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Responsible Forest-centred Climate Policy

Abstract

The 2021 Glasgow Climate Pact and latest IPCC reports unequivocally recognise that urgent, concerted action is needed to address the interconnected crises of climate change and biodiversity. These twin emergencies are now viewed as one and forests are at the centre of this emergent but dominant discourse. Aotearoa New Zealand faces the challenge of addressing this call to action and is well resourced to responsibly answer. There are multiple forestry models available to the government to select from, but often the difficulty lies in discerning the differences between models. Here we tackle this issue by assessing the spectrum of forestry models and evaluating the biodiversity and carbon sequestration outcomes of each. We then suggest that models which incorporate native species are best placed to solve the twin crises and, as such, government should prioritise native forests in its climate policy framework.

Keywords climate change, biodiversity, forest models, carbon sequestration, native species

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Climate–biodiversity–society

The nexus of biodiversity, society and climate is now firmly embedded in the climate agenda. The recent United Nations Intergovernmental Panel on Climate Change (IPCC) reports (the sixth assessment report) and United Nations Framework Convention on Climate Change (UNFCCC) Glasgow Climate Pact (2021) explicitly recognise that the protection, conservation and restoration of nature is key to limiting temperature increases to 1.5°C above the pre-industrial level and to adapting to climate change. The inclusion of biodiversity in the Glasgow Climate Pact's preamble and mitigation section acknowledges that climate change and biodiversity loss are not only interconnected through system links and feedbacks, but are the most pressing issues of the Anthropocene (IPBES, 2021). Therefore, the response should be to address these two challenges simultaneously.

At the centre of efforts to address the twin crises are forests. Forests tightly connect the two: carbon is absorbed by and stored in forests. Forests lessen the deleterious effects of climate change and regulate the climate. The climate change crisis, in turn, poses a serious threat to forest biodiversity and ecosystems. Risks range from wildfires and floods through to plant and animal pests, weeds and pathogens that exacerbate extinction and can lead to ecological tipping points.

The global recognition that both biodiversity and climate change are part of the same complex problem has resulted in public and private solutions that are close to win–wins, but others that solve one crisis at the expense of the other. In the quest to rapidly sequester atmospheric carbon, opportunities for restoration of biodiversity are often overlooked. Large-scale afforestation of monocultures is an example of solving one aspect of the climate biodiversity problem to the potential detriment of the other. Such policy trade-offs need to be carefully considered to ensure that adaptation, mitigation, equity and justice are all taken into account. The caution against planting large-scale monocultures in the race to reduce emissions has been echoed in recent reports from the IPCC on adaptation and mitigation, the Royal Society and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES).

In Aotearoa New Zealand we are acutely confronted with both the biodiversity and climate change crises. More than 4,000 native species are threatened or are at risk of extinction (Department of Conservation, 2020) and seven of the past nine years have been the warmest on record (National Institute of Water and Atmospheric Research, 2021). The two crises are not mutually exclusive. The effects of climate change are pervasive and threaten the health and functional capacity of ecosystems, and the goods and services they afford, across terrestrial, freshwater and marine environments.

Climate change pressures in the marine environment are widespread and difficult to control. The oceans are warming and changing in chemistry at broad geographic scales. Changes in phytoplankton abundance and distribution have been observed in coastal waters, with implications for the wider marine food web. Frequent pulses of unusually warm water ('marine heatwaves') are affecting the reproductive capacity of fish species and contributing to the loss of habitat-forming kelp forests. Many of our taonga marine species, including pāua, tuangi (cockles), kuku (mussels) and kina, are particularly sensitive to ocean acidification and will face growing pressures as the effects of climate change continue to be realised into the future.

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The government needs to respond responsibly to the international call to action. Forest-focused climate policy has the potential to address the two crises simultaneously, as well as meeting the short- and long-term needs of Māori, rural communities and forest-centric regions. Decisions made about forests have broader implications, such as the impacts of the release of sediment from clear-cut felling on coastal environments and communities.

A siloed approach

Since the 1990s, forests have been used as climate policy tools. At the inception of the Emissions Trading Scheme (ETS) in 2008, forests were included as tradeable units for offsetting emissions (Carver, Dawson and Kerr, 2017; Leining and Kerr, 2018). Forests earn units as they grow and forest owners face liabilities if carbon stocks are reduced through deforestation or harvesting. Because Pinus radiata (radiata pine) is known to sequester high volumes of carbon over a short time frame, investors and forest owners are favouring this species over other forestry techniques and compositions. Under the ETS, exotics comprise 90% of the 343,877 hectares registered as post-1989 forest, with the remainder being native species (Ministry for Primary Industries, 2021).

In 2019 the government updated its 2002 climate legislation. The Climate Change Response (Zero Carbon) Amendment Act 2019 established a new framework for reducing emissions and put in place a 2050 target to reach net zero. Against this target, government must set five-year emissions budgets. The first round of emissions reduction plans is due by 31 May 2022. The first emissions reduction plan is based on a four-year duration, from 2022 to 2025. This plan will outline the policies and strategies to meet the 2050 target. In 2020 the ETS accounting and operational settings were also reformed to better align with the targets under the Climate Change Response (Emissions Trading Reform) Amendment Act 2020.

In the consultation document for the emissions reduction plan, *Te Hau Mārohi ki Anamata: transitioning to a low-emissions and climate-resilient future* (Ministry for the Environment, 2021), forests are categorised into two classes: exotics and natives. The consultation document infers that the exotic class is *Pinus radiata*, whereas the term natives is used as a catch-all for the full diversity of species and forest types, from native conifers to broadleaved trees and beech. This classification follows a functionalist logic which can be traced back to early 20th-century colonial concerns about an impending timber famine and soil erosion due to agricultural practices (Brown, 1991; Brooking and Pawson, 2011; Roche, 2013; Starr, 2002). After rapid destruction of native forests, government authorities decided on radiata pine as the solution for providing a supply of wood, with natives dismissed as growing at the wrong pace and in the wrong place (Starr, 2002, p.281). Over the following decades radiata pine was planted extensively, and the genetics improved through government funding and research.

The classification of forests into radiata pine and natives has been remarked on by others as a siloed approach to land use (Hall, 2018). It ignores the biodiversity, sociocultural and adaptation features of a more integrated approach that would include natives. In recent climate policy discourse, most notably in the draft emissions reduction plan, this siloed approach still predominates. This is despite the expressed intention to treat offsetting and the ETS as only one part of a package (Ministry for the Environment, 2021, p.21) for tackling climate change. In the draft emissions reduction plan, sequestration is the deciding factor in how the species are treated separately and classified into exotics and natives. The predilection is clearly for radiata pine, which yields a higher rate compared to natives (Ministry for Primary Industries, 2017; Aimers, Bergin and Horgan, 2021). This bias sidelines other features of a more integrated approach and fails to recognise that biodiversity loss is part of the same complex problem as climate change.

Integrated forestry models

Multiple forest models are available to address the twin existential crises, but these are in general difficult to distinguish, and, first, effort must be made to decentre the focus on ETS in the government's forest-centred climate policy response. To assist in this, here we outline the main forestry models and describe the dual carbon and biodiversity outcomes for each.

Model 1: Rotational exotic carbon forestry

This model piggybacks on the predominant production forestry model in Aotearoa New Zealand, which is rotational timber plantations comprising even-aged stands of radiata pine harvested by clear-fell over rotations of 20–30 years. The model offers rapid carbon sequestration in the short term, but carbon credits can only be claimed from the first forest rotation, meaning the benefits of carbon trading from this forestry model are very short-term. Due to the simple composition and structure of the forest, and short time frame of rotation, this model offers little in terms of biodiversity benefits. In addition to failing to yield meaningful biodiversity benefits, there are often externalities arising from this form of carbon forestry, such as wilding invasions, soil erosion and sedimentation, and adverse visual amenity effects.

Model 2: Permanent exotic carbon forestry

This model normally comprises radiata pine planted in a regime to optimise carbon sequestration (high stem densities at large scales) in the first few decades, on the premise that native tree species will take up canopy dominance in the long term, making the forest permanent (Casey, McKinlay and Kerr, 2021). This model has been referred to colloquially as 'plant-and-leave' carbon forestry. However, experience to date suggests that these forests are not managed once they are established or have no provision for long-term forest permanence (i.e., tending regimes to promote regeneration are lacking, the ecological context and macroclimate are often unsuitable, there are inadequate levels of ongoing pest control) or management (no security afforded by long-term funding or permanent forest management plans). Biodiversity outcomes from the plant-and-leave forestry model are unknown and uncertain. Outcomes will depend on the macroclimate and ecological context and the extent to which the forests are managed in the long term. Adequate levels of intervention are unlikely to occur at the scales and in the contexts at which this forestry model is being implemented. The long-term outcomes for both carbon sequestration and biodiversity from plant-and-leave carbon forestry are unknown as we have not had sufficient time to see sufficient empirical results (Forbes and Norton, 2021).

> The biodiversity benefits of planted native tree stands can be excellent as the trees will provide resources (e.g., fruit crops, seasonal nectar sources, insect communities) that native species have adapted to but are often missing in many of today's landscapes.

Model 3: Continuous-cover mixed exotic species carbon forestry

Continuous cover implies that forestry management will ensure that a forest cover is retained, particularly where there is tree extraction (Barton, 2008). This forestry model strongly contrasts with the clear-fell harvest approach (i.e., model 1) in that unlimited time is available for development of mixed tree ages, species and forest structure. This makes continuous-cover forestry a closer analogue to natural forest compared to either forest models 1 or 2. The model focuses on a complementary mix of exotic species, observing species' traits (e.g., incorporating species of increasing shade tolerance with stand age), to achieve canopy replacement and forest permanence. The biodiversity outcomes will depend on the quality of habitat and ecological resources provided, although they will likely be less than from forestry models comprising high proportions of native tree species. Few examples of this forestry model currently exist, and further trialling and research is required before this model can be implemented at scale.

Model 4: Native forest regeneration

This is the most natural carbon forestry model and normally occurs following cessation of agriculture in areas of Aotearoa New Zealand's higher rainfall and air temperatures (Climate Change Commission, 2021; Mason et al., 2013). The model relies on natural regeneration and recruitment of later successional species through time. Regeneration might occur initially within an exotic weed cover such as *Ulex europaeus* (gorse; Wilson, 1994). Management is normally required to address plant pests, browsing mammals and enrichment planting (Forbes et al., 2020) to help ensure successional development to support rapid forest development. Early carbon sequestration rates are less than in the early decades of models 1–3; however, with adequate management, forest permanence is assured, and the native forest ecosystem presents an excellent opportunity for biodiversity restoration and carbon sequestration in the medium to long term (Carswell et al., 2012). Further, a wide range of values can be provided in addition to carbon sequestration and biodiversity restoration (Aimers, Bergin and

Horgan, 2021) and there are fewer adverse environmental externalities.

Model 5: Native tree plantations

This model can comprise either diverse restoration plantings (aiming to mimic the processes of model 4) or lower-diversity stands of native tree species appropriately spaced and tended using silvicultural treatments (e.g., thinning and pruning) to maximise tree growth rates. This model lends itself well to selective timber harvest through continuous-cover forestry techniques, and with adequate management (e.g., enrichment planting), forest permanence is assured. Recent analyses indicate that beyond 30 years of age, planted native tree stands can sequester increasing rates of atmospheric carbon over many decades, making this form of carbon forestry an excellent mid- and long-term form of carbon forestry (Kimberley, Bergin and Silvester, 2021). Incorporating faster-growing early successional native species is a means of yielding early carbon and biodiversity benefits. The biodiversity benefits of planted native tree stands can be excellent as the trees will provide resources (e.g., fruit crops, seasonal nectar sources, insect communities) that native species have adapted to but are often missing in many of today's landscapes.

Conclusion

For any forest to be truly permanent, there needs to be tree recruitment from the forest understorey to the forest canopy, which in today's landscapes cannot be assumed. Irrespective of the forestry model adopted, management will be needed to address issues such as plant and animal pests, competition in densely planted or formed stands, and dispersal failure due to the absence of seed sources or dysfunctional pollinator or dispersal vectors. The incorporation of native species in carbon forestry is a critical method for boosting biodiversity benefits. Due to the relative growth rates of radiata pine versus native tree species, a mid- to long-term view which accounts for both carbon and biodiversity gains needs to be taken if we are to use forestry to help address our climate and biodiversity crises in tandem.

Loss of native forest cover is a root cause of many aspects of our biodiversity crisis, whether it be lost species, habitats and riparian and coastal buffers, or soil stabilisation and resulting sedimentation. We need to adopt a balanced and efficient approach to the urgent need to sequester atmospheric carbon and select carbon forestry models which benefit both the climate and biodiversity and which are truly permanent.

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