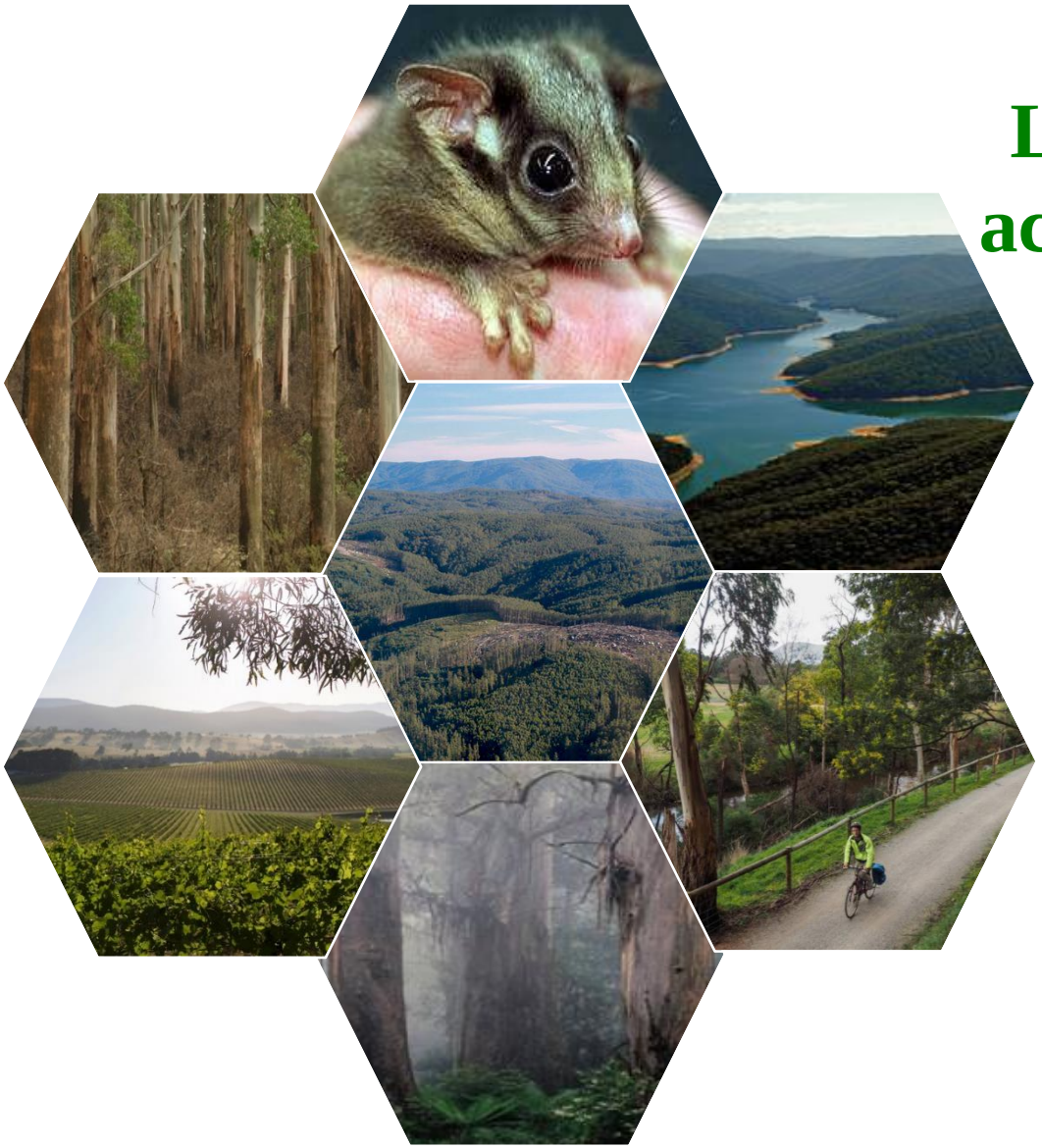
FORESTS

Challenges for ecosystem accounting



Lessons from ecosystem accounts for forests in the Central Highlands, Australia

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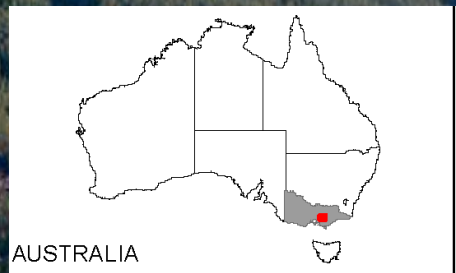
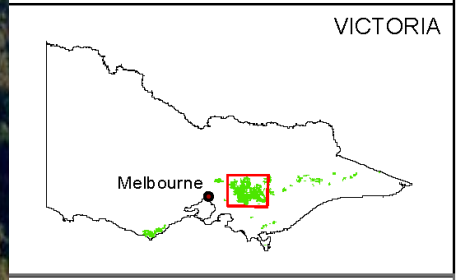
Tall, wet temperate evergreen eucalypt forest
Central Highlands, Victoria, Australia





1. Policy issues: - contested forest management
- conflicting uses of ecosystem services

Industries dependent on ecosystem services from the Central Highlands region

Water supply

Native timber

Agricultural production

Tourism

Carbon sequestration

Plantation timber

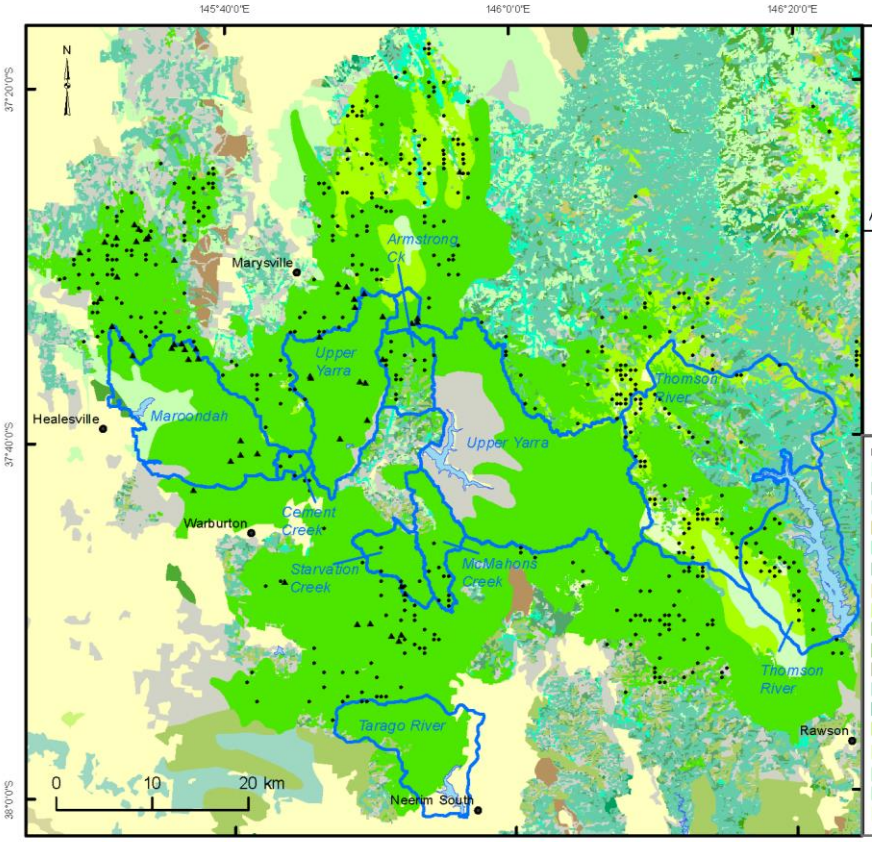
Ecosystem accounts demonstrated the trade-offs in physical and monetary terms, and this is influencing the decision-making process.

Challenges in the policy context for forests

1. Different land tenures:
   public, private, corporate
2. Multiple land uses:
   conservation, production, water supply, recreation, biodiversity
3. Market and non-market values
   eg timber vs biodiversity
4. Use of ecosystem services cross asset boundaries
5. Complex ecosystem:
   long-lived trees, influence of age structure on growth dynamics, stochastic disturbance events

2. Defining relevant spatial areas

Forest types and catchments



Boundary of the ecosystem accounting unit:

- Catchments
- Forest ecosystem types
- Forest management areas
- Natural resource management areas
- Biogeographic regions
- Local government areas
- Statistical areas

➡ Pragmatic boundary related to policy question

Basic statistical unit:

- Land cover as raster data
- Land use as polygon data

➡ Conversion loses resolution

- Continuum of forest states eg primary and secondary forest, plantation

➡ Difficult to classify and define boundaries

Resolutions of data sources:

- Biophysical data small-scale and spatially referenced
- Economic data highly aggregated to industries and sectors

➡ Assumptions associated with changing scales

3. Types of ecosystem services






Provisioning:

- water
- fibre
- food
- energy source
- genetic diversity
- habitat

Regulating:

- water filtration
- air filtration
- pollination
- seed dispersal
- carbon storage
- carbon sequestration
- flood mitigation
- erosion control

Cultural:

- recreation
- education and research
- spiritual

4. Measuring ecosystem condition

Purpose:

1. To measure the state of the ecosystem in terms of its capacity to continue to provide services to people ➡ related to human use
2. To measure the state of the ecosystem in terms of its ability to function without reference to human use ➡ related to naturalness

Measurements:

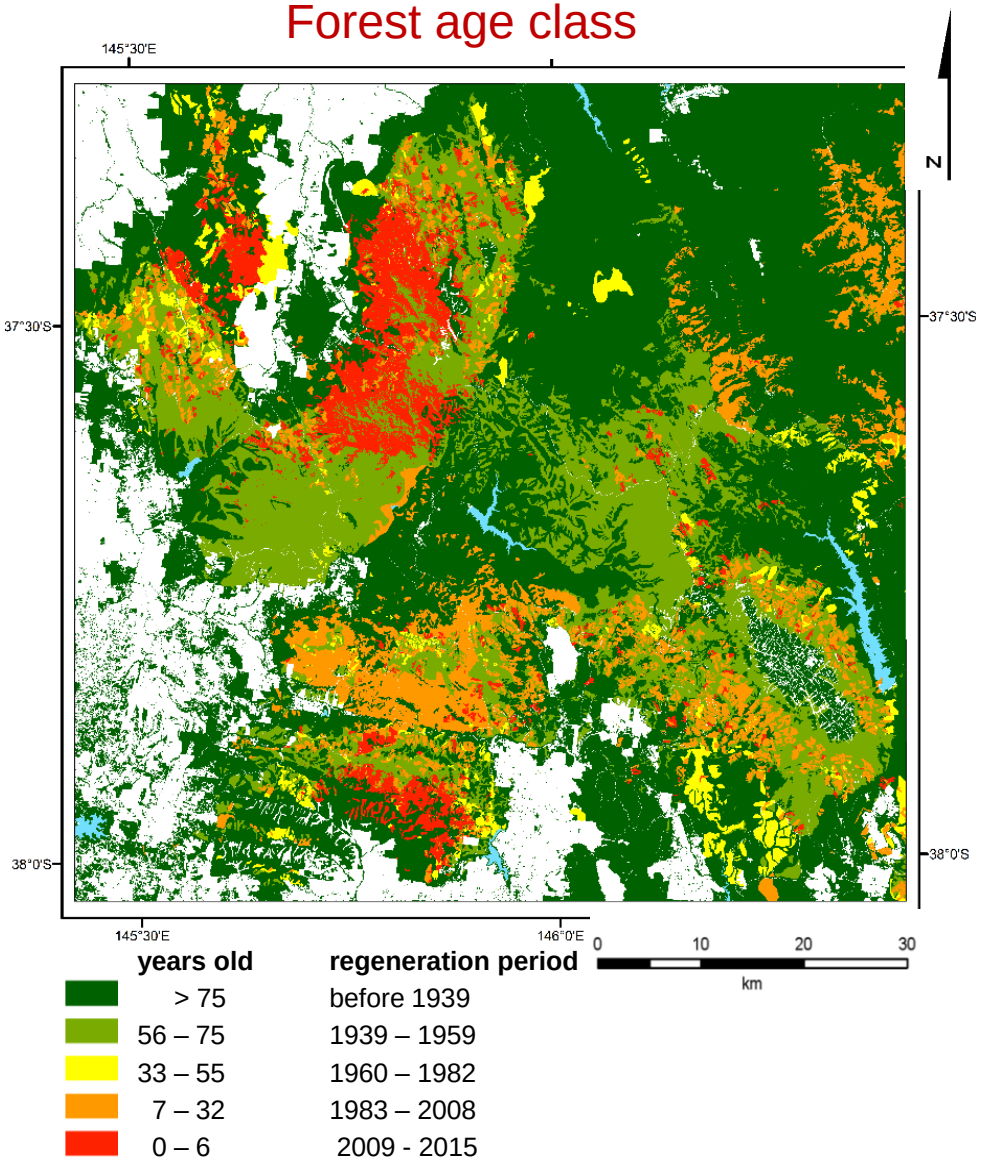
Characteristics	Indicators
Vegetation	Leaf area index, biomass, mean annual increment, structure
Biodiversity	Species richness, relative abundance
Soil	Soil organic matter, nutrient availability, water holding capacity
Water	River flow, water quality
Carbon	Carbon stock, net carbon balance, primary productivity
Habitat	Fragmentation, key features

Challenges:

Differentiation of types of characteristics and indicators:

1. General composite indicators
2. Indicators specific for ecosystem types
3. Indicators specific to supply of ecosystem services
4. Limited indicators of overall ecosystem function

Examples of measuring ecosystem condition



Potential characteristics:

- Forest age
- Structural complexity
- Tree density
- Composition
- Canopy cover / leaf area
- Ground cover
- Fragmentation

Potential indicators:

- Age class eg old growth
- Endangered species
- Index of species richness
- Biomass / volume
- Presence of weeds, pests, diseases
- Size, distribution, edges of patches

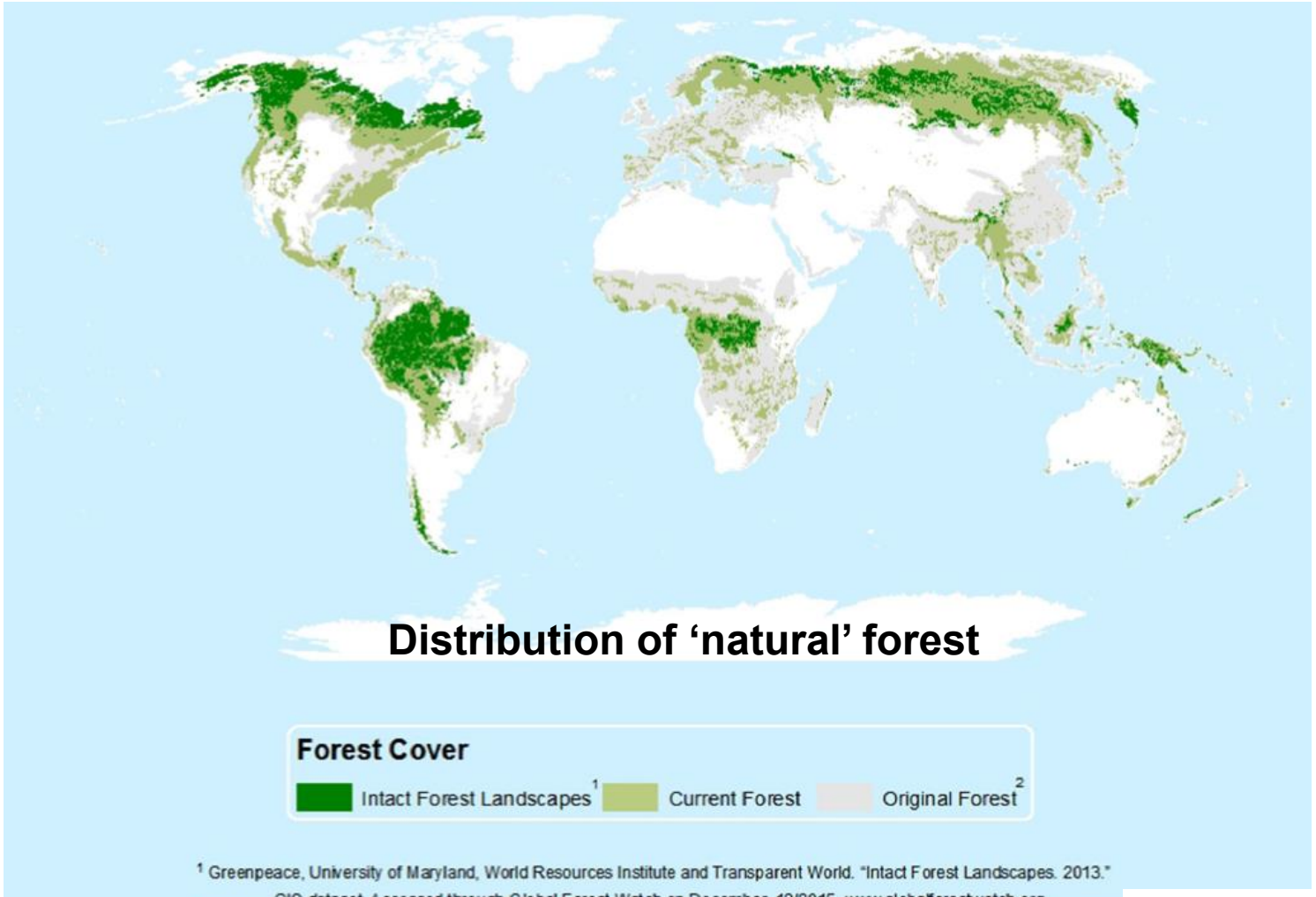
Challenges:

- Different characteristics relate to services
- No all-encompassing indicators
- Indicators are specific to policy issues
- Dilemma of the general vs specific

5. Defining reference levels for condition

Reference levels defined in relation to:

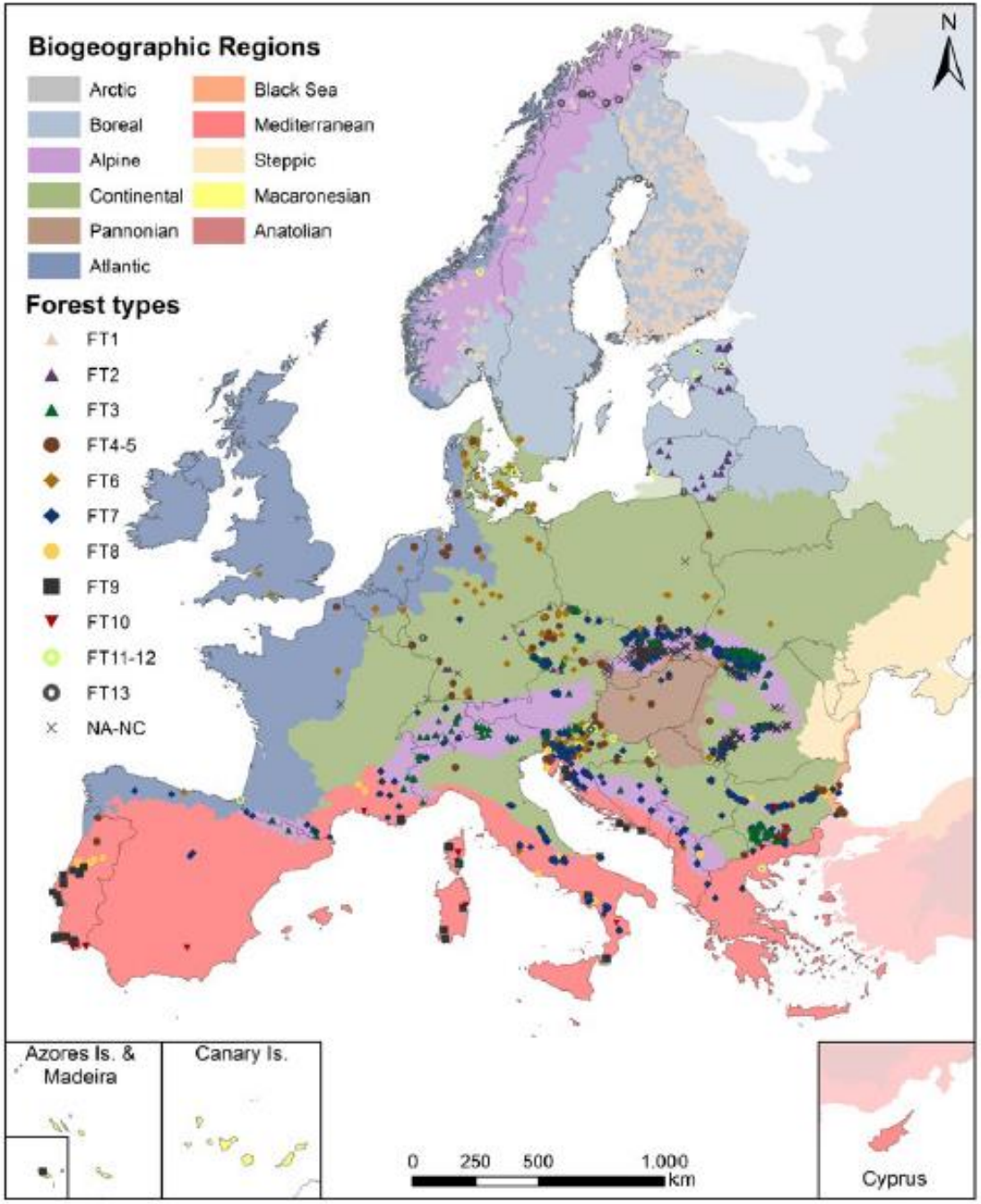
1. Benefits to people
2. Reference to a natural state
3. Relative reference to a point in time



[Kormos et al. 2017]

Distribution of primary forest patches in Europe

Demonstrates the possibility of a reference level of a ‘natural’ forest.

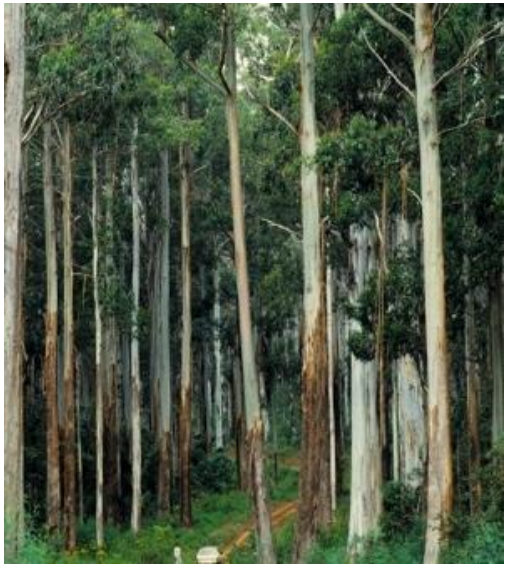


[Sabatini et al. 2018 Diversity and Distributions]

Classification of forest states

Stand origin	Natural forest		Man-made forest
Genesis	Self-sown forest		Planted forest
Tree species origin	Native forest		Exotic forest
Processes, structures	Primary forest	Secondary forest	Plantation
Management	Conservation objectives		Multiple use objectives
Forestry activities	Minimum intervention		Production

Primary forest

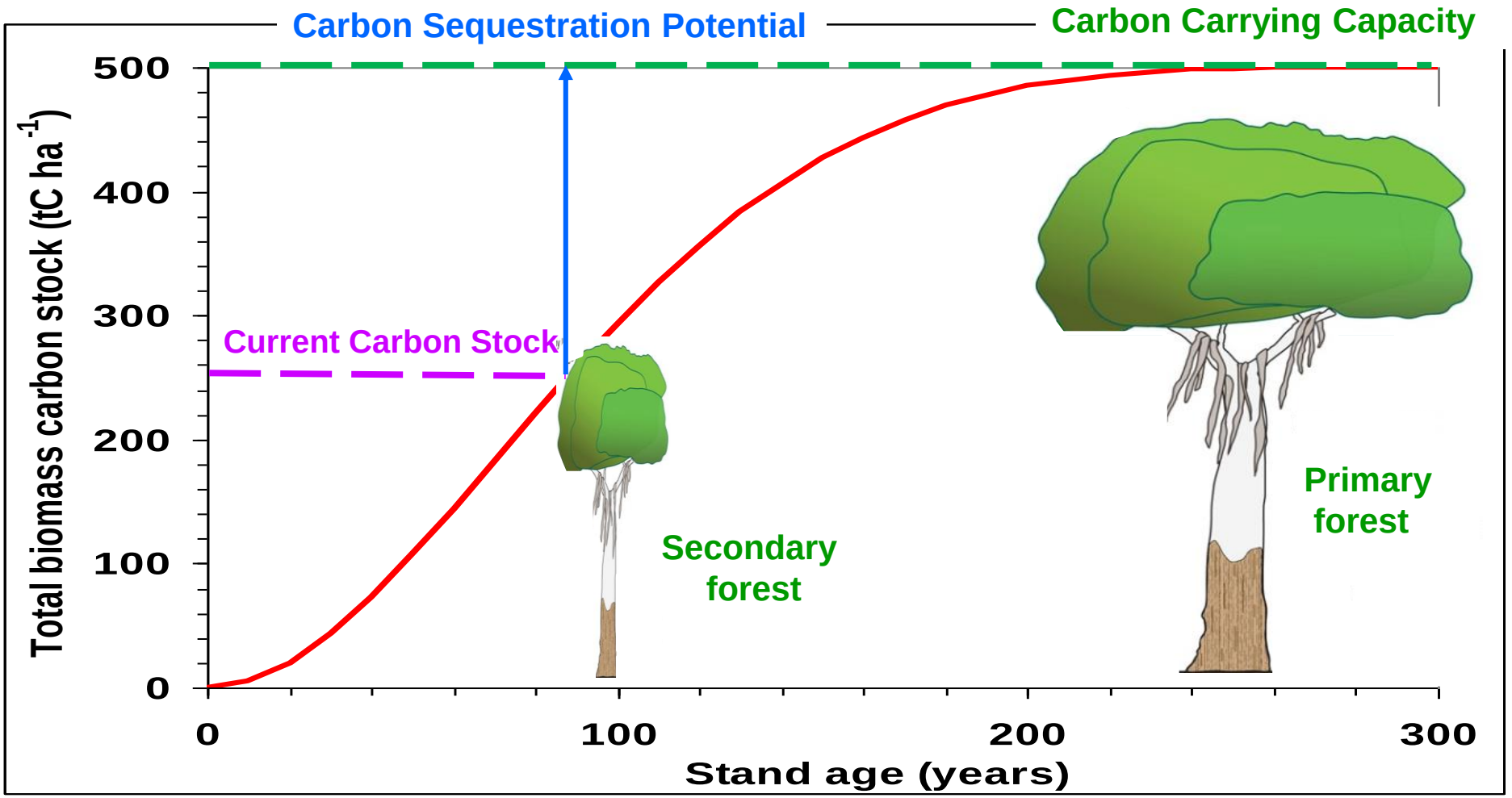


Secondary forest

Exotic plantation

Example: choice of reference level affects ecosystem account

A reference level for forest carbon stock of 'harvest maturity' of a secondary forest results in half the carbon stock of that in a primary forest,
and so does not reveal the carbon sequestration potential of allowing secondary forest to continue growing.



Change in condition used in carbon accounting

Net – Net

Net emissions in each year of the commitment period minus the net emissions in 1990.

Activities: cropland, grazing, revegetation

Gross – Net

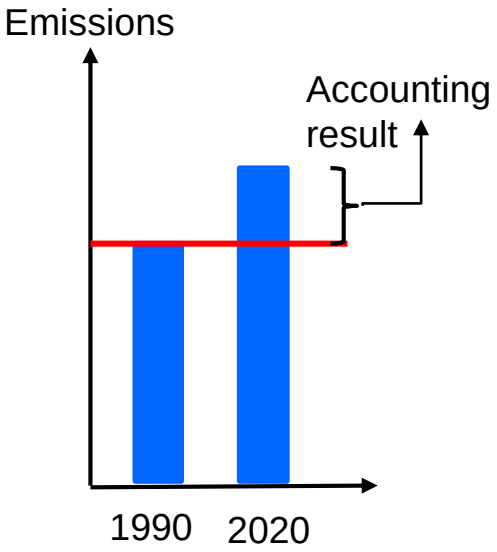
Net emissions in each year of the commitment period without comparing it with 1990.

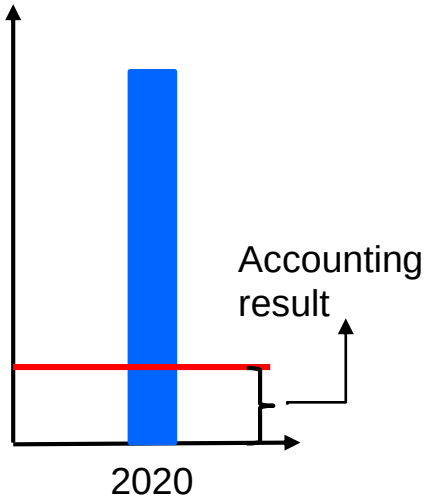
Activities: af/ re/ de/ forestation

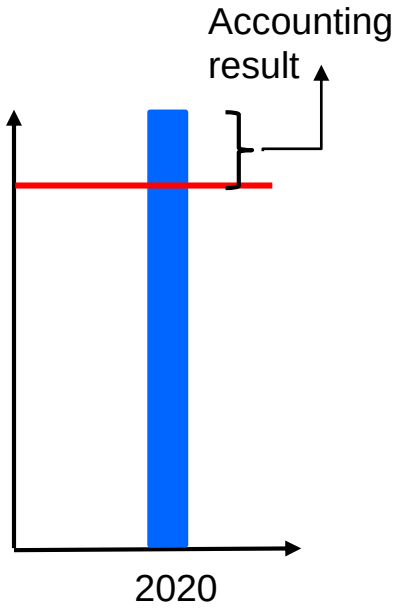
Reference level

Net emissions in each year of the commitment period minus the value of the reference level, eg natural disturbance regimes.

Activities: forest management







6. Valuation of ecosystem services

Methods used in the Central Highlands accounts

Method	Description	Services
Unit resource rent	Estimated as the market price less the unit costs of labour, intermediate inputs and produced capital	Services used in agricultural and plantation timber production Cultural and recreational services
Stumpage	Value of timber sold, less harvesting and haulage costs	Native timber provisioning
Replacement cost	Based on the cost of replacing the ecosystem services from alternative sources	Water provisioning
Payment for services	Use of values from market-based systems set up to either minimize or offset negative environmental impacts or for the provision of particular services	Carbon sequestration

Challenges:

- These methods are all exchange values

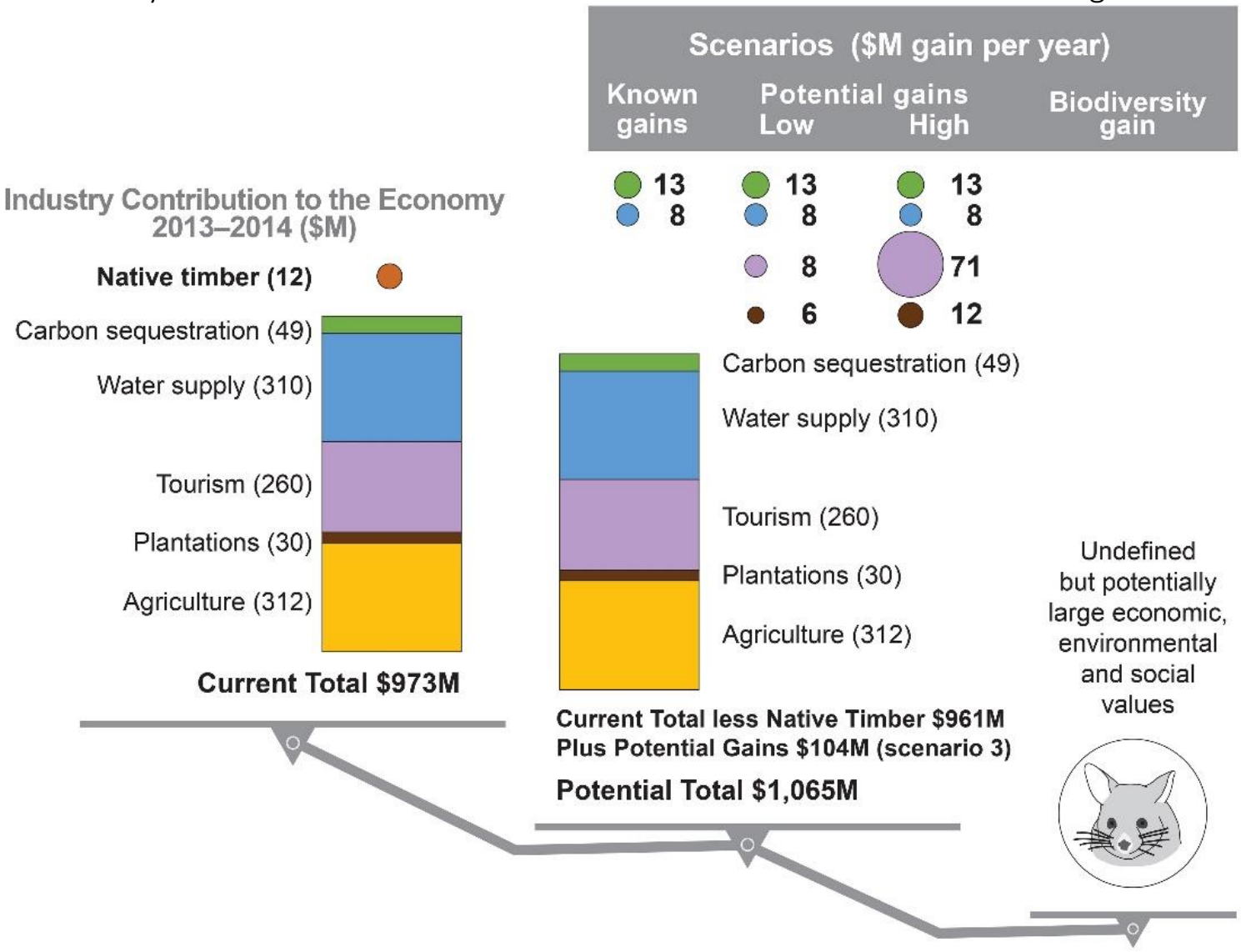
But are they comparable when trade-offs are assessed?

- Not all ecosystem services can be valued by these methods.

Balancing trade-offs between land use activities

Ceasing native timber harvesting increases ecosystem services for:

- Carbon sequestration and water provisioning – calculated known gain
- Plantation timber provisioning and recreational services – estimate potential gain
- Biodiversity - undefined gain



7. Barriers to measurements in forests

1. Measuring cryptic creatures
2. General or composite indicators vs specific indicators
3. Identifying the production boundary to differentiate the ecosystem service from production,
   eg water flows
4. Differentiating ecosystem services conceptually and physically, eg
   carbon sequestration – reducing atmospheric CO_2 conc.
   carbon storage – avoiding loss due to human activities
5. Scaling up site and biophysical data to landscapes
   - resolution and consistent time series of remote sensing data
   - changes in methods and technologies over time
   - ecological relationships between site and spatial data
6. Disaggregating economic data to spatial areas and land use activities.

Further Information:

Experimental Ecosystem Accounts for the Central Highlands of Victoria. July 2017.
Heather Keith, Michael Vardon, John Stein, Janet Stein and David Lindenmayer

Final Report - http://www.nespthreatenedspecies.edu.au/publications-tools/experimental-ecosystem-accounts-for-the-central-highlands-of-victoria-full-report-high-res-40mb

Appendices - http://www.nespthreatenedspecies.edu.au/publications-tools/experimental-ecosystem-accounts-for-the-central-highlands-of-victoria-full-report-high-res-31mb

Summary Report - http://www.nespthreatenedspecies.edu.au/publications-tools/experimental-ecosystem-accounts-for-the-central-highlands-of-victoria-summary

Video - http://www.nespthreatenedspecies.edu.au/news/video-environmental-economic-accounts-a-case-study-in-the-victorian-central-highlands

Ecosystem accounts define explicit and spatial trade-offs for managing natural resources.
Heather Keith, Michael Vardon, John Stein, Janet Stein and David Lindenmayer. 2017.
Nature Ecology and Evolution 1: 1683 – 1692.

The Conversation 11/10/2017
https://theconversation.com/money-cant-buy-me-love-but-you-can-put-a-price-on-a-tree-84357