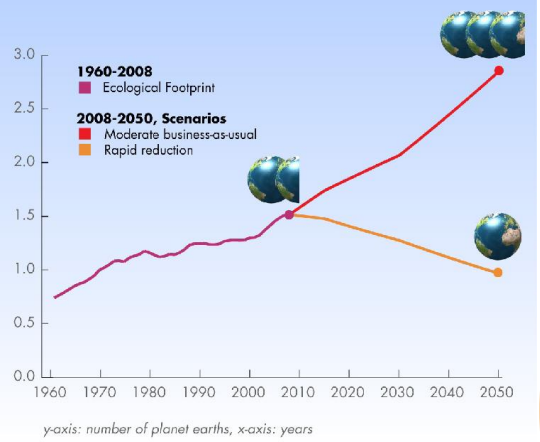
The Future Management and Ecology of Planted Forests

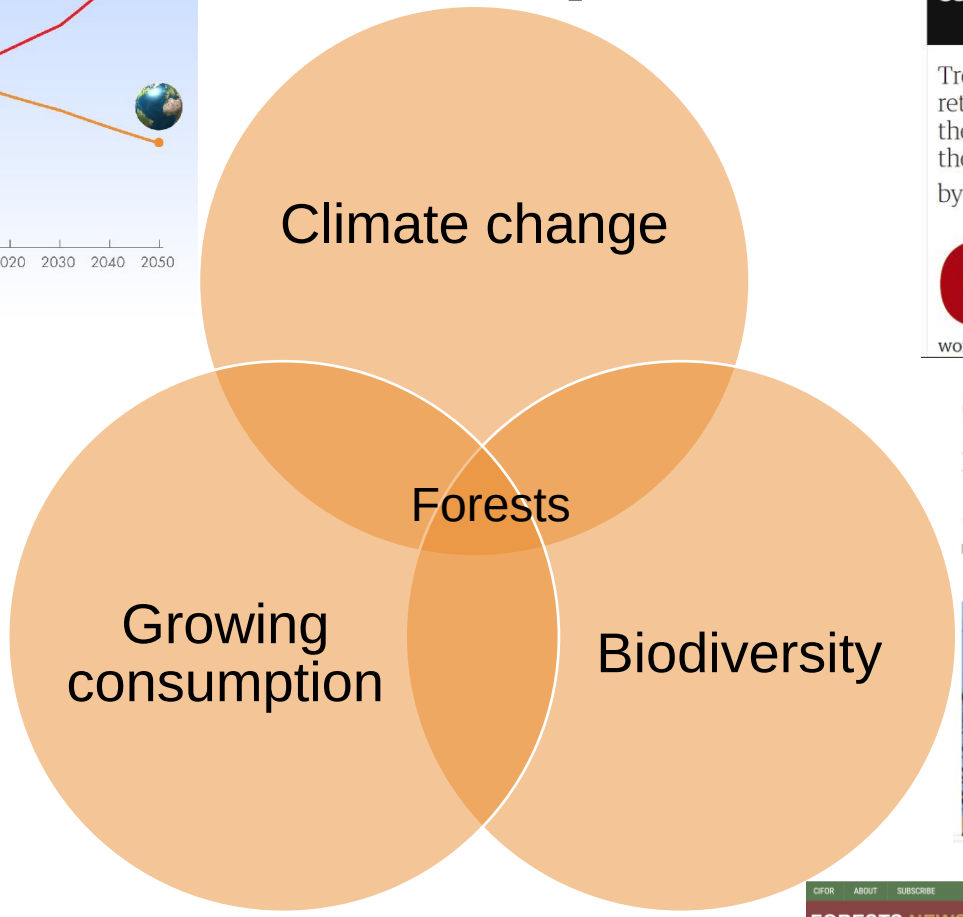
Peter W. Clinton

ANZIF — Embracing our natural capital: The science, technology and art of managing forests for all values, 15th October 2023, Gold Coast Australia.

Anthropocene



y-axis: number of planet earths, x-axis: years



This land is your land

Is this the end of forests as we've known them?

Trees lost to drought and wildfires are not returning. Climate change is taking a toll on the world's forests - and radically changing the environment before our eyes

by Alastair Gee

Camille Stevens-Rumann never used to worry about seeing dead trees. As a wildland firefighter in the American west, she encountered untold numbers killed in blazes she helped to extinguish. She knew fires are integral to forests in this part of the world; they prune out smaller trees, giving room to the rest and even help

Global warming: what will French forests look like in 2050?

Tech | March 23, 2022 | No Comments

Climate emergency declarations in 2,346 jurisdictions and local governments cover 1 billion citizens

Posted on *8 September 2023*

Article https://doi.org/10.1038/s41467-022-32244-w

Land use change and carbon emissions of a transformation to timber cities

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NEWS

Undisturbed forests could cease to exist in large tropical humid regions by 2050, study says

Degradation must be considered a deforestation risk factor

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What is still to come?

- Global population of 9.8 billion
- Increasing atmospheric CO_2 and other Green House Gases?
- More climate extremes (heat, wind), natural disturbance, fire, disease
- Greater demand for timber for use in construction with modern engineered timber, mostly for use in mid-rise accommodation
- More Deforestation?
- More tree planting? We need >400m ha of plantations
- Emissions reduction (technology)?

WORLD ECONOMIC FORUM

COVID-19

3 billion people could live in places as hot as the Sahara by 2070 unless we tackle climate change

May 13, 2020

Caught short: lack of recycled toilet paper in UK 'fuelling deforestation'

Less office waste material during Covid has led big lavatory roll makers to cut amount of recycled paper in tissues, according to consumer body

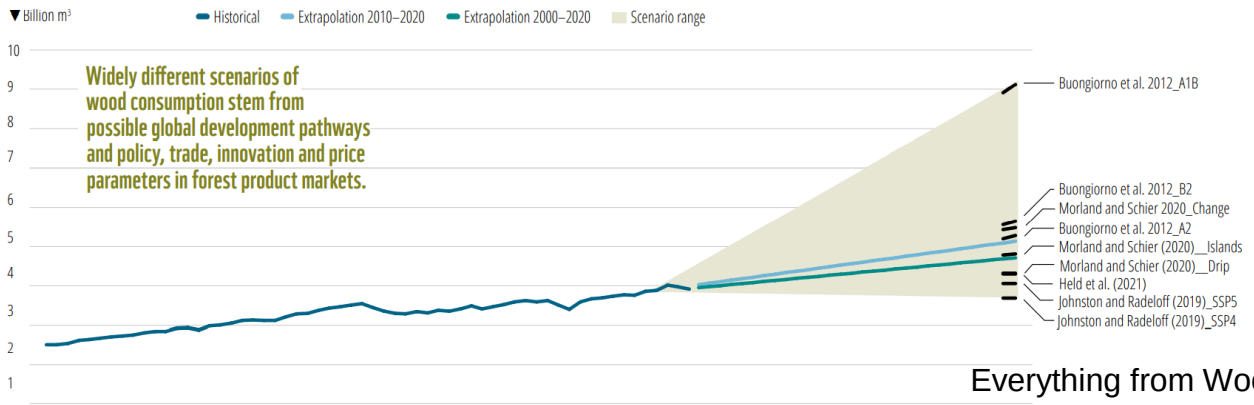
Why are forests important?

- More forests needed to meet current and future expectations for wood products and for environmental services and benefits from forests.
- The WBCSD highlighted back **in 2015 that up to** 300% more fibre is required to meet expected global shortage which would see the annual demand for wood triple by 2050 to more than 10 billion m^3 $year^{-1}$.
- Forests are widely seen as key to global sustainability now and into the future (water, biodiversity, climate regulation, fossil carbon substitution, well being)
- Of the 292 million ha of planted forests today, there are 131 million ha of plantations but only about 50 million ha of these managed intensively.

Figure 3.9:
Comparison of global consumption scenarios and trends, 1961–2050

Sources: Historical and linear trend extrapolations based on FAOSTAT and depicting extrapolations of the 10-year trend and 20-year trend (see Figure 3.1); sources depicted in the legend of the graph and described in the text include Buongiorno et al. (2012) [143], with IPCC scenarios A1B, A2 and B2; Morland and Schier (2020) [144]; Johnston and Radeloff (2019) [135] with scenarios SSP4 and SSP5; Held et al. (2021) [10]

Note: This figure is illustrative and shows the end-points of multiple scenarios in 2050. However, they may start from different base years, e.g. 2015 for [10], [135]. The studies [143] and [135] also end at different points (in 2060 and 2065, respectively) and linear interpolation of annual average growth rates



Everything from Wood WWF 2022

What is going to shape future forests?

- Global tree planting schemes e.g. The Bonn challenge 350 million ha of degraded and deforested land restored by 2030
- UN strategic plan for forests – increase forest area 3% by 2030 (120 m ha)
- EU green deal 3 billion trees by 2030 (3 m ha)
- New Zealand 1 Billion trees by 2030.
- World Economic Forum Davos 1 trillion trees
- With so many trees to plant, what should we planting?

- There are 1000's of tree species but the fact is that Globally, 44% of plantation forests are planted with introduced species, primarily with members of two key genus's, *Pinus* and *Eucalyptus.* So why these species?
- These species are considered to be fast growing, providing timber suitable for many industrial purposes. But should we be planting species to provide all possible benefits from tree planting.
- But what about their management and ecology?

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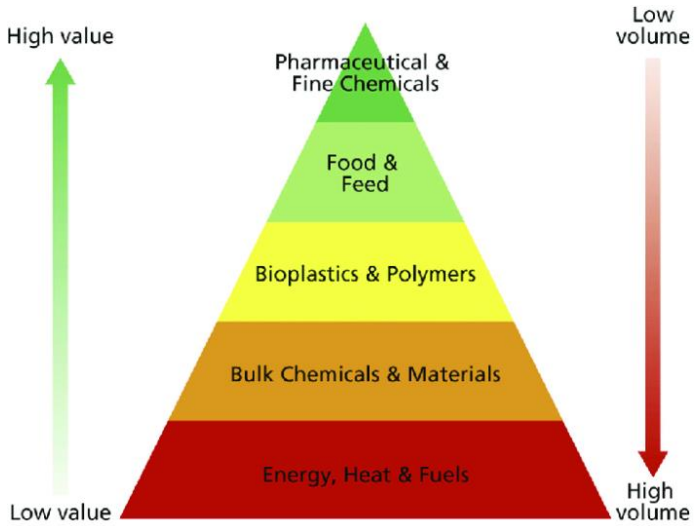
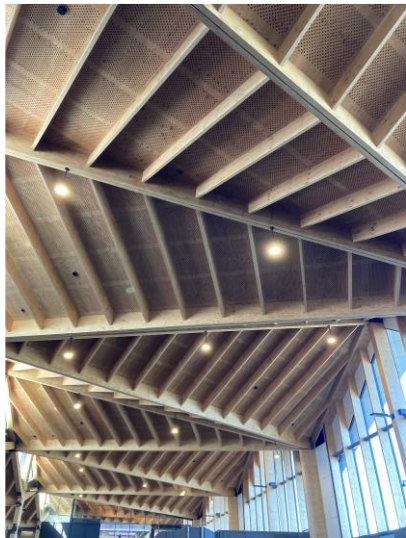
What will forests be used for? This will impact on their management and ecology

- Solid timber vs bioenergy vs deconstruction in to a range of products
- More wood used in construction
- Conventional rotations vs short rotations?
- Carbon forests eventually will mean older, larger trees with implications for future harvesting and products



Bio-based value pyramid (Own illustration adapted from various sources: Davis et al., 2017; Lange, 2014; Márquez Luzardoa and Venselaar, 2012).

- Forests in perpetuity – naturalisation, re wilding
- Biodiversity, species conservation
- Freshwater
- Clearly it will depend…..



What will the world look like in 2050 to a tree planted today?

- Many predict that it will not look the same.
- Will it be hotter, drier, with possibly more trees but fewer forests?
- What will forests look like in 2050, given that the trees planted from today will only be at least 30 years old by then?
- What tree species will have been planted?
- How many more trees will there be in 2050?
- Where will they have been planted and how successful will they have been?
- If post emissions reduction technology comes into being, what will the fate of forests be?
- Will they have been abandoned or be key to supporting the bioeconomy displacing fossil carbon?

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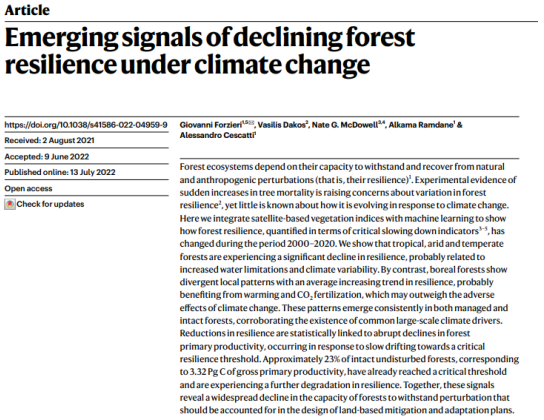
What does this mean for the ecology and management of forests?

- Different environments – altered climate
- Climate extremes will drive outcomes rather than averages
- More biotic and abiotic risks
- Trees are not the only organisms undergoing the influence of climate change
- Intensive management - More disturbance
- More younger forests due to disturbance and afforestation
- New forest types, integrated land uses?
- Ownership of forests globally – governments or private ownership?
- Paris targets exceeded, warming held to less than 1.5C?

There are many challenges to newly planted trees

- Browsing
- Weeds
- Drought
- Disease
- Dis interest
- Competing priorities e.g. carbon sequestration, timber, bioenergy, biodiversity



Article

Emerging signals of declining forest resilience under climate change

https://doi.org/10.1038/s41586-022-04959-9
Received: 2 August 2021
Accepted: 9 June 2022
Published online: 13 July 2022
Open access
Check for updates

Giovanni Forzieri[1,2✉], Vasilis Dakos[3], Nate G. McDowell[2,4], Alkama Ramdane[1] & Alessandro Cescatti[1]

Forest ecosystems depend on their capacity to withstand and recover from natural and anthropogenic perturbations (that is, their resilience)[1]. Experimental evidence of sudden increases in tree mortality is raising concerns about variation in forest resilience[2], yet little is known about how it is evolving in response to climate change. Here we integrate satellite-based vegetation indices with machine learning to show how forest resilience, quantified in terms of critical slowing down indicators[3–5], has changed during the period 2000–2020. We show that tropical, arid and temperate forests are experiencing a significant decline in resilience, probably related to increased water limitations and climate variability. By contrast, boreal forests show divergent local patterns with an average increasing trend in resilience, probably benefiting from warming and CO_2 fertilization, which may outweigh the adverse effects of climate change. These patterns emerge consistently in both managed and intact forests, corroborating the existence of common large-scale climate drivers. Reductions in resilience are statistically linked to abrupt declines in forest primary productivity, occurring in response to slow drifting towards a critical resilience threshold. Approximately 23% of intact undisturbed forests, corresponding to 3.32 Pg C of gross primary productivity, have already reached a critical threshold and are experiencing a further degradation in resilience. Together, these signals reveal a widespread decline in the capacity of forests to withstand perturbation that should be accounted for in the design of land-based mitigation and adaptation plans.

But what about their management and ecology?

- How best to manage these new forests?
- How fast will they grow and assume the role of a forest?
- What about all those trees?
- Will we see them as forests?

Journal of Experimental Botany, Vol. 62, No. 8, pp. 2763–2771, 2011
doi:10.1093/jxb/erq443 Advance Access publication 27 January, 2011

Journal of Experimental Botany
www.jxb.oxfordjournals.org

RESEARCH PAPER

Drought alters timing, quantity, and quality of wood formation in Scots pine

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Received 9 November 2010; Revised 9 December 2010; Accepted 9 December 2010

Abstract

Drought has been frequently discussed as a trigger for forest decline. Today, large-scale Scots pine decline is observed in many dry inner-Alpine valleys, with drought discussed as the main causative factor. This study aimed to

What do we need to do differently?

- Tree planting should consider biodiversity and accommodate genetic diversity to ensure forests are resilient and to encourage multiple values
- Manage to increase carbon storage
- Manage forests to provide a wide range of ecosystem services
- Enhance the health, biodiversity and resilience through adaptive management & diversification
- The challenge is how to achieve this and what sort of management will be required from nurseries through to establishment and early growth and tending of forests.
- Encourage the sustainable use of wood resources in construction
- Encourage the sustainable use of wood to substitute non-renewable, carbon-intensive materials
- Planted or natural forests – what can be achieved in 30 years?
- Think outside the forest

Climate smart forestry meets climate smart agriculture - a global driver of land use change

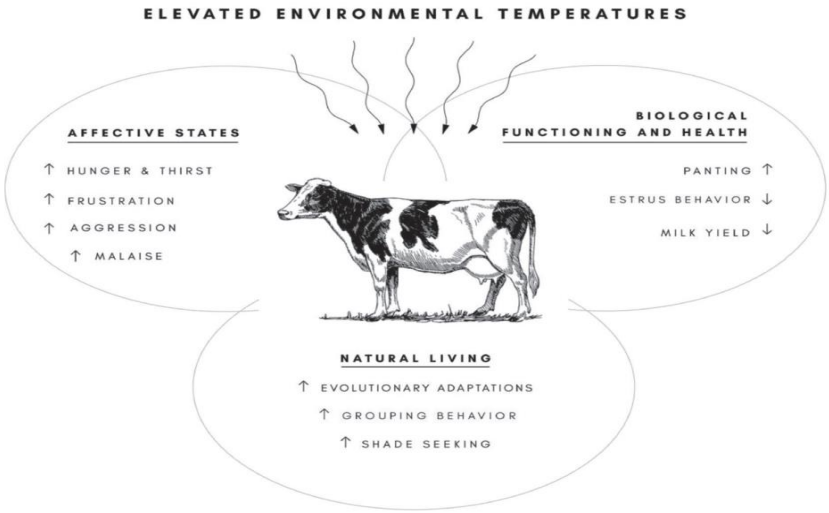

Figure 1. The relationship between the immediate effects of environmental heat stress and the 3 key constructs of animal welfare: (1) the biological functioning (and health) of the animal, (2) the affective states the animal is experiencing, and (3) the naturalness of its life under current heat management strategies.

Journal of Dairy Science Vol. 100 No. 11, 2017

- Emissions mitigation
- Improve animal health
- Economic opportunities for livestock mangers
- Many other benefits?
- Urban Forests?

What should we be worried about?

- There are going to be millions of hectares of new forests, many will effectively be monocultures, lacking the biodiversity to support all the ecological processes that contribute to forest resilience.
- Tree breeding, application of genomic and other emerging approaches may improve the tree itself but what about the ecosystem in which it grows?
- There are other genomes in the forest and these will also need to be considered when thinking about forest management and future ecology of new forests
- **There are also the critics of tree planting**
- It “detracts from deforestation, biodiversity loss, reducing emissions from fossil fuels and the size of the problem (emissions are large) plantings lack biodiversity, genetic diversity, increase Albedo, use water, increase fire, loss of rural livelihoods”
- We need to grow confidence in the future of forests

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Will managers adapt fast enough?

- Thirty years is not long in the life of a forest, or for that matter, long lived tree species. Do we really know how fast we need to go?
- Do we have the experience in the current work force, do we have the people with the appropriate skills?
- In the face of a climate and biodiversity crisis what will adaptive management look like with respect to management interventions?
- What are time frames, endpoints (harvest, carbon, biodiversity, shelter, food) for management
- Where will things stop? (CO_2, Temperature/warming)
- What will happen to forests planted between now and 2050 if cheap carbon removal technology eventuates?
- We need to take a long term view, possibly several hundred years?

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Final thoughts

- The area of Forests will continue to increase
- Loaming management crisis – who & how
- What do we want/need from all these forests? (substitution, biodiversity, water, food).

- More investigations into the Ecology of post disturbance e.g. drought, disease, fire
- More investigations of the Ecology of urban forests, agroforestry and silvopastoral systems
- Emergence of Indigenous views with respect to forest management and ecology
- Training more forest managers and forest ecologists
- New technologies, large scale observation and adaptive management, app based forest management

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Prosperity from trees *Mai i te ngahere oranga*