MANAGING BIODIVERSITY STRESSORS TO ENHANCE CLIMATE RESILIENCE

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I. Introduction

Until the Paris Agreement in 2015, climate change instruments, such as the United Nations Framework Convention on Climate Change (UNFCCC) and its 1997 Kyoto Protocol, focused on mitigating greenhouse gas emissions, with adaptation and resilience playing secondary roles.[1] In addition, while it is now well accepted that climate change contributes to the reduction of biodiversity,[2] in 1992, when both the UNFCCC and Convention on Biological Diversity (CBD) opened for signature,[3] this was not necessarily the case.[4] Hence, neither instrument directly refers to the impacts of climate change on biodiversity, nor to the need to consider adaptation and resilience in the context of biodiversity protection. At best, the UNFCCC touches upon this issue when it calls on the parties to address 'adverse events of climate change', which include impacts on the resilience of natural and managed ecosystems.[5]

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[1] United Nations Framework Convention on Climate Change (opened for signature 9 May 1992, entered into force 21 March 1994) 1771 UNTS 107 ('UNFCCC') (197 parties); Kyoto Protocol to the United Nations Framework Convention on Climate Change (opened for signature 11 December 1997, entered into force 16 February 2005) ATS 2 ('Kyoto Protocol') (192 parties); the Paris Agreement (opened for signature 12 December 2015, entered into force 4 November 2016) ATS 24 ('Paris Agreement') (192 parties).

[2] E Brondizio and others (eds), Global Assessment Report on Biodiversity and Ecosystem Services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES 2019); W Steffen and others, *Australia's Biodiversity and Climate Change: A Strategic Assessment of the Vulnerability of Australia's Biodiversity to Climate Change* (Report to the Natural Resource Management Ministerial Council, CSIRO Publishing 2009) 174.

[3] The Convention on Biological Diversity (opened for signature 5 June 1992, entered into force 29 December 1993) 1760 UNTS 79 ('CBD') (196 parties); UNFCCC (n 1).

[4] See, for example, JA McNeely, 'Climate Change and Biological Diversity: Policy Implications' in MM de Boer and RS de Groot (eds) *Landscape Ecological Impacts of Climate Change* (IOS Press 1990).

[5] UNFCCC (n 1) Preamble, arts 1, 3.1, 3.2, 3.3, 4.4, and 4.8; for more on the development and intersections between these international instruments see C Prip, Chapter 2, this volume.

Nevertheless, over the following three decades the international community turned its attention to adaptation and resilience, producing a plethora of international and domestic legal and policy instruments, and calling on regulators to manage climate and non-climatic stressors to biodiversity with the aim of enhancing ecosystem resilience.[6] Climate stressors include temperature changes and droughts, which lead to species' redistribution as well as altered fire regimes, resulting in larger and more intense landscape fires.[7] Non-climatic stressors primarily derive from inadequate management practices, particularly those relating to overexploitation, invasive alien species (IAS) and habitat decline.[8] In addition, climate and non-climatic stressors can exacerbate each other, adding layers of complexity to regulatory regimes.[9] For these reasons, scientists increasingly underscore the importance of adaptive management to maximising the adaptive capacity and resilience of ecosystems.[10] These calls are consistent with the ecosystem approach, adopted by the Conference of the Parties to the CBD in 2000,[11] which focuses on managing for change, as well as integrating Indigenous knowledge and social concerns.[12]

This Chapter evaluates the effectiveness of international legal frameworks, to determine whether conservation and climate law regimes are well-positioned to respond to emerging threats to biodiversity from combinations of climate and non-climatic stressors. As used in this chapter, references to 'the regime' include hard and soft law instruments,

[6] See below, Part III.
[7] Ad Hoc Technical Expert Group on Biodiversity and Climate Change, *Connecting Biodiversity and Climate Change Mitigation and Adaptation: Key Messages from the Report of the Second Ad Hoc Technical Expert Group on Biodiversity and Climate Change* (Secretariat of the Convention on Biological Diversity 2009); M Dunlop and others, *The Implications of Climate Change for Biodiversity Conservation and the National Reserve System: Final Synthesis* (Report to the Australian Government, CSIRO 2012) 31; B Abrahms and others, 'Managing Biodiversity Under Climate Change: Challenges, Frameworks, and Tools for Adaptation' (2017) 26(10) Biodiversity and Conservation 2277, 2289.
[8] Abrahms (n 7) 2289; generally S Maxwell and others, 'The Ravages of Guns, Nets and Bulldozers' (2016) 536 Nature 143.
[9] McNeely (n 4) 11.
[10] Abrahms and others (n 7) 2280, 2289.
[11] 'Ecosystem Approach' Decision V/6 of the 5th Meeting of the UN Conference of the Parties to the CBD (Nairobi, Kenya, 15-26 May 2000) (22 June 2000) UN Doc UNEP/CBD/COP/5/23 ('Decision V/6').
[12] ibid, principles 9, 11, 12.

guidelines, regional and national instruments and implementation measures that address the biodiversity-climate change interface. Overall, it cannot be said that this abundance of law and policy instruments contains sufficiently clear and binding obligations to amount to a law on adaptation, instead being more akin to a range of frameworks, that require transformed law and policy to work together, successfully to promote adaptation.[13]

The analysis highlights at least two challenges: first, international governance systems lack adequate collaboration and coordination mechanisms to facilitate complementary implementation by their parties; and second, doubts remain as to whether management at every scale is truly adaptive, or indeed, whether iterative change is sufficient. Regarding the first challenge, reform proposals and recommendations for improving adaptation span a range of treaty systems and highlight the risk that, in the absence of formal collaboration and coordination mechanisms, these treaty systems may lead to inconsistencies and the potential for conflict in conservation management. The second challenge stems from the fact that law and policy can result in static, rather than adaptive, management, already a significant issue given that there are limits to the adaptive capacity of ecosystems. Accordingly, governments need to transform regimes, not only by implementing adaptation-oriented measures, but also by emphasising the crucial role for mitigation in building climate resilience. Moreover, jurisdictions have existing responsibilities to manage non-climatic stressors, such as IAS and habitat degradation; tasks that they find sufficiently demanding, without the added effort of managing the same for climate resilience.[14]

Consequently, a business-as-usual approach to climate resilience and adaptation is unlikely to be effective at reversing biodiversity loss, calling instead for more flexible measures

[13] B Mayer, 'Climate Change Adaptation Law: Is There Such a Thing?' in B Mayer and A Zahar (eds) *Debating Climate Law* (Cambridge University Press 2021) 310, 311.
[14] RT Corlett, 'Safeguarding our Future by Protecting Biodiversity' (2020) 42(4) Plant Diversity 221, 226.

to deal with changes in real time. Yet, more than one commentator has pointed to the fact that law and policy lag.[15] They suggest that rather than retro-fitting measures to existing regulation, the regime needs to undergo 'transformational change'.[16] The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) has prepared two reports on biodiversity and climate change, calling for just such a transformation.[17] The IPBES-IPCC Workshop Report identified 41 ways to implement transformative change, including treating climate change and biodiversity loss as a synergistic issue, recognising that mitigation and adaptation are linked by the adaptive capacity of ecosystems and calling for transformed governance at the international level to promote cooperation on climate change and protection of biodiversity.[18] Against this backdrop, the discussion that follows identifies the contribution that law and policy can make to boosting efforts in addressing non-climatic stressors, and thus building capacity for species and ecosystems to persist in the face of an ever-changing climate.

The discussion commences in Part II with a brief outline of the literature on adaptive capacity and ecosystem resilience, before moving in Part III to developments at the international level which provide guidance for designing and implementing adaptation-oriented regimes. This is followed in Part IV by an evaluation of the ensuing regime, concluding that legal and governance systems which address climate change adaptation in the context of biodiversity protection need to undergo transformative change.

II. Climate Change, Adaptive Capacity and Ecosystem Resilience

[15] J McDonald, 'Creating Legislative Frameworks for Adaptation' in JP Lalutikof and others (eds) *Climate Adaptation Futures* (Wiley-Blackwell 2013) 126; Mayer (n 13) 315, 318-319.
[16] ibid.
[17] IPBES is an independent intergovernmental body whose Plenary sessions are linked to the work of the United Nations and employees of its secretariat are employed by UNEP. HO Pörtner and others, *IPBES-IPCC Co-Sponsored Workshop Report on Biodiversity and Climate Change* (IPBES 2021) ('IPBES/IPCC Workshop Report'); HO Pörtner and others, *Scientific Outcome of the IPBES-IPCC Co-Sponsored Workshop on Biodiversity and Climate Change* (IPBES 2021) ('IPBES/IPCC Scientific Outcome Report').
[18] IPBES/IPCC Workshop Report (n 17) 14-23, conclusions 2, 3, 5, 22, 26, 41.

As climate change progresses, it will exacerbate continuing biodiversity decline and magnify gaps in regulatory regimes. Governments have not yet succeeded in arresting biodiversity decline and, as noted in the introduction, temperature changes, droughts and increased landscape fires will aggravate this lacuna. Reducing non-climate stressors on biodiversity is well recognised as a strategy for enhancing adaptive capacity and ecosystem resilience – both touted as important mechanisms not just to assist in turning around biodiversity decline but also to facilitate adaptation as the climate changes.[19] Yet, the concepts have not been well-integrated into law.

Resilience, as a general concept 'describes the broad ability of a system to regain fundamental structures, processes, and functioning following disturbances'.[20] Climate resilience has wide-ranging applications that include resilience of communities, ecosystems, food production, economic systems and livelihoods.[21] However, in the context of biodiversity protection, climate resilience and adaptive capacity identify how well species cope with combinations of climate and non-climatic stressors. 'Adaptive capacity' refers to 'dynamics within a specific regime', or in other words, to the way ecosystems adapt to change, making adaptive capacity a component of ecosystem resilience.[22] For this reason, law, policy and measures that support adaptation, are also likely to enhance ecosystem resilience.

The notion of ecosystem resilience is not unique to the twenty-first century, with the idea having been mooted from at least 1973 by Holling, who studied wildlife and insects in the Great Lakes region of the United States of America (USA).[23] Importantly, resilience does not

[19] See, for example, synthesis in NE Heller and ES Zavaleta, 'Biodiversity management in the face of climate change: A review of 22 years of recommendations' (2009) 142(1) Biological Conservation 14.
[20] JC Chambers, CR Allen and SA Cushman, 'Operationalizing Ecological Resilience Concepts for Managing Species and Ecosystems at Risk' (2019) Frontiers in Ecology and Evolution 1, 2.
[21] Paris Agreement (n 1) arts 2.3, 7.2, 7.5.
[22] DG Angeler and others, 'Adaptive Capacity in Ecosystems' (2019) 60 Advances in Ecological Research 1, 3-4.
[23] CS Holling, 'Resilience and Stability of Ecological Systems' (1973) 4 Annual Review of Ecology and Systematics 1, 17.

equate with a static state in nature. Ecosystems can fluctuate, but they are classified as resilient if they can return to their equilibrium. Hollings' ideas are consistent with the later development of a rich body of literature on the importance of resilience and adaptive management.[24]

Resilience and adaptive management, however, do not mean returning ecosystems to a fixed point in time, but refer to transforming ecosystem management to attenuate the susceptibility of ecosystems and biodiversity to climate change.[25] Yet, many biodiversity laws, internationally, regionally and nationally, mandate protection as measured against historical coverage and ecosystem states. A case in point derives from introduced animals, such as dingoes in Australia. Dingoes are not regarded as native, nor protected under biodiversity laws, notwithstanding that they were introduced some 4000 years ago by First Nations peoples.[26] However, dingoes have achieved ecological integration and play an important function as an apex predator, helping to keep rabbits and kangaroos in check.[27] Where management practices rely on fixed temporal scales, rather than ecosystem function, these practices are often exposed as outmoded and unfit for purpose.

While this chapter primarily focuses on non-climate stressors, a changing climate has also contributed to new threats to biodiversity, such as temperature and rainfall changes, which

[24] Examples include Holling (n 23) 17; McNeely (n 4) 11; Steffen (n 2) 167-168; R Friend and M Moench, 'What is the Purpose of Urban Climate Resilience? Implications for Addressing Poverty and Vulnerability' (2013) Urban Climate 98, 99-103; IPBES/IPCC Scientific Outcome Report (n 17) 153; M Hisano, EB Searle and HYH Chen, 'Biodiversity as a Solution to Mitigate Climate Change Impacts on the Functioning of Forest Ecosystems' (2018) 93 Biological Reviews 439-440, 452; A Arneth and others, 'Post-2020 Biodiversity Targets Need to Embrace Climate Change' (2020) 117(49) PNAS 30882, 30883, 30888.

[25] Holling (n 23) 21; X He, 'Legal and Policy Pathways of Climate Change Adaptation: Comparative Analysis of the Adaptation Practices in the United States, Australia and China' (2018) 7(2) Transnational Environmental Law 347, 348; J Wenta, J McDonald and JS McGee, 'Enhancing Resilience and Justice in Climate Adaptation Laws' (2019) 8 TEL 89, 90.

[26] Biodiversity Conservation Act 2016 (Australian State of New South Wales) sch 5; Environment Protection and Biodiversity Conservation Act 1999 (Commonwealth of Australia) s 528; M Hall, 'The Native, Naturalized and Exotic – Plants and Animals in Human History' (2003) 28(1) Landscape Research 5, 8. In some jurisdictions dingoes may be protected in national parks, and for cats, see eg T Low, *Feral Future* (Viking 1999) 256-7; and for rabbits, A Franklin, *Animal Nation* (UNSW Press 2006) 147.

[27] BV Purcell and others, 'Euro-Australian Culture and Dilemmas within the Science and Management of the Dingo, *Canis lupus dingo*' in P Banks, D Lunney and C Dickman (eds) *Science Under Siege: Zoology Under Threat* (Royal Zoological Society of NSW 2012) 114, 116.

have led to increasingly severe and extended droughts, redistributions of species and altered fire regimes.[28] These climate-specific stressors are also threat multipliers, which aggravate background, non-climate risks to biodiversity that society has not succeeded in eliminating.[29] For example, species' redistributions occur as plants and animals shift to find suitable habitat, a circumstance that does not occur simultaneously because species respond to temperature changes in different ways.[30] This results in 'disrupted interactions' that can cause species extinctions and diminish biodiversity.[31]

Altered fire regimes result from a combination of warming temperatures and unsuitable management practices. From North America to the Amazon, Australia, and Europe, warming temperatures have resulted in bigger and more intense wildfires, as well as extended fire seasons, destroying habitat and directly killing wildlife.[32] These impacts are exacerbated by the conversion of wetlands, rainforests and shrublands to agricultural uses, displacing longstanding fire management practices of First Nations peoples, including controlled, low-severity fires.[33]

In addition to exacerbating changes in wildfire regimes, poor land management also results in habitat degradation and fragmentation, which interferes with landscape connectivity

[28] JM Chen, 'Legal Responses in the United States to Biodiversity Loss and Climate Change' in C McManus and B Ong (eds) *Routledge Handbook of Biodiversity and the Law* (Routledge 2017) 109, 112; MA Krawchuk and others, 'Global Pyrogeography: The Current and Future Distribution of Wildfire' (2009) 4(4) *PLoS One* e5102; J Wheatley, 'Biodiversity Under Climate Change: Biogeography, Prospects and Conservation Opportunities' (PhD thesis, University of York 2018) 123 <https://etheses.whiterose.ac.uk/22014/> accessed 4 May 2023.
[29] J Scheffran, 'Climate Change and Weather Extremes as Risk Multipliers' in M Brzoska and J Scheffran (eds) *Climate Change, Security Risks, and Violent Conflicts Essays from Integrated Climate Research in Hamburg*, (Hamburg University Press 2020) 19, 21.
[30] See, for example, Trouwborst, Chapter 10, this volume.
[31] GT Pecl and others, 'Biodiversity Redistribution Under Climate Change: Impacts on Ecosystems and Human Well-Being' (2017) 355 *Science* eaai9214.
[32] MD Flannigan and others, 'Forest Fires and Climate Change in the 21st Century' (2006) 11 Mitigation and Adaptation Strategies for Global Change 847; MA Cochrane and CP Barber, 'Climate Change, Human Land Use and Future Fires in the Amazon' (2009) 15(3) Global Change Biology 601, 604; AJ Pitman, GT Narisma and J McAneny, 'The Impact of Climate Change on the Risk of Forest and Grassland Fires in Australia' (2007) 84(3-4) Climatic Change 383, 383-384, 399; see also, PC McCormack and FS McCormack, Chapter 20, this volume.
[33] MA Cochrane and DMJS Bowman, 'Manage Fire Regimes, Not Fires' (2021) 14 Nature Geoscience 454.

and the ability of species to adapt and survive in the face of climate change.[34] Biodiversity stressors can also interact, so ineffective control of IAS will interfere with the capacity of native species to contend with the impacts of climate change.[35] In Australia, for example, the spread of introduced gamba (*Andropogon gayanus*) and buffel grass (*Cenchrus ciliaris*) has altered fire regimes by promoting the intensity and frequency of fires, threatening species who have not adapted to these changed patterns.[36]

At times, it may be difficult to separate climate and non-climatic stressors.[37] Indeed, the early part of the twenty first century represents something of a watershed moment, with climate change being implicated as the leading cause of ecosystem deterioration, either on its own, or by exacerbating non-climatic stressors.[38] Modelling indicates that the combined impacts of climate stressors and habitat degradation will result in 'a loss of up to 38% of vertebrate species'.[39] This is a telling statistic, because the more diverse an ecosystem is, the more resilience it has to the effects of climate change.[40] Accordingly, protecting biodiversity itself, has benefits beyond the conservation of individual species and populations, extending to safeguarding ecosystems and their functioning.[41]

III. International Law: Climate Resilience, Adaptation and Protecting Biodiversity

Neither the texts of the CBD nor the UNFCCC deal directly with climate resilience or adaptation in the context of biodiversity protection. Indeed, of the instruments negotiated at the Earth Summit, only Agenda 21 attempted to address the integrated challenge of managing both

[34] MJ Glennon and others, 'Relative Contribution of Climate and Nonclimate Drivers in Determining Dynamic Rates of Boreal Birds at the Edge of their Range' (2019) 14(10) Plos One 1, 8.
[35] Dunlop and others (n 7) 32, 57; Corlett (n 14) 225.
[36] TG Martin and others, 'Buffel Grass and Climate Change: A Framework for Projecting Invasive Species Distributions when Data are Scarce' (2015) 17 Biological Invasions 3197, 3199.
[37] Glennon and others (n 34) 2, 6-7.
[38] A Staudt and others, 'The Added Complications of Climate Change: Understanding and Managing Biodiversity and Ecosystems' (2013) 11(9) Frontiers in Ecology and the Environment 494.
[39] Wheatley (n 28) 123-124.
[40] Hisano, Searle and Chen (n 24) 439.
[41] ibid.

climate change and biodiversity, and this is a non-binding document.[42] Even so, international instruments already target non-climatic stressors and in the three decades following the Earth Summit, treaty systems have increasingly provided footholds for linking these two issues.

A. Biodiversity and Non-Climatic Stressors

The international community has adopted a range of instruments that specifically target non-climate stressors on biodiversity, that occur independently of measures targeting climate change. Article 8 of the CBD, for example, addresses in-situ conservation, which amongst other things targets habitat degradation, the impacts of IAS, establishing a system of protected areas and incorporating the knowledge and practices of Indigenous and local communities.[43]

Turning first to IAS, treaty systems other than the CBD also deal with these species, including the World Organisation for Animal Health and the International Plant Protection Convention.[44] While these arrangements focus on regulating pests and diseases of plants and animals in international trade, to the extent that IAS managed under the aegis of these systems assists with protection of plants and animals in the wild, obligations imposed on member states provide another component in safeguarding biodiversity. Elsewhere, provisions on managing IAS are found in global treaties, reports and resolutions adopted by the Conferences of the Parties (COPs), including the Convention on the Conservation of Migratory Species of Wild

[42] 'Agenda 21', UN Conference on Environment and Development (Rio de Janeiro, Brazil, 3-14 June 1992) (13 June 1992) paras 9.19, 12.19, 17.1(e), 18.1, 35.2.
[43] CBD (n 3) arts 8(a), 8(b), 8(f), 8(h), 8(l) 8(j).
[44] International Agreement for the Creation at Paris of an International Office for Dealing with Contagious Diseases of Animals and Annex (opened for signature 25 January 1924, entered into force 12 January 1925) ATS 15 ('World Organisation for Animal Health' or the 'OIE') (181 parties); the International Plant Protection Convention (opened for signature 17 November 1997, entered into force 2 October 2005) ATS 23 ('International Plant Protection Convention') (184 parties). Examples of relevant instruments implemented under these conventions include the 'Terrestrial Animal Health Code' (OIE 2021) <www.oie.int/en/what-we-do/standards/codes-and-manuals/terrestrial-code-online-access/> accessed 4 May 2023, and the 'Pest Risk Analysis for Quarantine Pests: International Standard for Phytosanitary Measures No. 11' (UN Food and Agriculture Organization (UNFAO) 2019) <www.fao.org/3/j1302e/j1302e.pdf> accessed 4 May 2023.

Animals (CMS)[45] and the United Nations Convention on the Law of the Sea (LOSC),[46] as well as regional treaties, such as the Convention for the Protection of the Marine Environment and Coastal Area of the South-East Pacific[47] and the Protocol Concerning Mediterranean Specially Protected Areas and Biological Diversity in the Mediterranean.[48] The totality of these instruments, however, does not amount to a binding (nor coherent) global regime for IAS; instead, dealing only with selected components of the IAS problem.[49]

Habitat protection follows a similar pathway. Beyond provisions found in the CBD, the text of treaties such as the Convention on Wetlands of International Importance Especially as Waterfowl Habitat (Ramsar Convention)[50] and the Convention for the Protection of the World Cultural and Natural Heritage (World Heritage Convention)[51] contain obligations to protect and conserve habitat.[52] Although the Articles do not specifically refer to climate change, they are nevertheless sufficiently broad to empower management of non-climatic stressors to contribute to ecosystem resilience in the face of climate change.

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[45] Convention on the Conservation of Migratory Species of Wild Animals (opened for signature on 23 June 1979, entered into force 1 November 1983) 1651 UNTS 333 ('CMS') (133 parties) arts II, III(4) and V(4); 'Invasive Alien Species and Migratory Species', 17th Meeting of the Scientific Council of the CMS (Bergen, Norway, 17-18 November 2011) UNEP/CMS/ScC17/Doc.11, Agenda Item 19.5, 19.

[46] UN Convention on the Law of the Sea (opened for signature on 10 December 1982, entered into force 16 November 1994) ATS 31, art 196 (175 parties and three associate parties).

[47] Protocol for the Protection of the Marine Environment and The Coastal Area of the South-East Pacific to the Agreement on the Protection of the Marine Environment and The Coastal Area of the South-East Pacific (opened for signature on 21 September 1989, entered into force on 24 January 1994) (5 parties) art VII, available at the Permanent Commission of the South Pacific, 'International Instruments' (*Comisión Permanente del Pacífico Sur*, n.d.) <http://cpps.dyndns.info/consulta/index.php/instinter/capitulo-i> accessed 8 May 2023.

[48] Protocol Concerning Mediterranean Specially Protected Areas and Biological Diversity in the Mediterranean to the Convention for the Protection of the Marine Environment and the Coastal Region of the Mediterranean (opened for signature 22 October 1999, entered into force 12 December 1999) 42 Official Journal of the European Community L 322/3 (Council Decision 1999/800/EC)(the 'Mediterranean Protocol') art 7; 'Action Plan Concerning Species Introductions and Invasive Species in the Mediterranean', Decision of the 15th Meeting of the Parties to the Mediterranean Protocol (15 January 2008) UNEP(DEP)/MED IG.17/10 (Annex V, Decision IG17/111) <www.informea.org/en/decision/decision-meeting-fifteenth-meeting-contracting-parties-convention-protection-marine-11> accessed 4 May 2023.

[49] O Outhwaite, 'Biosecurity, Invasive Species and the Law' in CR McManis and B Ong (eds) *Routledge Handbook of Biodiversity and the Law* (Routledge 2018) 83, 90-91, 93.

[50] Convention on Wetlands of International Importance Especially as Waterfowl Habitat (opened for signature 2 February 1971, entered into force 21 December 1975) 996 UNTS 246 ('Ramsar Convention') (172 parties).

[51] Convention for the Protection of the World Cultural and Natural Heritage (opened for signature 23 November 1972, entered into force 17 December 1975) ATS 47 (194 parties).

[52] ibid art 5; Ramsar Convention (n 50) arts 3.1 and 4.1.

B. Biodiversity and Climate Change

In 1992, Agenda 21 touched on climate change and ecosystem resilience, in the context of protecting the atmosphere, combating desertification and drought, protecting the oceans and making effective use of science to develop long-term policies and strategies.[53] In the decades that followed, the CBD has increasingly drawn attention to the need for national law and policy to support adaptation in the context of climate change.[54] In 2008, the COPs agreed to integrate climate change concerns into CBD programs, taking into account instruments issued under the auspices of the UNFCCC, including reports of the Intergovernmental Panel on Climate Change.[55] This trajectory was reinforced by the 2010 COPs of the CBD which adopted a number of influential decisions, including: Decision X/2 on The Strategic Plan for Biodiversity 2011-2020 and the Aichi Biodiversity Targets; Decision X/20 on Cooperation with Other Conventions and International Organizations; and, decision X/33 on Biodiversity and Climate Change.[56] These decisions called for greater emphasis on adaptation and ecosystem resilience, as well as collaboration and cooperation with other international institutions. In addition, Decisions X/2 and X/33 operate in synergy, underscoring the importance of the ecosystem approach, particularly the use of adaptation measures and the integration of activities to reduce non-climatic stressors, such as habitat degradation and impacts of IAS.[57]

As already indicated, the ecosystem approach was adopted by the COPs in 2010. It is particularly germane to adaptation mechanisms because Principle 9 calls on managers to

[53] Agenda 21 (n 42) paras 9.19, 12.19, 17.1(e), 18.1, 35.2.
[54] E Morgera, 'Far Away, So Close: A Legal Analysis of the Increasing Interactions between the Convention on Biological Diversity and Climate Change Law' (2011) 2(1) Climate Law 85, 85.
[55] 'Biodiversity and Climate Change' Decision IX/16, adopted at the 9th Meeting of the Conference of the Parties to the CBD (Bonn, Germany 19-30 May 2008) (9 October 2008) UNEP/CBD/COP/DEC/IX/16.
[56] Report of the 10th Meeting of the Conference of the Parties to the CBD (Nagoya, Japan, 18-29 October 2010) (20 January 2011) UNEP/CBD/COP/10/27*; 'Strategic Plan for Biodiversity 2011-2020, including Aichi Biodiversity Targets' Decision X/2, 'Cooperation with Other Conventions and International Organisations and Initiatives' Decision X/20, and 'Biodiversity and Climate Change' Decision X/33, each adopted at the 10th Meeting of the Conference of the Parties to the CBD (Nagoya, Japan, 18-29 October 2010) (29 October 2010) UNEP/CBD/COP/DEC/X/2, UNEP/CBD/COP/DEC/X/20 and UNEP/CBD/COP/DEC/X/33.
[57] CBD Decision X/33 (n 56) 27, para 8; CBD Decision V/6 'Ecosystem Approach' (n 11) principle 9.

anticipate and deal with change, as well as reduce existing threats to biodiversity and keep alternative management approaches open.[58] Moreover, in promoting the ecosystem approach, decision X/33 cements the role of adaptive management and the need to manage non-climatic stressors as ways of building ecosystem resilience.[59] The nexus between climate change and protection of biodiversity is also a cross-cutting issue, supported by a dedicated web platform which identifies how adaptation measures can be integrated into work programs of the CBD.[60]

What is more, over the last twenty years or so, the secretariats and parties to both the Ramsar Convention and the World Heritage Convention have specifically turned their minds to the linkages between their treaty systems and climate change. For example, in 2002, at the eighth meeting of the COP to the Ramsar Convention, the conference called on parties to increase their resilience to climate change by promoting wetland protection.[61] Elsewhere, decisions under the Ramsar Convention acknowledge the importance of traditional knowledge systems, including Indigenous peoples and local communities, in planning for adaptation.[62] In a similar way, the World Heritage Convention has produced a policy initiative, stressing the significance of integrating climate change and adaptation plans, to improve resilience at world

[58] CBD Decision V/6 'Ecosystem Approach' (n 11) 103, 106.
[59] CBD (n 3); Heller and Zavaleta (n 19) 15; M Fitzmaurice, 'Biodiversity and Climate Change' (2021) 23 International Community Law Review 230, 233.
[60] CBD Decision X/33 'Biodiversity and Climate Change' (n 56).
[61] 'Climate Change and Wetlands: Impacts, Adaptation, and Mitigation', Resolution VIII.3 of the 8th Meeting of the Conference of the Parties to the Ramsar Convention (Valencia, Spain, 18-26 November 2002), paras 14, 17; for a more detailed discussion about climate change and Ramsar wetlands, <www.ramsar.org/document/resolution-viii3-climate-change-and-wetlands-impacts-adaptation-and-mitigation> accessed 15 May 2023, see R Caddell, Chapter 3, this volume.
[62] 'Wetlands for a Sustainable Urban Future: Cultural Values and Practices of Indigenous Peoples and Local Communities and their Contribution to Climate-Change Mitigation and Adaptation in Wetlands', Resolution XIII.15 of the 13h Meeting of the Conference of the Contacting Parties to the Ramsar Convention (Dubai, United Arab Emirates, 21-29 October 2018), paras 15, 24, 25.

heritage sites.[63] The policy underscores the importance of strong legislative frameworks, which will support implementation at the national level.[64]

C. Climate Change Instruments

Climate instruments have typically ignored biodiversity loss, focusing instead on human adaptation. However, in very recent times, the climate COPs have started to recognise the deeply intertwined nature of climate change and biodiversity loss and its implications for planet Earth. The UNFCCC, for example, initially focussed on mitigating climate change by imposing binding obligations on industrialised countries to reduce their greenhouse gas emissions.[65] Adaptation and climate resilience were regarded as policy objectives, rather than mandatory duties, primarily seen in terms of developing countries, who were expected to adapt as an operative priority, rather than move to approaches that created fewer emissions.[66] As such, adaptation was not underpinned by substantive obligations, although ecosystem resilience was sufficiently important to warrant two provisions: inclusion in the definition of adverse climate change impacts and the requirement to disseminate information on national activities regarding adaptation.[67] In a similar vein, the 1997 Kyoto Protocol concentrated on developing countries, with the expectation that developed countries should minimise the adverse effects of climate change on developing countries and assist with adaptation costs.[68]

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[63] Convention concerning the Protection of the World Cultural and Natural Heritage (opened for signature 16 November 1972, entered into force 17 December 1975) 1037 UNTS 151; and see, United Nations Educational, Scientific and Cultural Organization (UNESCO), 'Climate Change and World Heritage' (*UNESCO World Heritage Convention Online*, n.d.) <https://whc.unesco.org/en/climatechange/> accessed 8 May 2023.
[64] ibid 4; for more detail on the World Heritage Convention and climate change, see Lyman and others, Chapter 9, this volume.
[65] UNFCCC (n 1) art 4, annex II.
[66] ibid arts 1, 8; G Sforna, 'Climate Change and Developing Countries: from Background Actors to Protagonists of Climate Negotiations' (2019) 16 International Agreements 273, 274-275.
[67] UNFCCC (n 1) arts 1, 4(1)(b).
[68] Kyoto Protocol (n 1) arts 3.14 and 12.8. UNFCCC (n 1) art 1 defines 'adverse effects' of climate change.

Notions of resilience and adaptation gained greater traction at the beginning of the twenty first century in sessions held in Montreal,[69] Nairobi,[70] (Cancun,[71] Durban,[72] and Paris.[73] These initiatives led to three important programmatic and institutional outcomes: the Nairobi Work Programme (2005/6); the use of National Adaptation Plans (2010); and the establishment of the Adaptation Committee (2010).

The Nairobi Work Programme was first established in 2005 as an unnamed body under the auspices of the UNFCCC's Subsidiary Body for Scientific and Technological Advice (SBSTA).[74] Its aims were broad, without specifically referring to biodiversity, and included the identification of vulnerabilities, impacts and adaptation to climate change as well as the dissemination of that knowledge among the parties to the UNFCCC.[75] It was anticipated that the program would particularly assist least developed, and small island developing states. The scope and expected outcomes emphasised cooperation among governments, as well as stakeholders from civil society, not only to improve management of climate change risks, but also to integrate adaptation measures, notably within the framework of sustainable development.[76] At the next COP, this programme became known as the 'Nairobi Work Programme on Impacts, Vulnerability and Adaptation to Climate Change'.[77] The Nairobi Work

[69] Report to the 11th Meeting of the Conference of the Parties to the UNFCCC (Montreal, Canada, 28 November-10 December 2005) (30 March 2006) FCCC/CP/2005/5/Add.1 ('2005 Montreal Report'), decision 2/CP.11.
[70] Report to the 12th Meeting of the Conference of the Parties to the UNFCCC (Nairobi, Kenya, 6-17 November 2006) (26 January 2007) FCCC/CP/2006/5, 26 [80], 17, 26.
[71] 'Addendum Part Two', Report to the 16th Meeting of the Conference of the Parties to the UNFCCC (Cancun, Mexico, 29 November-10 December 2010) (15 March 2011) ('2010 Cancun Report') FCCC/CP/2010/7/Add.1, Decision 1/CP.16, para 15.
[72] 'Addendum Part Two', Report to the 17th Meeting of the Conference of the Parties to the UNFCCC (Durban, South Africa, 28 November–11 December 2011) (15 March 2012) ('2011 Durban Report') FCCC/CP/2011/9/Add.1, Decision 5/CP.17.
[73] Paris Agreement (n 1).
[74] The SBSTA was established under the UNFCCC (n 1), art 9; '2005 Montreal Report' (n 69).
[75] ibid 8, annex.
[76] ibid 7.
[77] ibid 17, para 80.

Programme operates through the SBSTA and the program has been extended by the use of National Adaptation Plans.[78]

These National Adaptation Plans, which initially targeted least developed countries, were introduced at the COP at Cancun in 2010 as part of the Cancun Agreements, incorporating the Cancun Adaptation Framework.[79] That COP also acknowledged the importance of addressing adaptation on an equivalent footing with mitigation and established the Adaptation Committee to assist with implementation of the plans.[80] Yet, the development and implementation of these plans has been slow. At the end of 2020 a report by the Subsidiary Body for Implementation[81] documented the progress by least developed countries, concluding that while progress had been made, gaps persisted in a number of areas, including environmental monitoring and access to funding.[82]

The Adaptation Committee and the Nairobi Work Programme regularly collaborate and in 2014 met to discuss Indigenous and traditional knowledge in the context of adaptation.[83] They identified that Indigenous and traditional knowledge was critical to adaptation, but that challenges still remain in mainstreaming that knowledge into legislation, guidelines and protocols.[84] Indigenous knowledge, for example, can be critical to managing fire regimes in jurisdictions such as Australia and the Americas, where altered fire management has led to destructive wildfires.[85]

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[78] 2010 Cancun Report (n 71) 5, para 15.
[79] ibid.
[80] ibid 4, paras 2(b) and 13 ('Cancun Adaptation Framework') and 5, para 20 ('Adaptation Committee').
[81] Established pursuant to UNFCCC (n 1) art 10.
[82] UNFCCC Subsidiary Body for Implementation, *Progress in the Process to Formulate and Implement National Adaptation Plans: Note by the Secretariat* (20 November 2020) ('Progress on National Adaptation Plans') FCCC/SBI/2020/INF.13, 5-6 para 14.
[83] 'Report on the Available Tools for the Use of Indigenous and Traditional Knowledge and Practices for Adaptation, Needs of Local and Indigenous Communities and the Application of Gender-Sensitive Approaches and Tools for Adaptation', Report to the 40th Meeting of the UNFCCC Subsidiary Body for Scientific and Technological Advice (Bonn, Germany, 4-15 June 2014) (8 May 2014) FCCC/SBSTA/2014/INF.11*.
[84] ibid 9, para 21(c).
[85] L Gillson, C Whitlock and G Humphrey, 'Resilience and Fire Management in the Anthropocene' (2019) 24(3) Ecology & Society 14, 20, 23.

The call to strengthen the response to climate adaptation was reinforced by the Paris Agreement, which emphasised the need for governments to introduce policy objectives that enhanced adaptive capacity and strengthened ecosystem resilience, including by 'sustainable management of natural resources'.[86] In a similar vein, in 2011 the COP at Durban concluded that adaptation should be based on national priorities and integrated into 'relevant social, economic and environmental policies and actions'.[87] These expectations presuppose that national policies and actions are amenable to the incorporation of adaptation plans. Given that countries have differing capabilities and financial needs, the finding by the Subsidiary Body for Implementation that access to financing created barriers for least developed countries to implement adaptation plans, indicates significant challenges for those countries both with regard to biodiversity conservation and also with respect to adaptation to climate change.

Generally speaking, the notion of adaptation in climate change agreements has a strong anthropocentric focus, emphasising the needs of vulnerable people and communities, without specifically targeting protection of biodiversity. At best, biodiversity rates a mention as part of ecosystem resilience in definitions of adverse climate change impacts, or in non-binding parts of treaties, such as the preamble.[88] Consequently, this elevates the importance of other treaty systems for protecting biodiversity as the climate changes, including the CBD.

To recap thus far: scientists, policy makers and parties to treaty systems recognise the importance of managing biodiversity stressors for ecosystem resilience. This involves a multi-pronged response, including mitigation of anthropogenic climate change, as well as adaptation by managing climate and non-climatic stressors to biodiversity. At the international level, these approaches have generated much material but it is questionable whether, collectively, this

[86] Paris Agreement (n 1) arts 7.1, 7.9(e), 8.4(h) and 10.1.
[87] 2011 Durban Report (n 72) Decision 6/CP.17, 80.
[88] Paris Agreement (n 1) preamble.

material has been, or is likely to be, effective in leading to improved climate resilience. As Mayer concludes, notwithstanding the growing importance of adaptation, its meaning and objectives have not been clearly articulated and international instruments establish 'few if any obligations on states';[89] and that is as true for biodiversity adaptation as it is for human communities. At the national level, engagement with adaptation for biodiversity largely occurs by way of policy instruments or is otherwise integrated into existing management systems, such as the creation and maintenance of protected areas, as well as controlling IAS.[90] However, using treaty systems as a means of facilitating and rapidly upscaling adaptation, will also magnify failings in those systems.

IV. Reflections on Legal Frameworks: The Call for Transformative Change

At face value, governments have a great many resources at their fingertips, including the legal and policy instruments discussed above, that provide guidance and information on adaptation, biodiversity and climate change. It is, therefore, remarkable that more has not been achieved with regard to habitat loss, IAS and overexploitation. One reason for this, as identified by Mayer, derives from the voluntary nature of international instruments. There are at least two further reasons why jurisdictions face an uphill battle in designing and implementing effective measures to address threats to biodiversity. First, proposals, recommendations and obligations are scattered across a range of treaty systems, leading to inconsistent policy underpinnings and performance mechanisms. Second, the conservation law regime suffers from gaps in coverage and implementation. While some gaps stem from the fragmented nature of the regime, others stem from lack of political will and resource constraints.

A. Collaboration and Conflict

[89] Mayer (n 13) 310, 311.
[90] ibid.

The COPs of various treaty systems recognise the importance of cooperation and collaboration.[91] However, each is managed as if it were a separate concern, with governance structures making it difficult to treat climate change and biodiversity as an interconnected issue.[92] Even where regimes refer to the need for collaboration, this does not necessarily lead to cooperative efforts, because goals are not aligned and the focus of each treaty varies.[93] This regulatory fragmentation demonstrates the need for better integrated governance regimes, a point taken up by the IPBES 'Scientific Outcome' Report on Biodiversity and Climate Change, which emphasised that climate change and biodiversity are interdependent.[94] The report pointed to the fact that reducing non-climatic stressors will 'maximize the opportunity for wild organisms and ecosystems to adapt and survive climate change'.[95] Although biodiversity protection already deals with managing non-climatic stressors, such as IAS and habitat degradation, climate change introducers a multiplier effect, calling for greater and more effective efforts to deal with non-climatic stressors.

Article 8.4(h) of the Paris Agreement, for example, identifies areas for cooperation to include resilience of communities and ecosystems. In a practical sense, however, adaptation and resilience is predominantly seen in terms of human needs, including food production and livelihoods, notwithstanding additional references in the agreement to environmental policies.[96] Human needs are of course important, and climate change is expected disproportionately to affect vulnerable communities, a consequence aggravated by COVID-19.[97] This, however, leaves treaty systems such as the CBD with the responsibility of devising

[91] CBD Decision X/20 (n 56); Paris Agreement (n 1) arts 7.6, 7.7, 8.4, 11.3, 12, 14.3.
[92] Morgera (n 54) 87.
[93] Corlett (n 14) 226.
[94] IPBES/IPCC Scientific Outcome Report (n 17) 20.
[95] ibid.
[96] Paris Agreement (n 1) arts 2.3, 7.2, 7.5.
[97] 'Nationally Determined Contributions under the Paris Agreement, Synthesis Report by the Secretariat', Report to the 3rd Meeting of the Conference of the Parties Serving as the Meeting of the Parties to the Paris Agreement (Glasgow, Scotland, 31 October-12 November 2021) (17 September 2021) ('2021 Paris Agreement Synthesis Report') FCCC/PA/CMA/2021/8, paras 158 and 170.

and planning for climate resilience in a biodiversity context, without any direct and explicit mandate to tackle the effects of activities that have undermined biodiversity resilience, such as agriculture, forestry, aquaculture, mining, human health, and transportation. While the approach of the climate regime may be seen as leaving the protection of biodiversity to the expertise of the CBD, guidelines and recommendations still need to be drawn together. Above all, non-climatic stressors are closely connected to, and driven by, these other areas of international legal concern, so biodiversity conservation and adaptation cannot be achieved effectively without closer regulatory collaboration.[98] Moreover, as discussed, these issues are exacerbated by the fact that many instruments rely on voluntary measures without adequate accountability systems.[99]

In 2001, the UNFCCC, the CBD and the United Nations Convention to Combat Desertification in those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa (Desertification Convention)[100] established a Joint Liaison Group (JLG), aligned as the 'Rio Conventions', meeting periodically to consider how to interact better. The terms of reference for the JLG were settled in 2011, confirming a synergistic approach encompassing the sharing of information, including on interlinkages and technical issues and promoting better coordination at the national level.[101] Although the JLG has undertaken valuable work, a 2009 document indicated that challenges to more effective cooperation included the differing reporting cycles of each treaty system and the fact that the JLG can only implement requested activities where they are authorised by the governing bodies of each

[98] IPBES/IPCC Scientific Outcome Report (n 17) 153.
[99] ibid.
[100] United Nations Convention to Combat Desertification in those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa (opened for signature on 14 October 1994, entered into force 26 December 1996) ATS 18 (114 parties).
[101] Secretariat to the CBD, 'Terms of Reference and Modus Operandi for the Joint Liaison Group between the Three Rio Conventions' Agreed at the 11th Meeting of the Joint Liaison Group of the Rio Conventions (Bonn, Germany, 11 April 2011) <www.cbd.int/cooperation/doc/jlg-modus-operandi-en.pdf> accessed 8 May 2023.

convention.[102] A further analysis in 2022 of the linkages between international instruments dealing with climate change and biodiversity concluded that, while the CBD has been enthusiastic in consolidating climate change into their work, until recently, the UNFCCC had demonstrated less inclination to incorporate the protection of biodiversity into its work programmes.[103]

One proffered suggestion is for the COPs of the CBD and the UNFCCC to hold sessions together, to develop compatible targets as well as reduce dependency on non-binding measures and improve accountability processes.[104] Holding joint sessions is also an important factor in finding common ground where mitigation or adaptation measures result in actual or possible conflict with biodiversity protection. By way of example, the COPs of Ramsar have drawn attention to the potential for revegetation activities pursuant to the Kyoto Protocol to damage the ecological character of wetlands.[105] In an analogous vein, afforestation can mitigate climate change and assist with adaptation, yet where it uses non-native plants, it can lead to extensive monocultures that reduce ecosystem resilience and biodiversity, as well as forcing out local people, diminishing their connection with the land.[106] Again, wind farms can mitigate climate change by replacing fossil fuels with renewable wind energy but they also have the potential to destroy and fragment habitat during construction,[107] disrupt flight patterns for migratory

[102] Report to the 9th Meeting of the Joint Liaison Group of the Convention on Biological Diversity, the United Nations Convention to Combat Desertification, and the United Nations Framework Convention on Climate Change (New York, United States of America, 14 May 2009) parts V-VII.
[103] E Tsioumani, *Linkages and Synergies Between International Instruments on Biodiversity and Climate Change* (Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), International Institute for Sustainable Development and Helmholtz Centre for Environmental Research 2022) 18.
[104] C Turney, A-G Ausseil and L Broadhurst, 'Urgent Need for an Integrated Policy Framework for Biodiversity Loss and Climate Change' (2020) 4(996) Nature Ecology & Evolution 996.
[105] Ramsar Convention, Resolution III.3 (n 61).
[106] IPBES/IPCC Workshop Report (n 17) 18-19.
[107] For example, *Gullen Range Wind Farm Pty Limited v Minister for Planning* [2010] NSWLEC (7 May 2010) para 130, in which the New South Wales Land and Environment Court referred to potential habitat fragmentation in areas occupied by platypus (*Ornithorhynchus anatinus*).

species[108] and kill birds and bats during operation.[109] In these cases, an integrated strategy that enabled treaty systems to work synergistically would be more effective than current systems in ensuring that climate mitigation or adaptation activities do not themselves become biodiversity stressors. Overall, enhancing cooperative efforts is important to improving outcomes for biodiversity, because in managing climate and non-climatic stressors, regulators face significant regulatory hurdles.[110] As discussed, while the JLG promotes cooperative approaches, nonetheless, measures to protect biodiversity and deal with climate change are bedevilled by 'uncertainty around knowledge, contested values, and unclear decision-making pathways'.[111] Consequently, decision makers need to be responsive, in real time, an approach that calls for flexibility and synergy, which integrates the setting of goals and objectives for climate change and protection of biodiversity at the same time and together.[112]

B. Gaps and Implementation Challenges

Regulatory gaps and implementation challenges occur as a result of complex interplays of political will, resource constraints, lack of flexibility in management approaches and regulation that targets single stressors such as IAS. Moreover, ecosystems have limits to their adaptive capacity, so mitigation is critical to increasing the prospect of biodiversity surviving and having time to adapt to climate change, particularly because regulators have not been successful in halting biodiversity decline, indicating that current approaches to managing non-climatic stressors are wanting.[113].

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[108] S Jana and PM, 'The Impacts of Wind Farms on Animal Species' (2008) 58(5-6) Acta Veterinaria (Beograqd) 627.
[109] WP Kuvlesky Jr and others, 'Wind Energy Developments and Wildlife Conservation: Challenges and Opportunities' (2007) 71(8) The Journal of Wildlife Management 2487, 2489; M Santos and others, 'Predicting the Trends of Vertebrate Species Richness as a Response to Wind Farms Installation in Mountain Ecosystems of Northwest Portugal' (2010) 10(2) Ecological Indicators 192, 203; JK Larsen and M Guillemette, 'Effects of Wind Turbines on Flight Behaviours of Wintering Common Eiders: Implications for Habitat use and Collision Risk' (2007) 44 Journal of Applied Ecology 516, 516.
[110] Arneth and others (n 24) 30882.
[111] IPBES/IPCC Scientific Outcome Report (n 17) 124.
[112] ibid.
[113] ibid 19-20.

C. Mitigation, Adaptation and Political Will

The fact that mitigation and adaptation are linked is underscored by Article 7.4 of the Paris Agreement, which observes that stronger levels of mitigation can reduce the need for, and cost of, adaptation measures. Notwithstanding this finding, a synthesis report presented at the COP in Glasgow indicates that countries are not on track to limit global temperature rise to 2 degrees Celsius by the end of the twenty first century, let alone limit temperature rise to 1.5 degrees Celsius, the preferred option.[114] This lacklustre progress imposes greater expectations on the potential for adaptive forms of management, which take into account how ecosystems and biodiversity are reacting to climate change, to arrest biodiversity decline. Yet, to be effective, adaptation needs to be translated into law and policy, which to a large degree hinges on economic and political influences, including the political will of governments and available resourcing.[115]

A stark example of the significance of political will derives from Australia. In 2011 the Federal Government introduced the Clean Energy Act 2011, which placed a price on carbon for approximately 500 of the country's highest polluters, such as electricity and mining companies.[116] The scheme commenced in July 2012 and as of January 2014, it had reduced emissions by 4.2 megatons of greenhouse gases, indicating it had the potential to be very successful.[117] Nevertheless, the scheme was dismantled in July 2014 following a change of government, which repealed the legislation because of its perceived cost on business.[118] After

[114] 2021 Paris Agreement Synthesis Report (n 97) 6, paras 14, 15.
[115] D Bodansky, 'Prologue to the Climate Change Convention' in IM Mintzer and JA Leonard (eds) *Negotiating Climate Change: The Inside Story of the Rio Convention* (Cambridge University Press 1994) 45, 47.
[116] Clean Energy Act 2011 (Commonwealth of Australia).
[117] Australian Climate Change Authority, *Reducing Australia's Greenhouse Gas Emissions – Targets and Progress Review* (Commonwealth of Australia 2014) 81.
[118] Clean Energy Legislation (Carbon Tax Repeal) Act 2014 (Commonwealth of Australia). In 2023, the Albanese Government introduced the *Safeguard Mechanism (Crediting) Amendment Act 2023*, targeting 215 of the worst polluters and obliging them to reduce their greenhouse gas emissions by 4.9 per cent over the next five years (sch 1). It is too early to tell the impact this legislation will have.

this debacle, Australia has continued to lack meaningful policies to reduce its emissions, signalling that it is unlikely to meet its international commitments. In this context, adaptation plans are more crucial, but also more difficult to implement.[119]

Lack of political will can also hamper regional cooperation. In the Asian Region, the South Asian Association for Regional Cooperation (SAARC) was established in 1985, initially as an economic and political initiative, but later as an institution that also included protection of the environment as an area for mutual cooperation.[120] However, in the main, SAARC has been critiqued for not promoting environmental cooperation, notwithstanding its acknowledgment that regional measures to deal with climate change adaptation need much more work.[121] Part of the reason for this shortcoming stems from limitations in resources and capacity, along with the fact that national laws and policies, including those on climate change, are not regularly updated, making it impractical to negotiate a unified regional policy.[122]

Even in jurisdictions which take a leading role in the development of policy, instruments can be obscure in making the linkages between climate change and non-climatic stressors, potentially leading to sub-optimum conservation measures. The European Union (EU) , for example, has taken a leading role in guiding the development of policy on climate resilience.[123] In 2021 it adopted a strategy, 'Forging a climate-resilient Europe - the new EU Strategy on Adaptation to Climate Change' (EU Adaptation Strategy).[124] The strategy

[119] K Crowley, 'Fighting the Future: The Politics of Climate Policy Failure in Australia (2015-2020)' (2021) 12(5) WIREs Climate Change 1, 1-4.
[120] Migrant Forum in Asia, 'South Asian Association for Regional Cooperation (SAARC)' (*Advocacy Programs*, April 2016) <https://mfasia.org/mfa_programs/advocacy/south-asian-association-for-regional-cooperation/> accessed 8 May 2023; H Zafarullah and AS Huque, 'Climate Change, Regulatory Policies and Regional Cooperation' (2018) 21(1) Public Administration and Policy 22, 26-27.
[121] Zafarullah and Huque (n 120) 26, 29.
[122] ibid; but for an analysis of legal frameworks for climate and biodiversity laws in Asia, see Eales and McCormack, Chapter 17, this volume.
[123] C Damro, I H and D MacKenzie, 'The EU and Climate Change Policy: Law, Politics and Prominence at Different Levels' (2008) 4(3) Journal of Contemporary European Research 179, 179.
[124] European Commission Communication 82, 'Forging a Climate-Resilient Europe – The New EU Strategy on Adaptation to Climate Change' (24 February 2021) COM (2021) 82 ('EU Adaptation Strategy').

pointedly notes that even if drastic efforts are made to reduce emissions, the impacts of climate change will persist for decades, signifying that 'substantial adaptation efforts would still be required'.[125] With this in mind, the EU Adaptation Strategy provides leadership in the region and beyond by cooperative efforts that focus on countries vulnerable to climate change, such as Africa, Small Island Developing States and Least Developed countries. The preferred approach is a 'humanitarian-development-peace' initiative, based on cooperation and alleviating pressure on resource constraints by providing technological assistance and exchange of information.[126] If this policy is successful, it could provide an example of a framework for regional governance of adaptation law and policy as a starting point for analogous developments elsewhere around the world.

Nevertheless, the most recent biodiversity strategy adopted by the EU, 'EU Biodiversity Strategy for 2030, Bringing Nature Back Into Our Lives' and its annexed action plan (EU Biodiversity Strategy)[127] does not effectively link biodiversity and climate change. The EU Biodiversity Strategy begins by observing that biodiversity decline and the climate crisis are 'intrinsically linked', identifying the main drivers of biodiversity loss as including both climate change, and non-climatic stressors such as over exploitation and IAS.[128] The EU Biodiversity Strategy also refers to the need to 'decarbon[ise]… the energy system', and in conjunction with the Action Plan refers to policies that can improve responses to climatic and non-climatic threats to biodiversity, including planting three billion trees by 2030, improving the management of protected areas and nature restoration.[129] Notwithstanding these references, and the apparent political commitment to addressing the combined global crises of biodiversity

[125] ibid 1.
[126] ibid 18.
[127] European Commission Communication 380, 'EU Biodiversity Strategy For 2030 – Bringing Nature Back Into Our Lives' (20 May 2020) ('EU Biodiversity Strategy') COM (2020) 380.
[128] ibid 2.
[129] ibid 10, annex 'Action Plan' 2-4.

loss and climate change, the EU Biodiversity Strategy and the EU Adaptation Strategy do not appear to be integrated. For example, apart from the specific goal of tree planting, the broad statements of these two instruments lack clearly defined outcomes and do not cross refer.

D. Adaptative Management and Flexibility of Measures

As noted above, healthy ecosystems have a greater potential for adapting and recovering from climate change than degraded ecosystems.[130] Adaptive management has been identified as an important regulatory tool for monitoring and managing for ecosystem health, particularly as the climate changes and novel conservation interventions are deployed, or ecosystem restoration seeks to create conditions other than by reference to an historical baseline.[131] Adaptive management requires continuous monitoring and adjustment of measures, allowing decision makers to respond quickly to changes in ecological condition, including due to extreme events such as wildfires or droughts, but also to generate detailed information about the relevant ecosystem to underpin more effective, anticipatory and tailored management arrangements.[132]

Active monitoring and adjusting interventions for effective adaptive management are, however, both time consuming and expensive, presenting significant obstacles to achieving adaptive management in individual cases, let alone developing a consistent global adaptive management framework.[133] While developing and least developed countries are likely to experience financial limitations most intensely, developed countries also experience

[130] IPBES/IPCC Scientific Outcome Report (n 17) 124; EU Biodiversity Strategy (n 127) 2.
[131] For example, C Murray and D Marmorek, 'Adaptive Management and Ecological Restoration', in P Friederici (ed) *Ecological Restoration of Southwestern Ponderosa Pine Forests* (Island Press 2003) 417; L Greig and others, 'Insight into Enabling Adaptive Management' (2013) 18(3) *Ecology and Society* 24.
[132] ibid.
[133] CT Moore and others, 'Adaptive Management in the US National Wildlife Refuge System: Science-Management Partnerships for Conservation Delivery' (2011) 92 Journal of Environmental Management 1395, 1398.

restrictions on their financial resources;[134] rendering effective, adaptive management for biodiversity a global challenge. National adaptation plans may represent some progress towards adaptation,[135] but not all jurisdictions have drafted and implemented these plans and not all use monitoring to gauge the progress of adaptation.[136] Without this information it is difficult for regulators to develop law and policy that respond to the finely balanced approach required of adaptive management;[137] and, in fact, there are few examples and a great deal of complexity in effectively implementing adaptive management through domestic laws.[138] On the one hand, decision-making frameworks need to be sufficiently certain to allow for monitoring, accountability and continuity of measures.[139] On the other hand, they need to be sufficiently flexible to deal with the unpredictable nature of climate change and to accommodate alternative knowledge systems such as those deriving from Indigenous peoples.[140]

One aspect of biodiversity law in which adaptive management is particularly necessary, and for which adaptive management offers important opportunities to improve biodiversity conservation as the climate changes, is the management of protected areas.[141] In the context of habitat protection, regulators tend to rely on protected areas, which by their nature are more tightly managed than other areas in terms of non-climatic stressors, such as IAS control and habitat degradation.[142] Yet, to date, protected areas cover only approximately 15 per cent of land and 7.5 per cent of the ocean,[143] and there is no guarantee that they will be a panacea for

[134] Progress on National Adaptation Plans (82) 5-6, para 14.
[135] 2021 Paris Agreement Synthesis Report (n 97) 30, para 155.
[136] ibid para 155(b).
[137] Mayer (n 13) 310, 315.
[138] J McDonald and M Styles, 'Legal Strategies for Adaptive Management under Climate Change' (2014) 26(1) Journal of Environmental Law 25.
[139] McDonald (n 15) 127.
[140] IPBES/IPCC Scientific Outcome Report (n 17) 153.
[141] See, for example, SL Tanner-McAllister, J Rhodes and M Hockings, 'Managing for climate change on protected areas: An adaptive management decision making framework' (2017) 204(1) Journal of Environmental Management 510.
[142] IPBES/IPCC Workshop Report (n 17) 16.
[143] ibid.

climate resilience or ecosystem adaptation.[144] Undoubtedly protected areas play an important role in preserving biodiversity, but world-wide their creation has not stopped biodiversity loss.[145] Resource constraints also mean that regulators are unable to preserve areas and ecosystems representative of species that need protecting; and in general, landscapes continue to be subject to 'anthropogenic pressures, such as land clearance', which will be exacerbated by the impacts of climate change.[146] This leads to a fragmented and piecemeal system that does not safeguard ecological processes which are important for maintaining climate resilience.[147]

Moreover, protected areas are rarely selected and managed as a means of adapting to climate change.[148] Consequently, managers tend not to be able to address matters such as species' shifts – including the movement of IAS – in real time. For example, species' shifts have been identified in Australia with respect to buffel grass, which was introduced into northern Australia in the nineteenth century as a grazing grass but has spread beyond grazing land and is driving habitat loss and ecosystem degradation across sensitive arid ecosystems.[149] Modelling demonstrates that climate change will likely cause the grass to decrease in the north of the continent and increase in the south.[150] This shift presents regulators with 'a window of management opportunity', allowing them to implement area-based strategies to stop or control the spread of buffel grass, but regulators need to manage specifically for this contingency, rather than applying a broad, inflexible strategy.[151] In addition, although protected area-based

[144] J Baille and Y-P Zhang, 'Space for Nature' (2018) 361(640) Science 1051.
[145] IPBES/IPCC Workshop Report (n 17) 16.
[146] BT Trew and IMD Maclean, 'Vulnerability of Global Biodiversity Hotspots to Climate Change' (2021) 30 Global Ecology and Biogeography 768, 769.
[147] PC McCormack, 'The Legislative Challenge of Facilitating Climate Change Adaptation for Biodiversity' (2018) 92 Australian Law Journal 546, 558-59.
[148] Dunlop and others (n 7) 6.
[149] Australian Government, *Ecosystem Degradation, Habitat Loss and Species Decline in Arid and Semi-Arid Australia due to the Invasion of Buffel Grass (Cenchrus ciliaris and C. pennisetiformis): Threat Abatement Advice* (Commonwealth of Australia 2021) <www.dcceew.gov.au/environment/biodiversity/threatened/threat-abatement-advices/buffel-grass-introduction> accessed 9 May 2023.
[150] P Zhang and others, 'Species Range Shifts in Response to Climate Change and Human Pressure for the World's Largest Amphibian' (2020) 735(2) Science of the Total Environment 139543, 8, 32.
[151] ibid.

measures may not eliminate IAS, such measures can help to highlight new areas for invasion, provide supplementary habitat for species that are affected by IAS such as buffel grass in surrounding areas, and create crucial ecological corridors that contributing to ecological connectivity and foster adaptation, as species' ranges are already shifting to adapt to new conditions'.[152]

Notwithstanding the significance of protected areas, it is also important to keep in mind that over-reliance on them can lead to lack of flexibility and a 'static' approach towards regulation.[153] Where this occurs it is often compounded by the fact that policymakers can be hesitant to try new methods, such as restoration on a landscape scale.[154] This hesitancy frequently occurs because conservationists who frame the debate tend to emphasise criteria and management practices familiar to them, hindering attempts at managing non-climatic stressors.[155]

Where species shifts are occurring across international boundaries, regulatory challenges become more pronounced because of the need for regional and international cooperation.[156] In treaty systems such as the CMS, references to protecting and restoring habitat throughout the range of migratory species impose a level of obligation, but the provisions neither have a climate change focus, nor do they specify adaptive management.[157]

Another area of regulation for non-climate stressors, that can benefit biodiversity adaptation and resilience if the framework embedded greater flexibility, is the management of

[152] S Woodley, J Jarvis and A Rhodes, 'Ensuring Area-Based Conservation Meets the Twin Challenges of Biodiversity Loss and Climate Change' (2021) 37(3) Parkes Stewardship Forum 456-457, 460
[153] Arneth and others (n 24) 30888.
[154] SM Hagerman and T Satterfield, 'Entangled Judgments: Expert Preferences for Adapting Biodiversity Conservation to Climate Change' (2013) 129 Journal of Environmental Management 555, 555, 561.
[155] ibid 561.
[156] GT Pecl and others (n 31) 7.
[157] CMS Convention (n 45) arts II and III; for more analysis on this point and the novel interpretation and policy efforts being implemented under CMS to mitigate this potential impact on biodiversity adaptation, see R Caddell, Chapter 3, this volume, and A Trouwborst, Chapter 10, this volume.

fire regimes and integration of Indigenous knowledge. Climate change is hastening biodiversity loss and ecosystem degradation by increasing the severity and occurrence of landscape fires.[158] Although fire is often a natural element of forest and bushland areas, a warming climate has lengthened the fire season, placing additional demands on fire regulators, accompanied by the potential for devastating impacts on biodiversity and ecosystems 'at national to global scales'.[159] Against this backdrop, Indigenous knowledge holders and cultural fire practitioners around the world have advocated for new, more ecologically and culturally sensitive ways of engaging with fire.[160] Australian bush regions as well as savanna landscapes in Australia, Africa, the Great Plains of the USA and South America, have an extensive record of Indigenous fire management practices.[161] With European occupation, however, strategies changed in many cases from burning to fire suppression.[162] This has resulted in more intense and frequent fires, which in New South Wales, Australia, killed an estimated three billion native vertebrates during the 2019-2020 fire season.[163]

Indigenous fire practices vary, but one commonality is the use of a mosaic burning pattern, which disrupts the fuel base, lessening the intensity and spread of fires.[164] Notwithstanding the modification of landscape by European colonisation, and climate change itself, Indigenous practices provide complementary foundations for management.[165] Yet,

[158] EU Biodiversity Strategy (n 127) 2.
[159] M Flanagan and others, 'Impacts of Climate Change on Fire Activity and Fire Management in the Circumboreal Forest' (2009) 15 Global Change Biology 549, 549, 558-559.
[160] For example, K Copes-Gerbitz, SM Hagerman and LD Daniels, 'Transforming Fire Governance in British Columbia, Canada: An Emerging Vision for Coexisting with Fire' (2022) 22 Regional Environmental Change 48; SA Clark, A Miller and DLHankins, 'Good Fire: Current Barriers to the Expansion of Cultural Burning and Prescribed Fire in California and Recommended Solutions' (Final Report, Karuk Tribe 2021).
[161] Gillson, Whitlock and Humphrey (n 85) 23.
[162] Clark, Miller and Hankins (n 160).
[163] WWF Australia, *Australia's 2019-2020 Bushfires: The Wildlife Toll* (WWF Australia 2020) 2.
[164] R Fisher and N Burrows, 'We are Professional Fire Watchers, and We're Astounded by the Scale of Fires in Remote Australia Right Now' (*The Conversation*, 7 December 2021) <https://theconversation.com/we-are-professional-fire-watchers-and-were-astounded-by-the-scale-of-fires-in-remote-australia-right-now-172773> accessed 8 May 2023.
[165] J Ansell and others, 'Contemporary Aboriginal Savanna Burning Projects in Arnhem Land' (2020) 29(1) International Journal of Wildland Fire 371, 372.

western-based law and policy can be hostile to Indigenous practices, including by advancing historical European perspectives which create protected areas from which Indigenous peoples and traditional fire regimes are often excluded.[166] Examples of laws that suppress Indigenous fire practices include The Environmental Penal Law of Venezuela, the Forest Code in Brazil, and the Forest Act 2009 of Guyana.[167] Elsewhere, even where regulation permits planned burning in protected areas,[168] park managers may persist with efforts aimed at fire suppression.[169] The latter treats fire as a hazard, evincing a lack of political will, not only in engaging with Indigenous perspectives concerning fire management, but also, engaging more broadly with adaptive management of fire-adapted biodiversity. These anomalies evince the complexity of legal processes that underpin regimes, indicating that 'international, regional and local governance systems must…[become] mutually supportive for goals to be achieved'.[170]

In Australia, incorporation of Indigenous perspectives on fire management is piecemeal. New South Wales has a cultural fire management policy, but it only applies in National Parks and needs better integration into broader landscape management in state and local laws and policies.[171] A different situation presents in Northern Australia, where savanna fire management has been led by Indigenous managers for at least a decade, as a tool for

[166] B Bilbao and others, 'Sharing Multiple Perspectives on Burning: Towards a Participatory and Intercultural Fire Management Policy in Venezuela, Brazil, and Guyana' (2019) 2(3) *Fire* 39, 56; M Shawn-Fletcher and others, 'Catastrophic Bushfires, Indigenous Fire Knowledge and Reframing Science in Southeast Australia' (2021) 4(3) Fire 61.
[167] ibid, citing Ley Penal del Ambiente, República Bolivariana de Venezuela, Gaceta Oficial No. 39.913 (Official Gazette No. 39,913); Guyana Forestry Commission (GFC), 'An Overview of Forest Fire Management in Guyanas', in the Proceedings of the Second Regional Seminar on Forest Fires in The Amazon Region (Sao Paulo, Brazil, 17–21 October 2016).
[168] Kenya Grass Fire Act [1972] (revised edition 2012) ch 327.
[169] KW Nyongesa and H Vacik, 'Fire Management in Mount Kenya: A Study of Gathiuru Forest Station' (2018) 9(8) Forests 481, 481.
[170] J Russell-Smith and others, 'Can Savanna Burning Projects Deliver Measurable Greenhouse Emissions Reductions and Sustainable Livelihood Opportunities in Fire-Prone Settings?' (2017) 140 Climate Change 47, 56.
[171] Australian State of New South Wales (NSW) and Office of Environment and Heritage, *National Parks and Wildlife Service Cultural Fire Management Policy* (NSW Government 2016); for a summary of other jurisdictions in Australia, see Commonwealth of Australia, 'Cultural Burning Practices in Australia', A Background Paper to the Royal Commission into National Natural Disaster Arrangements (Commonwealth of Australia 2020) 6-10.

reducing carbon emissions under the national Carbon Farming initiative.[172] Not only has Indigenous fire management substantially reduced the area burned each year, but it has also reduced greenhouse gas emissions by 'more than seven million tonnes of carbon dioxide equivalent'.[173] The Western Arnhem Land Fire Abatement project[174] is typical of these initiatives and it operates as an eligible offset project under Commonwealth legislation, contributing to a twenty million dollar a year industry.[175]

The experience of Northern Australia provides a compelling example of how Indigenous practices could help to lead a shift in top-down regulation of fire as a hazard, towards more flexible, adaptive, small-scale and culturally inclusive approaches to fire that reduce the impact of fire on biodiversity, as well as provide a means of mitigating climate change. This does not, however, suggest that management aims at returning ecosystems to a point in the past, but instead it uses Indigenous know-how to transform management practices and deal with problems, in real time.[176]

E. Invasive Alien Species

The fact that Article 8(h) of the CBD calls on the parties to prevent the entry of, and eradicate, alien species that threaten biodiversity indicates international recognition that jurisdictions need to manage IAS. In addition, from at least 2001, the CBD reinforced that IAS were a world-wide phenomenon, predicted to increase rapidly in extent and severity by the 21st century.[177]

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[172] Now the Emissions Reduction Fund, see R Fisher and J Altman, 'The World's Best Fire Management System is in Northern Australia, and it's led by Indigenous Land Managers' (*The Conversation* 10 March 2020) <https://theconversation.com/the-worlds-best-fire-management-system-is-in-northern-australia-and-its-led-by-indigenous-land-managers-133071> accessed 5 May 2023.
[173] ibid.
[174] The Western Arnhem Land Fire Abatement project is part of the Indigenous Carbon Industry Network, where Indigenous owners and rangers use customary fire knowledge for landscape scale fire management, ALFA Arnhem Land Fire Abatement (ALFA NT, n.d.) <www.alfant.com.au> accessed 8 May 2023.
[175] Ansell and others (n 165) 374; Carbon Credits (Carbon Framing Initiative) 2011 (Commonwealth of Australia); Fisher and Altman (n 172).
[176] Russell-Smith and others (n 170) 55.
[177] 'Invasive Alien Species, Status, Impacts and Trends of Alien Species that Threaten Ecosystems, Habitats and Species' Report to the 6th Meeting of the Subsidiary Body on Scientific, Technical and

This prescient observation came with the in-built complication, identified as early as 1990 by JA McNeely,[178] that it would not be possible to predict how species would respond to climate change.[179]

As already indicated, at the international level, international instruments that manage IAS run the gamut from the CBD to the World Organisation for Animal Health and the International Plant Protection Convention.[180] Each of these instruments deals with a specific facet of the IAS problem resulting in a piece-meal and inconsistent regime. Binding obligations are imposed in some respects, such as preventing the introduction of pests and disease by way of international trade, while elsewhere, notably in biodiversity instruments, IAS management provisions largely remain voluntary.[181] In addition, regional and national instruments also vary in their degree of compulsion, comprising a mixture of policy documents, legislation and subordinate rules.[182]

Apart from the uneven nature of the legal framework, difficulties already identified in this Chapter such as resource constraints and shortfalls in political will, apply equally to the regulation of IAS. Hence, developing countries (and indeed, developed countries) are more likely to allocate scarce resources towards protection of agricultural industries or areas that are ecologically valuable.[183] One telling response to a recent survey conducted by the CBD on

Technological Advice ('SBTTA') to the CBD (Montreal Canada, 12-16 March 2001) (26 February 2001) UNEP/CBD/SBSTTA/6/INF/11, 8.

[178] McNeely was the chief conservation officer for the IUCN; McNeely (n 4) 16.

[179] ibid.

[180] CBD (n 3) art 8(h); OIE, Terrestrial Animal Health Code 2021 and UNFAO, Pest Risk Analysis for Quarantine Pests 2019 (n 44).

[181] Outhwaite (n 49) 90-91, 93; an exception is CBD art 8(h) which calls on parties to prevent the introduction of, and control and eradicate, IAS.

[182] Examples include Regulation (EU) 1143/2014 of the European Parliament and the Council on the Prevention and Management of the Introduction and Spread of Invasive Alien Species (22 October 2014) 57 Official Journal of the European Community L 317/35; Australian Invasive Plants and Animals Committee, *Australian Pest Animal Strategy 2017-2027* (Australian Department of Agriculture and Water Resources 2016) <www.awe.gov.au/sites/default/files/sitecollectiondocuments/pests-diseases-weeds/consultation/apas-final.pdf> accessed 8 May 2023.

[183] A Bonner, A Biglan and K Drugan-Eppich, 'The Dismal State of Federal Funding for Experimental Evaluations of Interventions to Reduce Greenhouse Gas Emissions' (2021) Perspectives on Behavior Science 1, 26; FC Aguiar

IAS, clearly spells out the challenge of allocating resources to achieve effective outcomes, noting that, that for small island nations in the Pacific, baseline activities such as gathering comprehensive and complete data are resource intensive (something that is likely to resonate across jurisdictions): 'I don't know of any country that has managed to achieve this internationally'.[184] In some cases, as occurs in confined areas such as islands, or where species have only recently been introduced, eradication is practicable. [185] Land managers, for example, have been able to eradicate IAS on Macquarie Island by baiting and shooting.[186] However, in other cases, particularly those involving animal IAS, broadscale killing is rarely effective as a long-term strategy.[187] In some cases this is attributable to re-bound increases in populations due to enhanced availability of food and resources for remaining population.[188] In other cases, older animals, such as wild boars, have learned to avoid shooters. [189] Part of the problem is lack of knowledge and critical evaluation of data, calling into question the capacity of regulators to manage the IAS problem by using the same methods that have thus far failed.[190]

What is more, in some jurisdictions, society has begun to question regulatory reliance on killing animals classified as IAS, adding layers of complexity to regulation.[191] At the

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and others, 'Adaptation to Climate Change at Local Level in Europe: An Overview' (2018) 86 Environmental Science and Policy 38, 47-48.

[184] 'Comments from the Survey on Headline Indicators Post-2020 Global Biodiversity Framework', Report to the 24th Meeting of the SBSTTA to the CBD (Meeting Online, 3 May-9 June 2021) (23 May 2021) CBD/SBSTTA/24/INF/29, 416, 150.

[185] P Olsen, *Australia's Pest Animals, New Solutions to Old Problems* (Australian Bureau of Rural Sciences 1998) 53.

[186] Australian Department of the Environment, 'Fact Sheet: Macquarie Island: from Rabbits and Rodents to Recovery and Renewal' (Commonwealth of Australia 2014) <www.dcceew.gov.au/sites/default/files/env/pages/f47bc054-b46d-40f2-85a5-7825525bfb48/files/fs-macquarie-island.pdf> accessed 8 May 2023.

[187] Olsen (n 185) 31, 53; B Zeng and Rolf Gerritsen, 'Inadequate Contribution of Commercial Harvest to the Management of Feral Camels in Australia' (2013) 56(8) Journal of Environmental Planning and Management 1212, 1212-3.

[188] Olsen (n 185) 31, 41, 53.

[189] ibid 55.

[190] J Gurevitch and D Padilla, 'Are Invasive Species a Major Cause of Extinctions?' (2004) 19(9) TRENDS in Ecology and Evolution 470, 470, 474.

[191] G Wandesforde-Smith and others, 'Coping with Human-Cat Interactions Beyond the Limits of Domesticity: Moral Pluralism in the Management of Cats and Wildlife' (2021) 11 Frontiers Veterinary Science 682582; S Riley, 'Listening to Nature's Voice: Invasive Species, Earth Jurisprudence and Compassionate Conservation' (2019) 22(1) Asia Pacific Journal of Environmental Law 117; S Riley, 'Horses, Ethics and Culture: Wildlife

international level, Article 12 of the CBD Guiding Principles for the Prevention, Introduction and Mitigation of Impacts of Alien Species that Threaten Ecosystems, Habitats or Species (Guiding Principles IAS)[192] states that eradication techniques should be 'ethically acceptable' to stakeholders. This notion has already provided a rich area for debate, thwarting eradication programs in Italy and Australia. In the former case, a proposed cull of grey squirrels near Turin was halted after a group of animal advocates commenced litigation against the cull;[193] while in the latter case, decades of proposals to cull wild horses in the Kosciuszko National Park have caused public outcry, most recently, to such an extent that the New South Wales state government passed the Wild Horse Heritage Act 2018 (NSW), temporarily halting a planned cull until a new management plan commences.[194]

Another problem stems from the fact that by focussing on individual IAS as isolated stressors, regulators do not engage with interactions among climate and non-climatic threats.[195] An evaluation of the Federal government's 2015 Threat Abatement Plan for Predation by Feral Cats, is instructive.[196] Table A1 of the plan contains a list of 84 mammal species that may be adversely affected by feral cats and the relative risk of cat predation compared to other stressors.[197] For eight vulnerable species, there were more than four stressors whose impacts

Regulation in Kosciuszko National Park' (2019) 36 Environmental and Planning Law Journal 674; SL Crowley, S Hinchliffe, RA McDonald, 'Killing Squirrels: Exploring Motivations and Practices of Lethal Wildlife Management' (2018) 1(1-2) Environment and Planning E: Nature and Space 120, 130; I Braverman, 'Animals and the Law in the American City' in Keith H Horokawa (ed) Environmental Law and Contrasting Ideas of Nature, A Constructivist Approach (Cambridge University Press 2014) 12-13.

[192] 'Guiding Principles for the Prevention, Introduction and Mitigation of Impacts of Alien Species that Threaten Ecosystems, Habitats or Species', Decision VI/23 of the 6th Meeting of the Parties to the CBD (The Hague, Netherlands, 2002) (27 May 2002) UNEP/CBD/COP/6/20 240.

[193] Judgment No. 4009 *Spagnesi and Genovesi v The Republic of Italy* [2000] Court of Appeal of Turin – IV, (copy on file with author); Sandro Bertolino and Piero Genovesi, 'Spread and Attempted Eradication of the Grey Squirrel (*Sciurus carolinensis*) in Italy and Consequences for the Red Squirrel' (2003)109 Biological Conservation 351, 354.

[194] See generally, S Riley, 'Horses, Ethics and Culture' (n 191); New South Wales Department of Planning, Industry and Environment, *Kosciuszko National Park Wild Horse Heritage Management Plan* (NSW Government 2021).

[195] Staudt and others (n 38) 500.

[196] Australian Department of the Environment, *Threat Abatement Plan for Predation by Feral Cats* (Commonwealth of Australia 2015).

[197] ibid 30.

were equal to, or greater than the threats posed by cats.[198] In addition, the risks posed by humans (altered fire regimes, altered weather patterns, habitat alteration, habitat destruction, vehicle mortality) accounted for almost 60 per cent of the total risks, while risks attributed to IAS accounted for 37.5 per cent of the total risks.[199] Consequently, where biodiversity loss is attributed to a range of causative factors, focussing exclusively on one IAS will not necessarily provide positive outcomes, although dealing with one isolated stressor allows national authorities to demonstrate that they are doing something.[200]

V. CONCLUSION

Climate change is emerging as the biggest threat to biodiversity, not only because of its direct impacts, such as temperature increases and drought, but also because it intensifies non-climatic threats, such as altered fire regimes and the effects of IAS.[201] International law indicates that regulators should manage for climate resilience, by implementing adaptive management and introducing measures that deal with combinations of climate and non-climatic threats.

Adaptive management is an iterative process that requires continual monitoring and adjustment of measures, yet in some cases its integration into legal instruments appears to have stagnated. Habitat degradation for example, is often seen in terms of managing protected areas, and in the main, does not grapple with the benefits presented by alternative understandings, such as Indigenous land management practices. Moreover, addressing non-climatic stressors, such as IAS, is problematic when the underlying system is fragmented and does not adequately take into account interactions among climate and non-climatic stressors. Moreover, due to

[198] S Riley and others, 'Submission to the House of Representatives Standing Committee on the Environment and Energy Inquiry into the Problem of Feral and Domestic cats in Australia (Cat Inquiry)' (17-20, July 2020), submission 151, <www.aph.gov.au/Parliamentary_Business/Committees/House/Former_Committees/Environment_and_Energy/Feralanddomesticcats/Submissions> accessed 8 May 2023.
[199] ibid.
[200] ibid, 17, 21.
[201] McCormack (n 147) 546.

limits on the adaptive capacity of ecosystems, climate resilience cannot be separated from mitigation measures.[202] At the same time, these difficulties are exacerbated by the fact that countries are not meeting important milestones, such as biodiversity and mitigation targets, making it more difficult to manage non-climatic threats and build climate resilience.[203]

The totality of these challenges indicates that countries are not as well placed as they could be to manage emerging biodiversity stressors from climate change, let alone deal with the compounding effects of climate change on existing stressors. This has led to calls for transformative change to governance systems as well as the regulation that underpins them. Primarily, greater cooperation is needed among treaty systems and if regulation is to be truly adaptive it needs to embrace new ways of managing biodiversity stressors, as well as ecosystems and the environment at large.

[202] Corlett (n 14) 226.
[203] ibid.