evident over time, as we will see. They provide an illuminating case study around how evidence can be used strategically to tell stories that either reinforce the status quo in fire management or push towards establishment of a new dominant framing of what needs to be done to achieve biodiversity conservation, hazard reduction, and confront the challenges of climate change.

**Crisis—And Opportunity?**

The predicted increase in catastrophic bushfires is not just a scientific theory but has become a very public debate. This is because several countries have experienced record-breaking wildfire seasons in recent years, which have attracted global media attention that could be considered a window of opportunity. Fires can be truly transformative at a massive scale, and seeing such transformations can have a notable effect on public opinion about the ways in which ecosystems should be deliberately managed with (and for) fire (Bowman et al. 2011). There have been a number of recent devastating fire events that have captured worldwide attention and brought some of these issues relating to both fire and biodiversity conservation to the fore, and along with them the policy failures that led to the situation in which we find ourselves. This includes the historic 2018 wildfire season in the USA, which included California’s deadliest wildfire in the town of Paradise. Said to be facilitated by climatic conditions that breed wildfires but sparked by ageing electrical infrastructure, these fires have been used to call attention to maladaptive forest management practices (Melo 2020), the threats posed by extreme heat waves, and the ripple effects of our current problematic behaviours that have impacted the global climate system. Most recently, 10 million hectares burned in Siberia in the summer of 2019, and as this is written in the
summer of 2020, this same area is on fire once again. Although fire is an enduring feature of boreal forests, there have also been a number of heatwaves and large, intense wildfires in the Arctic. The images and impacts of these wildfires have received a great deal of attention and helped bring awareness to the broader public of the intersections between climate change, wildfire, biodiversity, and human health (Blumberg 2019).

Beyond the American and Arctic examples, there was also the 2019 wildfire season in Brazil, Bolivia, Paraguay, and Peru, which highlighted the devastating outcomes of what happens when large-scale deforestation and slash-and-burn agriculture combine with a drying climate. In these examples, there is a clear link to governance, in that although the rate of deforestation has been decreasing, particularly in the Amazon region, in recent years, it is increasing again, with several hundred hectares being cleared per day, only to be replaced by non-native grasslands and crop-lands (Brando et al. 2020). There are a number of themes that are similar to the Australian case study that follows, including the fact that this was a foreseeable disaster, as well as the government’s problematic responses to confront the drivers of shifting fire regimes. In the case of Brazil, these include the economic drivers of clearing, which continued apace, even as it was clear the fires were endangering rainforest (Brando et al. 2020). In response to the Brazilian crisis, researchers have suggested a number of changes to governance that could potentially be implemented during this window of opportunity, which are also similar to those in other areas prone to wildfire, including innovative strategies to reduce clearing, cooperation across political boundaries, interagency cooperation, and the need for a new sustainable development paradigm to replace the current model (Nobre et al. 2016; Brando et al. 2020). Brazil is globally important in fulfilling a demand for new agricultural land to feed an ever-growing population, and is similar to other areas in that national policies struggle to confront global economic drivers. Of all these disasters, perhaps the most omnipresent in the public’s mind at the start of 2020 was the unprecedented fire season in Australia. In response to the ‘Black Summer’ fires, as they became known, there were renewed calls to act on climate, protect the country’s rural and peri-urban environments, and save the country’s unique flora and fauna. Such calls are easier understood than responded to, however, as the causes for the increase in such
catastrophic fires are complex and not driven just by climate change or the actions of any one actor but by a number of biophysical, socio-economic, and management conditions that are exacerbating the problem. The stakes for people and nature are so high that this is an area where framing contests have become evident, not just within the agencies that manage fire but also in very public forums. Although the details of the debate will vary across contexts, there are a number of quite public framing contests that have emerged in the wake of the recent Australian fires that can provide insight into areas where conditions are ripe for transformation.

Catastrophic Bushfires and Contested Knowledge in Australia

Australia has had more than its fair share of high-profile fire events that have not only brought to light the very tangible impacts of environmental change on both ecosystems and communities, but also demonstrate the impacts of failed knowledge governance. The most recent bushfire season in 2019/20 was, by many measures, catastrophic, with 11–18 million hectares having burnt over several months, resulting in the loss of an estimated 5900 buildings and 2800 homes burnt and 33 lives lost (Baldwin and Ross 2020). Although the exact numbers are contested, hundreds of millions of animals have been estimated to have lost their lives as well, and 20 endangered animals may have been pushed closer to extinction (Woinarski et al. 2020). Australia is no stranger to fire, of course, even catastrophic ones, but many of the most recent fires were in ecosystems that do not normally burn, including 54% of the temperate rainforest in New South Wales (DPIE 2020). This same report found the fires had affected many high biodiversity value areas and significantly reduced ecological conditions from an already stressed baseline. This grave situation is on top of a number of high-profile catastrophic fire events in the last 20-year period, which has included the 2003 fires in the Australian Capital Territory and Victoria, the 2006/2007 season, and the 2009 ‘Black Saturday’ fires. These have not only resulted in the loss of life, property, and the degradation of ecosystems but have once again drawn
into sharp focus the inadequacies of many aspects of fire management, governance, and policy. For all of the increased public attention on the escalating fire situation in Australia, a barrier exists in the form of deeply ingrained political behaviours. There has long been a tendency in Australia to respond to fire disasters with enquiries, policy recommendations, and more burning. There have been over 300 enquiries on the topic of bushfires and fire management since the late nineteenth century, with dozens of inquiries and policy recommendations just in the last decade (55 between 2009 and 2017), resulting in 1300 policy recommendations, only a fraction of which have been implemented (Bushfire and Natural Hazards CRC n.d.; Tolhurst 2020). Perhaps unsurprisingly, the response to the ‘Black Summer’ of 2019/20 has been to plan further enquiries, which will inevitably lead to more recommendations.

Amidst these scores of enquiries and policies, the framing of what constitutes ‘good’ fire management has been paramount. Discussions of what works and what does not, and whether current practices are helpful or harmful for communities and/or ecosystems can actually lead to mal-adaptive change have abounded. This has led to, amongst other things, an increasingly vocal discourse among experts about whether there is actually a need for more burning, or whether the fact that the response has always been to burn more is doing more harm than good, or at least not solving the problems we are aiming to solve. Previous catastrophic bushfires have led to marked changes in fire management practices that were already thought to be problematic in some ecosystems, with reform serving to lead to outcomes that may not effectively address either risk reduction or conservation objectives (Clement et al. 2016). Governance reform, therefore, has been no guarantor of better outcomes for biodiversity.

The framing conflicts that have emerged in recent years among experts, practitioners, and decision-makers have been exacerbated by issues about who does and does not get to take part in the discussion. What constitutes an ‘expert’ in Australian fire management is an interesting point for consideration. Several fire scientists have pointed out that a great deal of fire management practice in Australia and elsewhere is not based on peer-reviewed evidence, but on long-held assumptions that have established
habit and routine, that is, ‘the way we have always done it,’ built on outdated ideas that have not been scientifically proven, for example, that there is a direct relationship between fuel load and flammability, or that you need to burn every five years to reduce fuel load. These tensions have been evident in the many news stories, opinion pieces, and conferences involving experts during the 2019/2020 bushfire season (c.f. Bushfire and Natural Hazards CRC 2020). It is important to understand that prescribed burning can do little to prevent catastrophic bushfires. However, it can reduce the risk of typical wildfires if such burns are done near property (Gibson and Pannell 2014; Penman et al. 2015). This is not typical practice, despite this evidence, because even though this is more effective, it is often not the most economically efficient response (Florec et al. 2020), nor does it allow agencies to meet their large prescribed targets. This is why prescribed burning so often consists of burning large areas of national parks, even though it is thought by many experts to be a blunt instrument for little reward in terms of risk, and also negatively impacts biodiversity. There is still resistance among some experts and decision-makers to upending the received wisdom underpinning most prescribed burning activities. In part, the argument is that burning signals that ‘something’ is happening, which is thought to provide political and social capital, but this is based more on perception than evidence.

The culture of experts, the culture of fire management agencies, and the influence on how evidence is used were key factors identified as impeding effective biodiversity governance in the previous research I undertook on fire in the Australian Alps. Several experts discussed how a few key actors had ways of framing what should be done to deal with bushfires that were particularly dominant, but often not evidence-based. As one researcher put it:

It’s a cultural thing with fire. There’s almost no peer-reviewed science. There has been a culture of massive public body of literature without peer review.

- The big names in fire science, the “fire gods”, almost never have anything peer reviewed. And even if you know the evidence, there’s a tendency to fall back on practice
The conflicts that have re-emerged during and after the most recent bushfire season are reminiscent of many of the exact same sentiments my earlier researcher revealed, including this tendency to operate under a framing that was dominant but not based on sound evidence. As another researcher noted:

We are putting in a fire regime in Victoria unlike anything it has ever seen before in pre or post-Aboriginal times or pre or post-European times…It is based on the assumption, on the wrong assumption, that if you burn an area you will reduce the fuel. It may be true in some areas, but it is not true in other ecosystems. It is absolutely totally the reverse in many ecosystems.

Returning to this idea of ‘taking out the stuff that burns,’ this is still the dominant framing that influences the culture of fire management, with little nuance across different contexts.

Prescribed burning is one of the main practices used by land management agencies to reduce fuel loads, with the aim to reduce fire risk for life and property, but these have been contentious both in terms of how much they actually reduce risk and in terms of their impacts on biodiversity (Penman et al. 2011; Giljohann et al. 2015; Clement et al. 2016). The dominant culture of burning more fuel loads—in the hopes that ecosystems will ultimately burn less—may have actually increased flammability in some ecosystems, such as subalpine snow gum, adding to the burden of repeated intense bushfires that have already ravaged those landscapes and the substantially elevated fire risks arising from climate change (Zylstra 2018). In contrast to the received wisdom that prescribed burns are needed every five years, recent research suggests that these snow gum forests tend to get less flammable as they mature. And yet, policies to increase prescribed burning following enquiries into the 2003 and 2009 fires led to the implementation of blanket targets for areas that needed to be burned each year in the states of New South Wales and Victoria (Kanowski et al. 2005), which has resulted in large-scale burning of public estates that are high in biodiversity. Not only can such programmes threaten ecological values, they can ignite major fire events, escaping beyond containment lines and affecting sensitive environments as well as communities. Perverse outcomes have also been documented,
including incentives to burn areas of high biodiversity value, away from people, to reach the target and avoid complaints about air quality, and wildfires did not count against the target (Clement et al. 2016).

These and other problematic forms of fire management are demonstrably not fit-for-purpose, as a previous diagnosis I undertook of the governance in the Australian Alps demonstrates (Clement 2015; Clement et al. 2016). This research concluded that there were a number of issues that resulted in poor fit between governance systems and the challenge of managing bushfires and biodiversity, including:

- Conflicting mandates and lack of coordination between governance systems targeting fire management and those targeting biodiversity;
- Narrowly defined accountability that focused on financial aspects and targets rather than outcomes;
- Mismatches between the scales of bushfires, which cross state boundaries, and authority to coordinate across those jurisdictional boundaries;
- Political pressure to burn in order to be ‘seen to be doing something’;
- Displacement of ecological experts and the rise of staff with generalist skills in land management agencies; and
- Constraints on the capacity for experts to provide ‘frank and fearless’ advice, limits on their discretion to make decisions, and institutional impediments that prevented adjustments in response to learning (e.g. limited flexibility in funding).

The renewed debate following the most recent fires had revealed that many of these problems with governance are persistent. There are still conflicting values and knowledge around the role of prescribed burning in risk reduction and biodiversity conservation, as well as problematic interplay dynamics between the rules governing fire management and those governing biodiversity conservation, suggesting continued failure of knowledge governance.

Encouragingly, my previous research had revealed a number of managers within agencies are frustrated with the status quo in governance, and the tendency to respond to fires with more fire and more pressure to burn in areas that should not be burned. Many of these people had quietly expressed their reservations but received little traction, and the polarised
framing contest we are observing in response to the ‘Black Summer’ catastrophe is dominated by researchers who have the capacity to speak out independently, whereas it is much more difficult for bureaucrats to provide frank and fearless advice across many domains, including with respect to fire, biodiversity, and climate change. Much of this polarisation is owed to the increasingly simplified stories that are being told about fire by experts, with data about both fire histories and contemporary impacts of fire being used selectively to bolster narratives aimed at either keeping fire out of landscapes or increasing its intentional use.

What has been interesting about this most recent debate is that many of the exact same tensions between biodiversity conservation and fire management were evident, but there has been a much more vocal group of experts speaking out on the topic. This awakened debates that have been happening for a long time amongst fire experts, but often in less visible settings, such as in conferences, in meetings, and in the academic literature. What may be new is the capacity for experts to be able to speak out via a number of different forums that allow these debates to play out publicly. It remains to be seen if this fresh dynamic in the ongoing fire debate in Australia will translate into new dominant framings being established, and, furthermore, whether this will result in action across any or all of the fronts (biodiversity conservation, burning for hazard reduction, or climate change). Even though the state of Victoria has shifted towards a more risk-based approach (rather than blanket prescriptions) since my research in the Alps, the rationale behind their models is not transparent and has led to some questions about whether it really does address the known problems with current approaches to prescribed burning. There was a great deal of concern in the Alps that efforts to improve burning prescriptions were increasingly criticised as being part of the fringe because of moves towards employing more generalists in conservation and land management agencies. As one expert, who was employed in New South Wales National Parks and Wildlife Service, said in my research in 2013:

It will be interesting to look ahead in eight years or so, people sitting in the jobs will be different and how they do they job will be different. It will be more like, oh yeah, we burn. That’s what we do. There could be a cultural
shift. Right now, to go to 5% [the prescribed burning target], most people don’t want to do it, they don’t want to burn because it’s affecting the environment. They see the value of threshold burning for some species; but apart from that this broad acre burning is a ‘no’

Despite many experts both within academia and within governments being concerned about prescribed burning, and many holding more nuanced views, there are still many extremes in this debate. One idea is that prescribed burning is in not problematic for ecosystem health or biodiversity conservation. In a recent presentation, a well-known expert in Western Australia said: ‘there is no evidence of biodiversity loss or decline in health that can be attributed to prescribed burning’ and that critics of the current burning regime were an ‘ideologically driven opposition.’ His presentation concluded with the idea that what Australia needed was the courage to burn more, and that ‘it takes courage to take fire out, but it also takes courage to put fire in’ (Burrows 2020). There were clearly divergent views in other presentations at the same conference, including evidence that there was little correlation between fire severity and area burned during these most recent fires (Bushfire and Natural Hazards CRC 2020). There have also been arguments that ‘greenies’ were responsible for the catastrophic bushfires because they stopped logging from happening, despite counter-arguments from researchers that logging actually made the fires worse (Alexandra and Bowman 2020; Lindenmayer et al. 2020).

These are just a few examples in this debate where experts, who are ostensibly working with the same body of evidence, yet can come to strikingly different conclusions. Not all claims have peer-reviewed evidence behind them, but many do. Given the complexity of the issues, this is partly because there are still unanswered questions. But another aspect, as we have already seen, is related to values, and a recent keynote at a fire management conference argued that evidence that contradicted the received wisdom around fire management was often dismissed as the product of poor analysis, the failure of peer review to support experience on the ground, and/or the ‘far left’ ideologies that are ostensibly pervasive in academia (Burrows 2019). These does not quite match what is seen in the academic literature, however, as there are still papers being published...
that argue that more prescribed burning is the solution (Morgan et al. 2020).

These are not new or unknown problems, as the aforementioned diagnosis of governance shows and the proliferation of policy recommendations reminds us. But, particularly in the aftermath of the 2019/20 fire season, there are very real consequences for the ecosystems that will be the victims of the ongoing failure to deal with these conflicting frames, which have long deferred important decisions about what needs to be done. In an examination of the dynamics of the Australian Alps as a social-ecological system, we found that fire and other landscape-scale drivers of ecological change were transforming the Australian Alps (Lockwood et al. 2014). Repeated, large-scale, intense fires were increasingly undermining the resilience of the landscapes, and many areas were struggling to recover in the wake of previous fires, and vast areas of the Alps were affected again during the 2019/2020 season. Without governance reform, we found that biodiversity outcomes across all scenarios were projected to get worse by 2030 (Mitchell et al. 2015), and it unfortunately seems that the course has not changed.

Another of the framing conflicts to emerge is around the role of climate change in fire, which has also played out very publicly. It is easy to misestimate the power of experts—self-appointed, legitimised by governments, or otherwise—speaking out in an era where media coverage is constant and the demand for sensationalist reporting on catastrophe insatiable. But there is already a history of public debates having demonstrable impacts on fire policy in Australia, so it is worth paying attention to just how much current debates around fire management have captured the attention of the public and policymakers, and/or how much the framing of these debates has been shifted. The catastrophic nature of the 2019/20 fires, combined with very powerful and widely publicised images of their impacts on ecosystems and communities, helped them to become symbol of climate inaction and a rallying cry at a time when global momentum for climate action was picking up speed through such initiatives as the climate strikes facilitated by Greta Thunberg. As noted earlier, the role of climate change in fire is thought to be a chief driver of changing fire regimes, but it is difficult to tease out the role of climate from other drivers, such as fire management activities. The fires have added
urgency to calls to better understand these complexities, with a race underway to undertake more attribution studies to decipher the role of climate change in fires (Phillips and Nogrady 2020), but there were still plenty of calls to address climate change even in the absence of these findings (Fitzpatrick 2020). Yet even without the results of those studies, there seems to have been a broad shift in understanding since the ‘Black Summer’ fires that taking action on climate can also help Australia reckon with a future that is set to be transformed by increasingly massive and destructive blazes.

Although the federal government expressed some resistance to the idea that the role of climate change in fire needs to be taken more seriously, at lower levels of governance, there was support across political parties and different stakeholders. For example, the New South Wales state government has been responsive to public calls to action, at least in principle, promising that it will probe the role of climate change in causing the fires, despite federal government insistence that Australia is doing more than its fair share (Gordon 2019). Communities and firefighters were important contributors to this change in thinking, with a number of rural mayors calling on the government to take urgent action on climate change—a remarkable feat in a country where numerous states are dependent on mining for the prosperity of their economies and, as such, have been historically reluctant to support actions to cut emissions. As Simon Shire of the Byron Shire in New South Wales said: ‘Everybody who’s involved with the bushfires is talking about climate change, the only people who aren’t talking about it are the politicians and their media supporters’ (McIlroy 2019). Such statements were important because they help to re-frame the debates, and, demonstrably in the New South Wales case, increase political pressure to act.

The question is whether this drive for action on fire and climate change can engender benefits for biodiversity. It is difficult to say exactly why fire attracts more attention than some other environmental problems, but it is likely because its transformative powers are difficult to ignore when faced with the dramatic images that accompany media coverage of
bushfires—images that play off human emotions and prompt action in response. This visibility of the consequences of fire sit in stark contrast to the steady and often silent loss of biodiversity and the degradation of ecosystems. Ostensibly, the disparity between the capacity of each of these disasters to engage the public and spark the necessary process of re-framing makes crusading for a change in governance pertinent to biodiversity and ecosystem degradation seem forlorn. And yet, in case of the fire, there are strong arguments to be made for transformative change in governance that could bring biodiversity benefits. While these transformative changes might necessarily include the same kind of dramatic re-framing that is required with respect to the issues of biodiversity and ecosystem degradation, they are able to leverage a much more tangible connection to both people and place. There are still lessons for those focused primarily on biodiversity and not on hazards, as part of the present re-framing of the debates on fire, the discussion is being pushed beyond simple risk management and into realms that examine the fundamental aspects of the system that are contributing to the problem and need to change. This kind of broad, system-level discussion is precisely what is needed in order to kick-start a process of re-framing debates around biodiversity and ecosystems (O’Neill and Handmer 2012).

**Framing the Future**

Many of the themes in previous examples emerge yet again in this discussion of contested fire regimes in Australia, most noticeably the fact that expert perceptions may not always match those of the public, despite informing fundamental assumptions in governance systems. Building on the previous chapter, what this case study also reveals is that we have to be careful to understand who we are talking about when we talk about experts, in order to understand the degree to which they are either contributing to a fit-for-purpose form of governance, or further entrenching existing ideas. It is too soon to tell which expert perspective will win out in the current framing contests around fire in Australia, but it is important
to note that, under conditions of uncertainty, if framing is considered to be incongruent with the current dominant culture in fire management, then they are more likely to result in stagnation and deferred decisions about how to change (Kaplan 2008). It is important to note that this research suggests that framing that favours a greater focus on biodiversity could be successful if one or more conditions are met: (1) if the uncertainty about alternative fire management practices is reduced through clearer framing, (2) if an actor or groups of actors are willing to undertake ownership of new ideas and strategically advocate for them, and (3) if key individuals use institutional work strategies (Lawrence et al. 2009) to generate changes in culture, cognition, norms, and rules (Chap. 3, Domain 5, Table 3.2).

Based on the current state of affairs revealed in this research, it would be wise to start with the cognitive and normative aspects outlined in Table 7.1, which focus on how to develop new practices in parallel to existing ones. This is because one of the concerns expressed by some participants is that government agencies need clear prescriptions and heuristics for decision-making, not more details about the complexities of fire dynamics. Interviewees clearly understood the criticisms of current practice, but could not understand what the alternatives were being presented to them, or how they could meaningfully apply them in practice. Though researchers tend to care a great deal about communicating complexity and uncertainty, their communication of knowledge needs to be simplified if it is to successfully change practice. There is also danger in dressing up new practices in old clothing, which forms the bases of discussion on nature-based solutions.

**Leveraging the Power of Nature to Confront Societal Challenges**

There is an emerging umbrella concept in the environmental management literature that captures a number of the notions that have been discussed in this book. This umbrella concept, nature-based solutions (NBS), has in some cases been framed as a panacea, offering the answer
to a wide range of environmental, economic, and social problems, with the potential to address the growing concerns of governance across all five domains of change. NBS is a relatively new term that has as its conceptual foundation an ecosystem approach, which underpins the Convention on Biological Diversity and is built on the idea that biodiversity and

| Table 7.1 Potential institutional work strategies to enable change in fire governance |
|----------------------------------------------------------------------------------------------------------------------------------------|
| **Institutional work strategy** | **Example** |
| Theorising: Developing and naming concepts and practices to support them becoming part of the way people understand and respond | Developing and naming new fire management concepts and practices, and developing new prescriptions that outline clear alternatives and where they could be practically implemented |
| Mimicry: Associating new practices with taken-for-granted practices to make them feel more familiar and readily adoptable | Beyond just providing the skills and knowledge needed to take these up, also making them feel more familiar and readily adaptable within existing practices by connecting them to existing ways of doing things now, as well as organisational cultures |
| Constructing identities: Deliberately working to re-define the relationship between the actor and the field in which they operate | Find key allies within the fire management space who are open to changing practice, to help reshape ideas about fire management as being separate to biodiversity to one where there is a responsibility to protect ecosystems and property |
| Constructing normative networks: Development of informal networks where new norms and standards of practice can develop, including standards for compliance, monitoring, and evaluation | Constructing networks of scientists and managers can help with this, and such networks are already emerging in Australia |
| Changing normative associations: Remaking the connections between practices and the moral and cultural foundations of those practices. This may initially support new parallel practices which ultimately lead actors to question norms in other areas | Reframing ideas about burning practices that are thought to damage biodiversity as well as undermine community safety to demonstrate how, if they continue current practice, this is inconsistent with the social licence with the community to protect them |
human well-being depend on functioning and resilient natural ecosystems (CBD 2004). Similar to the concept of ‘natural solutions’ (Dudley et al. 2010), the idea of NBS is that they align the interests of biodiversity conservation and climate change adaptation.

NBS are defined by the International Union for the Conservation of Nature (IUCN) as ‘actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits’ (Cohen-Shacham et al. 2016, p. 5). The term emerged in 2002, and started to gather momentum in the latter half of the decade as it made its way into organisational policies and assessments (IUCN 2009), and it now forms a major part of IUCN programmes. As a concept, NBS flowed out of the idea of ecosystem services, which focuses on the benefits that nature provides to people, and it is said to mark a ‘subtle yet important shift in perspective: not only were people the passive beneficiaries of nature’s benefits, but they could also proactively protect, manage or restore natural ecosystems as a purposeful and significant contribution to addressing major societal challenges’ (Cohen-Shacham et al. 2016). This shift has informed the conception of NBS as the means by which ‘nature’ can be managed actively in order to confront many of the environmental and socio-economic challenges that have emerged in the Anthropocene.

In theory, NBS seem a ‘win-win’ opportunity that allows biodiversity to be injected into many different policies, whether they be about agriculture, rural development, urban land use planning, or the management of natural hazards such as floods and fires. In practice, however, the concept of NBS appears to be significantly diverging from its origins in nature conservation. This section focuses on the potential of the concept of NBS to expand ideas about what it might mean to conserve biodiversity in the Anthropocene, particularly with respect to novel ecosystems and, in the case of urban areas, designed ecosystems. The principles of NBS also suggest that integrating this concept into governance systems and management actions could help facilitate more fit-for-purpose governance by building adaptive capacity. As an umbrella concept that integrates both traditional and innovative approaches to nature conservation focused on solving a wide range of challenges, it might also offer insight
into not only what success means in such landscapes, but also how changing ‘business as usual’ affects the logics of decision-making (Domain 3). This section explores the challenge of living up to the lofty theoretical promises of NBS in practice and connects the largely conceptual ideas in the NBS literature to the practical governance and implementation of NBS interventions, for which there is scant literature to date because of the newness of the concept.

What follows is based in part on action research undertaken as part of one of the NBS demonstration projects, Urban GreenUP, funded under the European Commission’s Horizon 2020 research and innovation programme, which aims to translate theoretical ideas about how NBS can resolve societal challenges into practice and test the effects over a five-year period. While this project, as the name suggests, is entirely focused on urban areas and not on the places where concerns about ‘novel ecosystems’ arise, there is still a great deal to be learned about how the principles of NBS can be translated into practice and the governance challenges of doing so. From the perspective of biodiversity conservation, it is also important to note that urbanisation is an important driver of biodiversity decline. It will continue to be so as the world’s population increases, and cities expand in response. Enhancing the biodiversity values of these places and integrating NBS into urban developments could at least ensure biodiversity is taken seriously in these areas. Moreover, as over half the world already lives in urban areas and nearly 70% of the population is projected to reside in cities by 2050 (United Nations DESA 2019), urban areas are also, for many people, the main place in which they interact with nature. People are known to prefer biodiverse urban green spaces to those that are less diverse, and higher biodiversity is also associated with enhanced psychological well-being (Hoyle et al. 2017; Southon et al. 2018). Although this connection to biodiversity does not always increase conservation awareness among the public (Shwartz et al. 2014), urban residents tend to express high levels of support for nature conservation (Liordos et al. 2017). Furthermore, despite urban areas often being dismissed by biodiversity experts because they cannot provide the same level of functionality as native vegetation remnants, novel urban ecosystems can be richer in species, even native species, than rural areas and provide important habitat for rare species (Kowarik 2011).
Origins, Principles, and Promises

As framed by the IUCN, the concept of NBS would seem to have potential as a pathway to reframe biodiversity conservation in a way that can allow for the integration of novel and hybrid ecosystems into biodiversity conservation, providing benefits for ecosystem function and the kind of ecosystem services that people value. It seems to provide an alternative framing that allows for alternative objectives, baselines, and metrics, but maintains the core focus on biodiversity. The original intention was to link biodiversity conservation with goals for climate adaptation and resilience, with the concept expanding to embrace sustainable development goals (Eggermont et al. 2015; Pauleit et al. 2017). Although NBS are often associated with innovating, utilising nature and technological advances via biomimicry and new engineering materials (Maes and Jacobs 2017), as originally conceived, they are strongly grounded in traditional approaches to conservation. Not only is biodiversity front and centre in the definition, but the concept has strong roots in tried and true nature conservation practices, including the ecosystem approach, forest landscape restoration, ecosystem-based adaptation, protected areas, and even ecological restoration (Cohen-Shacham et al. 2019). The eight principles developed via the IUCN programme (Cohen-Shacham et al. 2016, 2019) are also promising in light of discussions in previous chapters:

1. **NBS embrace nature conservation norms (and principles).** There is also an emphasis on how this is not an alternative or substitute for nature conservation, but a complementary approach as part of a portfolio of activities across a whole landscape. This is consistent with the idea that the management of novel ecosystems in highly modified landscapes can complement the conservation of intact systems and allows for management of the whole landscape (Hobbs et al. 2014).

2. **NBS can be implemented alone or in an integrated manner with other solutions to societal challenges (e.g. technological and engineering solutions).** This is consistent with the idea that novel ecosystems—and even more so, designed ecosystems—can be combined with other systems to provide the full range of ecosystem services.
3. **NBS are determined by site-specific natural and cultural contexts that include traditional, local, and scientific knowledge.** This not only addresses the idea that novel ecosystems require us to grapple with the social dimensions of ecosystems, but explicitly requires they be reckoned with and integrated as a matter of course.

4. **NBS produce societal benefits in a fair and equitable way in a manner that promotes transparency and broad participation.** Again, this deals with some of the key governance challenges of the Anthropocene, particularly those outlined in Domain 2. This principle explicitly acknowledges that even if we accept novel forms of nature, there will still be a need to confront the tensions between what local people and key stakeholders might want from their landscapes and the services they might provide to others, whether it be conserving biodiversity or confronting pressing issues such as the mitigation of natural hazards or water security.

5. **NBS maintain biological and cultural diversity and the ability of ecosystems to evolve over time.** The connection to the previous chapters is obvious here, as it acknowledges that ecosystems—whether they be novel, cultural, or largely intact systems—exist within novel and changing contexts, and that this is an issue that can be addressed through new approaches. The fact that they should have the ability to evolve over time suggests that they can become self-organising, though this is not explicitly stated.

6. **NBS are applied at a landscape scale.** The focus on landscape scale is important for reaching beyond single-species approaches, and this landscape scale view allows for clearer emphasis on ecosystem processes and function, which can provide the conditions for incorporating novel and hybrid ecosystems (Chap. 4).

7. **NBS recognise and address the trade-offs between the production of a few immediate economic benefits for development, and future options for the production of the full range of ecosystem services.** This principle explicitly calls for caution in shifting objectives that simplify ecosystems (e.g. monocultures planted for carbon sequestration). It should provide some comfort to those who are anxious at the prospect of allowing novel ecosystems to creep into conservation. For governance, it is also important to note that NBS call for fair and
transparent processes to discuss and negotiate trade-offs between ecosystem services.

8. **NBS are an integral part of the overall design of policies, and measures or actions, to address a specific challenge.** This allows for the explicit recognition of NBS in formal institutions and policies, and can allow for the incorporation of novel, hybrid, and designed ecosystems.

They have gone further to illustrate how NBS can operationalise and extend ecosystem-based approaches (Cohen-Shacham et al. 2019). There is also potential to facilitate reform of biodiversity governance, though they have identified several gaps in the principles for NBS, with no explicit link to adaptive management or adaptive governance, effectiveness, uncertainty, multi-stakeholder participation, and temporal scale (Cohen-Shacham et al. 2019).

Still, it is worth noting that, in principle, there is a great deal of potential to use NBS as an enabling concept for incorporating novel ecosystems into conservation practice, and potential synergies between the two concepts. There are echoes of the themes in the Anthropocene debate here, where the utilitarian focus of NBS, which sees nature as a tool, can be rightly criticised for being overly simplistic and reinforcing the hubris that created the Anthropocene in the first place. Yet it also fits with the framing of Anthropocene as a potential opportunity for reorienting society on a more sustainable trajectory (Chap. 1). While it might oversell our capacity to solve complex challenges with nature, there is potential merit in reframing nature as a solution rather than focusing solely on its loss, which is precisely what the literature on novel ecosystems calls on us to do.

In its international conceptualisations, NBS seem especially promising for allowing a broadening out of what conservation and restoration in the Anthropocene might mean without losing the foundations of these practices. The IUCN’s conception is particularly promising, as it puts forward a case for innovation, but places biodiversity conservation at the heart of new practices and establishes a robust standard for doing so (IUCN 2020). On the surface, NBS also seems to offer both a promising framework of principles for governance reform that allows for novel, hybrid,
and other highly modified ecosystems and a promising tool for implementing those reforms. The fact that NBS squarely places the focus on the values of nature and reaches beyond ideas about returning to some pre-Anthropocene state is promising in landscapes that have crossed a threshold. However, such ideas rarely adhere to their noble origins, and there has already been a marked departure from how NBS were originally envisioned to their current conception, perhaps in part because of where they have most quickly attracted significant public investment.

The EU has sought to position itself as a pioneer in the field of NBS, directing millions of euros towards projects to advance its theoretical foundations and practical implementation (O’Sullivan et al. 2020). However, NBS have already taken on a very different form so far in Europe than what is outlined in the principles, with biodiversity seemingly taking a back seat to other environmental dimensions (e.g. air quality) and the desire to achieve social and economic goals. There are a number of potential explanations for why the concept of NBS has been transformed in the process of implementation in Europe. First, the shift towards seeing nature as a tool to solve societal challenges to the benefit of both people and biodiversity is only a shift for those who do not see nature as a resource to be shaped by humans. For the EU, biodiversity is characterised as equivalent to the word nature, and it is unreservedly utilitarian in focus, with the EU biodiversity research programme materials noting that ‘ever since humans mastered fire, invented tools, and discovered agriculture, nature has been viewed as a source of strength and growth on which we depend’ (EU Research 2012). It is no surprise then that their definition is also very utilitarian in focus, suggesting that nature can be deployed at will to resolve the challenges of an increasingly urbanised planet: ‘solutions that are inspired and supported by nature, which are cost-effective, simultaneously provide environmental, social and economic benefits and help build resilience. Such solutions bring more, and more diverse, nature and natural features and processes into cities, landscapes and seascapes, through locally adapted, resource-efficient and systemic interventions’ (European Commission n.d.). This definition is thought to be roughly equivalent to the IUCN’s definition, but as we shall see, it has led to a number of different interpretations in practice.
Another reason could be divergent ideas about what constitutes nature and core concepts that were initially thought to comprise NBS, such as restoration. The IUCN suggests NBS represent a ‘subtle yet important shift in perspective’ towards seeing nature as a tool that can be leveraged by humans. The shift might not be so subtle for everyone, and may, in fact, reinforce the view that nature is a tool to be used for human ends for those with different value systems. Again, this raises the issue of framing, as it depends on which aspects of the concept are elevated. While one framing is that NBS are fundamentally about putting biodiversity and nature conservation at the heart of climate adaptation, there is another framing that elevates ‘societal problem-solving’ element.

This latter framing aligns with how the concept has been used so far in many cities. Despite its apparent potential to change the way we view the role of biodiversity conservation and restoration in climate adaptation, all concepts are reinterpreted in context. In some places, NBS may simply be a new way to re-frame the many human-oriented conceptions of nature that have long dominated approaches such as landscape planning, green infrastructure, cultural landscapes, and rural development measures, all of which seek to accommodate biodiversity and socio-economic objectives. The fact that NBS have its origins in ecosystem services is also potentially meaningful, in that ecosystem services, particularly in Europe, are framed as a very utilitarian concept that focuses on what nature does for humans (sometimes attaching monetary figures to that value), rather than as a means of delivering benefits to the environment for its own sake (Borie and Hulme 2015; Batavia and Nelson 2017). Though there have been ongoing efforts to address these shortcomings (Davidson 2013) within the EU context, the fact that there is little intact biodiversity left and a long history of use in the region has meant that the utilitarian interpretation of NBS has been unassailable.

Beyond these divergent ways of framing nature, the differences between the theory of NBS and their practice in EU may be based in part on their primary emphasis on solving urban challenges. In urban environments lacking in biodiversity, gains are not difficult to achieve. Any introduction of nature in this context is a quantifiable benefit, and EU typologies of NBS tend to focus more on the degree of engineering of biodiversity rather than on the restoration of nature for the benefit of ecosystems...
(Eggermont et al. 2015). The EU has also sought to direct the evaluation and monitoring aspects of NBS, making these elements central to their investment. Crucial in this is the framework for implementing and monitoring NBS that the EU developed through their EKLIPSE mechanism, an approach where they draw on global expertise to respond to a particular research challenge. The EKLIPSE framework that was developed as part of this programme outlines possible benefits across ten challenge areas that can be monitored for impacts (Raymond et al. 2017, b):

1. Climate mitigation and adaptation;
2. Water management;
3. Coastal resilience;
4. Green space management (including enhancing/conserving urban biodiversity);
5. Air/ambient quality;
6. Urban regeneration;
7. Participatory planning and governance;
8. Social justice and social cohesion;
9. Public health and well-being; and
10. Potential for new economic opportunities and green jobs.

As is evident from these categories, biodiversity is buried deep in the fourth challenge and, even then, it does not feature prominently. The main focus of these challenge areas is on the benefits directly provided to humans, even for those that are ostensibly environmentally focused (e.g. air-quality improvements provide human well-being benefits). While this is undoubtedly an advance on standard practice in urban areas and has the potential to provide net gains for the environment, it seems a long way from the idea of NBS as a supplement to ecological restoration and ecosystem-based management. All projects, including the Urban GreenUP project, funded under the EU Horizon 2020 programme, are required to use the EKLIPSE framework to monitor the impacts of various interventions. A key challenge is that the ‘framework’ does not actually provide indicators, but rather ideas about how NBS might positively impact the environment, society, and the economy, which are yet to be substantiated.
The hope of the NBS projects being funded by the EU is that they will provide that substantiation, as well as a robust proof of concept for NBS in urban areas. Any bit of nature that could deliver on all ten of these challenges would be of enormous benefit to society, even if not centrally focused on biodiversity. There is reason to be sceptical, however, as there is still scant evidence that NBS lives up to its supposed potential (Kabisch et al. 2016). There are reasons to explore NBS as an umbrella concept that both creates a greater range of tools for the sustainability toolkit and has global applicability (Dorst et al. 2019). However, at this early stage, there are reasons to be cautious about some interpretations of the concept in practice, which seem to be largely focused on a new way to green cities. NBS need to offer more than just another way to make places greener if they are to solve the varied challenges mentioned earlier, and they certainly need to be more than a new label for old practices if they are to play a major role in confronting the fundamental drivers of ecological decline that characterise the Anthropocene.

Hope for the Future, or Chimera of Change?

Very little has been written about how well the practical implementation of NBS aligns with the principles and aspirations set forth in the IUCN’s international guidelines, or its forthcoming standards (IUCN 2020). Much of the NBS literature is conceptual (Eggermont et al. 2015; Nesshöver et al. 2017; Cohen-Shacham et al. 2019; Dorst et al. 2019), or it re-badges a greening project as NBS after the fact. Given these problems, such abstractions are of little use in assessing the effectiveness of NBS. It is more useful to consider the practical example offered by the aforementioned Urban GreenUP project, and the literature which has evaluated the extent to which NBS projects in Europe seem to be achieving the lofty objectives. Drawing on the principles of NBS presented earlier and the themes of this chapter, what follows is an attempt to assess the extent to which, in the European context, NBS has delivered in two key areas of aspiration: (1) embedding the principles of nature conservation into interventions, including a focus on landscape scale and enhanced ecological function, and (2) participatory governance built on principles
of co-production and co-design. I also touch on how NBS could be integrated with other policies and tools to address place-based, specific challenges.

Urban GreenUP aims to ‘renature’ urban areas and develop a transferable methodology for implementing NBS in other areas. Most of the investment is in three ‘front-runner’ cities: Valladolid, Spain; Izmir, Turkey; and Liverpool, UK. There are also five ‘follower’ cities which are meant to draw on lessons from these three cities, testing the methodology in a sort of living laboratory model to see if the approach can be replicated in very different contexts. There are two European follower cities (Mantova, Italy; and Ludwigsburg, Germany) and three non-European cities (Chengdu, China; Medellin, Columbia; and Quy Nhon, Vietnam). There are also 18 cities which comprise the project’s ‘network of cities’, the purpose of which is to disseminate knowledge about implementation of NBS outside of the aforementioned cities (Urban GreenUP 2020).

Importantly, the project is not fundamentally a research project, but a demonstration project. This means the focus is on developing and implementing a series of NBS ‘interventions’ in several areas of each city, which requires monitoring of conditions before and after these interventions are implemented. The differences between this ‘before and after’ will help us to determine if they have a quantifiable effects across a range of indicators, organised according to the EKLIPSE challenge areas (Table 7.2). The project is currently finalising interventions and embarking on the post-intervention monitoring period. This section explores each of the aforementioned three themes, primarily with respect to the Liverpool example, to understand the ways in which this new concept is being implemented. Rather than focusing on how the project itself could improve its practices, the focus here is on what we can learn for broader issues relating to ecosystem transformation and reform of biodiversity governance.

A core principle of NBS is that they should embed both the principles and norms of nature conservation into interventions, including a focus not just on biodiversity per se but also on contributions to landscape-scale conservation and enhancement of ecosystem function (Cohen-Shacham et al. 2019). The project has published a number of reports that are informative in terms of understanding how NBS are conceptualised in urban contexts, how they might be implemented, and what the barriers to their implementation are. From this it seems that NBS can include
| Type of indicator | KPI |
|-------------------|-----|
| **Challenge 1: Climate change mitigation and adaptation** |
| Environmental (physical) | Tonnes of carbon stored in vegetation |
| Environmental (physical) | Heatwave risk |
| Environmental (physical) | Projected maximum surface temperature reduction |
| Economic indicators (benefits) | Economic value of carbon sequestration by vegetation |
| Environmental (biological) | Increased opportunity for species movement in response to climate change as a result of NBS |
| **Challenge 2: Water management** |
| Environmental (physical) | Run-off coefficient in relation to precipitation quantities |
| Environmental (chemical) | Nutrient abatement and abatement of pollutants |
| Economic | Volume of water removed from water treatment system |
| Economic | Volume of water slowed down entering sewer system |
| Economic | Economic benefit of reduction of storm water to be treated in public sewer system |
| **Challenge 4: Green space management** |
| Social | Accessibility of urban green spaces for population |
| Social | Assessment of typology, functionality, and benefits provided |
| Environmental (biological) | Increase in density and seasonal spread of floral resources for pollinators |
| Environmental (biological) | Increase in plant species richness and functional diversity as a result of NBS |
| Environmental (biological) | Increase in insectivore (e.g. bat) abundance and use of corridors for movement as a result of NBS |
| Environmental (biological) | Pollinator species increase |
| Social indicators (benefits) | Increased connectivity to existing GI |
| **Challenge 5: Air quality** |
| Environmental (chemical) | Annual mean levels of fine particulate matter |
| Environmental (chemical) | Trends in levels of nitrogen oxides (NOₓ) and Sulphur oxides (SOₓ) |
| Economic | Value of air quality improvements |

(continued)
dozens, if not hundreds, of different types of interventions that go from the building and street scale (e.g. green walls and roofs, planting trees, pollinator verges) to the city scale (e.g. floodable parks) to the regional scale (e.g. green corridors connecting parks) (Urban GreenUP 2018a). While there is an effort to highlight the importance of biodiversity, for example, by encouraging the use of local species and a diverse mix of species, the vast majority of the interventions are at smaller scales, and there is a clear focus on construction materials, urban design principles, and ‘greening’ hard surfaces rather than on nature conservation principles.

The types of NBS that are described in this ‘catalogue’ are carried through to the Liverpool project, where most of the 40 NBS interventions are small scale, such as tree plantings in containers, floating habitats, pollinator verges, small-scale sustainable urban drainage systems (SUDs), rain gardens, cycling paths, and green walls. They are spread across three demonstration areas that include two areas in the city centre (the business improvement district and the Baltic Triangle, a revitalised creative quarter that includes former warehouses) and an area in and around the city’s biggest urban park, Sefton Park. Although some

| Type of indicator | KPI                                                                 |
|------------------|----------------------------------------------------------------------|
| **Challenge 6: Urban regeneration**                        | **KPI**                                                             |
| Social           | Diversity of NBS (land use and functionality)                       |
| Economic         | Savings in energy use due to improved green infrastructure          |
| **Challenge 7: Participatory planning and governance**       | **KPI**                                                             |
| Social           | Social learning concerning NBS                                      |
| Social           | Perceptions of citizens on urban nature                            |
| Social           | Engagement with NBS interventions                                  |
| Social           | Crime reduction                                                     |
| **Challenge 9: Public health and well-being**                | **KPI**                                                             |
| Social           | Perceptions of health and quality of life                          |
| Social           | Increase in walking and cycling in and around areas of interventions|
| **Challenge 10: Potential of economic opportunities and green jobs** | **KPI**                                                             |
| Economic         | Changes in mean house prices/rental markets                        |
| Economic         | Number of jobs created; gross value added                          |
| Economic         | Additional business rates                                           |
| Economic         | Job creation, increased footfall and spend in the areas of interventions|

Table 7.2 (continued)
interventions seek to improve existing green space or its connectivity, the interventions are largely disconnected. A key reason for this is that Liverpool is a post-industrial, fairly compact city that is already fully developed, with a great deal of ‘grey’ infrastructure that is difficult to green because of issues such as property ownership and unfavourable conditions (e.g. narrow pavements, underground utilities, etc.). The interventions were ultimately focused on areas where there was opportunity and willing partnerships.

Despite the EKLIPSE framework downplaying biodiversity indicators, the Liverpool project made a concerted effort to include biodiversity indicators in its monitoring (Table 7.2) (Urban GreenUP 2018c). Both biodiversity and governance indicators are highlighted in this table, but all indicators are shown to demonstrate just how wide-ranging the challenges NBS are expected to address, even when they are small-scale and dispersed across a wide area. Whether they will deliver on these promises remains to be seen, and the reliance primarily on novel habitats such as green roofs and walls as NBS in urban areas may make sense due to space constraints, but their conservation value is contentious (Williams et al. 2014). Though they are likely better than brick or concrete facades for a range of reasons (e.g. energy efficiency), there are still a number of unknowns. For example, it is as yet unproven that they offer similar benefits to adding on-ground habitats (e.g. parks), and they can be an expensive investment that require long-term maintenance, so their cost-effectiveness has been questioned (Perini and Rosasco 2013). In terms of biodiversity, greening areas and adding new habitat will clearly provide net gains.

Looking more broadly at NBS projects, there are scant assessments to date that looked at the contribution of NBS to biodiversity, other than the case studies provided as examples in the NBS guidance documents. A recent review looked at 199 projects in Europe that had goals to conserve nature, restore nature, and to ‘find ways to thrive through harnessing nature’s contribution to people’ (Xie and Bulkeley 2020). They found many of these that had goals and implementation activities explicitly mentioned biodiversity-related attributes, but it is worth questioning whether this was a re-badging exercise for taking care of parks that already existed. Most of the projects favoured what were called ‘ecosystem based’
approaches, but that idea is not quite in line with what would be envisioned by most ecological restoration and conservation projects that are ecosystem based. Though the results were viewed as positive, it was a desktop review of metrics of success that indicated quite basic targets, for example, aiming to conserve parks that already existed or planting vegetation in existing green spaces (Xie and Bulkeley 2020). Although undoubtedly an improvement in terms of net biodiversity, such metrics focus on outputs rather than outcomes, which say very little about the impact of the interventions or their potential for longer-term success (Wallace 2003; Howe and Milner-Gulland 2012).

There are also several key issues that emerge in looking at how NBS are being implemented. First, there is the question of what ‘counts’ as an NBS. In an urban context, there are already a number of similar concepts, such as green infrastructure, which are already thought to offer a range of benefits. If NBS are to provide benefits for biodiversity and climate resilience, beyond just adding ‘green stuff’ to landscapes where there is none, then there is a need to think more seriously about what NBS actually are and what makes them different from other approaches to greening. The IUCN has done this in their work, but the implementation of NBS in Europe has been so different from these ecosystem-based origins that it is difficult to compare the two. Though the fact that NBS are an umbrella concept is considered a positive attribute, they are in danger of meaning everything and nothing at the same time, as everything from a few street trees in a container to restoring coastal wetlands could be called an NBS. The devil, as usual, is in the details.

The second issue, which flows from this, is that in Europe, many of the NBS interventions do not leverage, restore, or enhance existing ecosystems to address societal challenges. Most are a hybrid of traditional and ecological engineering approaches or constructed ecosystems, which tend to be called ‘designed’ ecosystems in the novel ecosystems literature. They have thus far proven to be very expensive interventions. Given their ‘designer’ status, there are also reasonable questions to be asked about whether many of the current NBS meet the IUCN’s fifth principle, that is, they should maintain biological and cultural diversity and the ability of ecosystems to evolve over time. This is perhaps understandable in many cases. Developing self-sustaining and resilient ecosystems is a tall
order in urban environments where human impacts are constant. This presents perhaps an even bigger economic problem than a nature conservation problem, however, particularly in the case of cities such as Liverpool, which has experienced years of austerity and the de-funding of green space management (Mell 2020).

Finally, the principle of landscape scale interventions is essential, from the perspective of both biodiversity and resolving the many and varied challenges in the EKLIPSE framework; yet, it is difficult to achieve in many urban areas. It may be reasonable in newer cities, as in the case of Izmir, but in older, industrial, and highly urbanised areas like Liverpool, it can cost thousands of euros to undertake surveys just to see where a few trees can be planted—an ostensibly simple process that is deeply complicated on account of the city’s long history of urban development, narrow streets, and lack of pre-existing green space in some areas that can provide anchor points for larger interventions. This example of ‘squeezing’ small NBS interventions, such as the planting of trees and the creation of floating habitats into urbanised spaces, shows just how challenging it can be to realise the principles of NBS in practice, even with the best of intentions. While the level of investment in NBS across Europe is laudable, information gained from the many projects across Europe should take the issue of whether the level of investment in NBS, as conceived at present, is commensurate with the level of benefit well beyond the life of these projects. They should also be compared to alternatives within cities that could equally enhance biodiversity, climate resilience, and more, such as improved funding for the management of parks.

If one takes the concept of NBS outside of cities and into areas with more space, however, many of these issues become less complicated and the concept is perhaps more promising.

The management of novel ecosystems or, as discussed in Chap. 5, renewed approaches to the management of cultural landscapes could very much meet the principles outlined in IUCN guidance whilst also addressing a number of challenges outlined throughout this book. For example, one of the contentious elements of novel ecosystems is that their restoration to historical baselines would require intensive investment of time and resources. Managing novel ecosystems to meet the principles of NBS as described earlier, however, could be significantly more cost-effective
than efforts to return to their ‘ideal’ state, whilst offering substantive biodiversity benefits. Moreover, the fact that novel ecosystems are meant to be self-organising and resilient should also lend itself to alignment with the NBS principles and standards. The NBS framing could also help structure discussion about how to develop new goals that focus on environmental, social, and economic challenges people care about. It is evident that improved management of most novel ecosystems could bring benefits across a range of those challenge areas, and the indicators being used by NBS projects in Europe, though imperfect, do provide insights into new metrics that might be used to define ‘success’ in highly modified and transforming landscapes.

All of this, however, must consider how NBS projects are governed. It is a positive step forward that the NBS projects in Europe are asked to ‘co-produce’ and ‘co-design’ NBS projects, and this is also a major feature of the NBS literature (c.f. Frantzeskaki and Kabisch 2016; Dorst et al. 2019). As discussed at several points in previous chapters, the principles of co-production can enhance adaptive capacity and are central to good knowledge governance. One of the reasons that co-production has featured so heavily is that NBS are meant to be place-based, locally adapted solution (Pauleit et al. 2017; Dorst et al. 2019) that are also developed and implemented in transparent, participatory processes (Cohen-Shacham et al. 2019). The issue of co-production and co-design has been impeded in part by the way these projects have been funded so far.

The investment in NBS in Europe is admirable in that it seeks to test whether NBS actually lives up to its promises when implemented in the real world, which will do a great deal to advance the concept. However, the fact that these are funded with stringent conditions that inhibit flexibility, place-based development of solutions, and other adaptive management principles can significantly limit capacity to adhere to co-production principles. Projects funded by the European Commission generally have to outline what they are going to do before they do it; additionally, although there is room for minor deviations from these plans, most substantive deviations require a fairly involved process of seeing an amendment to the grant.

What this means in practice is that partners on a project need to design a series of NBS interventions before they receive the funding—that is to
say, before they have done a full diagnosis of the areas that are in most need, and before they are able to fully explore issues around feasibility (e.g. where there are willing partners and whether they can align with other NBS or urban greening projects). This process not only precludes meaningful public and stakeholder engagement before the project is implemented, but it also precludes such meaningful engagement during the project, as most of the decisions have already been made and are codified in the funding agreement. In the case of Liverpool, this meant the Liverpool City Council and Mersey Forest, the two leading partners in the project, had to undertake most of the groundwork before funding had been acquired, choosing the demonstration areas, scoping the interventions, and identifying potential willing partners without the ‘co-production’ and ‘co-design’ elements that are meant to be so central to NBS.

It also encourages choices that are not necessarily ideal in terms of the ‘problem-solving’ aspects of NBS. When conditions are attached to successful implementation, it is reasonable to choose places where there are more favourable social, economic, and environmental conditions for the interventions. This ultimately meant choosing areas that had more green space (e.g. Sefton Park) or where few people actually live (e.g. the city centre). Whilst rational and valuable for providing proof of concept, it does undermine what NBS are meant to do. Liverpool is one of the most socio-economically deprived cities in the UK, and it also has green space that is inequitably distributed, with the most economically deprived areas of the city having less access to green space and lower quality green spaces (Urban GreenUP 2017). Most notably, the north of the city was not included in the project, where there is a need for both a green space and the presence of a number of challenges that could be addressed via NBS.

Allowing flexibility on where and what can be implemented would not only allow more tailored, potentially more effective, solutions, but also good governance. Directing investment to areas that are not in the most need raises issues of fairness, and the lack of engagement in where and what would be implemented raises issues of accountability and legitimacy (Chap. 3, Table 3.1). Whilst there were a few consultation opportunities and the partners sought to engage community groups and other stakeholders in the design of a number of interventions, the project was limited in how many collaborative design opportunities it could offer.
Returning to this idea of co-production, for co-production to occur, projects should:

1. Situate the process in a particular context, place, or issue.
2. Explicitly recognise the multiple ways of knowing and doing.
3. Articulate clearly defined, shared, and meaningful goals that are related to the challenge at hand.
4. Allow for ongoing learning among actors, active engagement, and frequent interactions (Norström et al. 2020).

While the project certainly aimed to tailor the NBS interventions to the Liverpool context, this was constrained by the need to choose which aspects of that context would be the focus before the project was even underway. This is not problematic if there are clear opportunities to make substantial adjustments based on the other three principles, but these opportunities are institutionally constrained. These constraints make realising the other three principles nearly impossible, as one cannot develop shared goals when the goals are already established, and multiple forms of knowledge cannot be meaningfully integrated other than as an input to monitoring or as feedback in consultation. Regarding the fourth principle, there were limited, defined points of interaction with the community and other stakeholders, and a general reluctance to engage with the community. This reluctance was for a number of reasons, including past negative experiences with engaging the community, but also because there was concern about building expectations that could not be delivered on under the time and financial constraints. Moreover, although many of the interventions might not be considered particularly innovative in a global sense, for Liverpool and the other Urban GreenUP cities, implementing even the smallest of interventions faced a range of political, technical, legal, and social and cultural barriers (Urban GreenUP 2018b). It could take months of negotiation, design, testing, and legal agreements just to get a few trees planted or a green wall built, and installation could present further challenges. Monitoring such small-scale interventions is equally challenging, and it remains to be seen whether there will be demonstrable impacts across many of the indicators, particularly given the fact that the UK went into lockdown during the
COVID-19 pandemic, which provided its own extensive improvements in air quality and other indicators that could be much more significant than any of the Urban GreenUP NBS.

The nature and extent of these barriers draw into sharp focus the difference between the theoretical promise of NBS and the practical impediments to achieving real change in the way things are done. Increasingly NBS are presented as a force for radical change in urban environments that can bring nature back to cities, fight pollution, build resilience to climate change, and resolve a wide range of social, economic, and democratic challenges. While there are some promising results, there is a need to move beyond the rhetoric and establish conditions for genuine co-production and co-design. This could create the conditions for learning well beyond any single project, and it could build adaptive capacity as well (see Chap. 3, Domain 5). In addition, if NBS are to be mainstreamed, they need to be built into policy (Zwierzchowska et al. 2019). This could not only alleviate some of the institutional barriers, but it could also establish standards for what constitutes NBS and how they should be governed. At present, much of the NBS being implemented amounts to standard urban greening projects. Though they will likely bring improvements on a number of fronts, to advance the concept, they need to be scaled up and, ideally, aligned with international principles to genuinely deliver innovative solutions with nature at their core.

Beyond these urban examples, there is perhaps much greater potential to use NBS as a means to reframe the management of novel ecosystems. The principles and standards established by the IUCN could provide a new way of thinking about what benefits these highly modified ecosystems could provide, and directing attention to resolving place-based challenges align with good governance principles. If NBS is to be a useful tool in addressing many of the concerns discussed through this book, it would need to take its foundations in nature conservation more seriously. As with all conceptual panaceas, NBS offers a vision that is easily embraced by a variety of actors for a variety of reasons. As the process of implementation discussed here indicates, however, these bespoke concerns can eclipse—and have eclipsed—some of the more idealistic goals of NBS.

This does not mean, however, that NBS as a concept should be abandoned. No less than in the case of the current debate over fire...
management regimes in Australia, further engagement in NBS, both conceptually and practically, offers us a chance to refine our goals, make necessary contextual adjusts to implementation, and, above all else, re-frame our discussions and expectations. Poised as we are in the wake of the COVID pandemic at what many see as a potentially transformative moment in environmental discussions, the need for such reflection—and with it the demand for new, more pragmatic notions of implementation—is more urgent than ever.

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