Assessing net primary productivity of Australia's tallest trees (Mountain Ash).

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INTRODUCTION

- The terrestrial biosphere is an important component of the global carbon cycle, as it has one of the largest exchanges of CO_2 with the atmosphere and has one of the largest reservoirs for carbon accumulation. The net uptake of atmospheric CO_2 occurs via photosynthesis, as vegetation acquires ~ 120 Gt C yr^{-1} from the atmosphere and respiratory processes releases approximately 60 Gt C yr^{-1} back into the atmosphere (IPCC, 2001). However, with the increase in anthropogenic CO_2 in the atmosphere it is important to understand the processes which uptake, store and release carbon dioxide within the terrestrial biosphere may change under future climate and land management scenarios (Jacobson *et al.*, 2000).
- In order to determine the amount of carbon stored within the terrestrial biosphere especially in the above ground biomass of live trees, assessments need to be made on the amount of carbon stocks present in forest ecosystems and the accumulation of carbon in live trees. Forestry inventory techniques, such as the Continuous Forest Inventory (CFI) Plots, allows us to measure changes in tree growth parameters and productivity patterns of forest ecosystems and from this information we can then determine the change in carbon stocks over time (Whitely, 1999)(IPCC,2000).
- Accounting for carbon stocks in land based systems and how this changes over time is of great importance to the Australian Greenhouse Office, National Carbon Accounting Scheme (NCAS), as this scheme identifies the change in carbon stocks in above ground biomass in response to land cover change (Australian Greenhouse Office, 2005).

RESEARCH AIMS

- To calculate net decadal increment for 275 year old, 79 year old and 23 year old *Eucalyptus regnans* tree diameter and height measurements were taken in order to determine the growth patterns and the total net increment growth for the three age classes and allow us to compare productivity rates over time with stand age.
- To calculate the net decadal Above Ground Net Primary Productivity (NPP_{AG}) rate for each site and determine the amount of carbon which has accumulated in the three different age class trees throughout their lifespan. We will then be able to compare (NPP_{AG}) between the stands ages to determine which age class is the most productive.

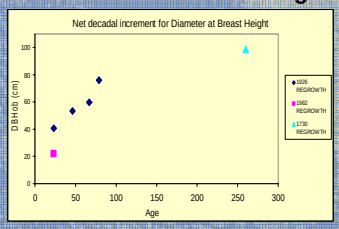
METHODOLOGY

- The sampling procedure undertaken in this study will be carried out in accordance with methods adopted by the Australian Greenhouse Office for the NCAS and instructions set out in Field Instructions CFI Permanent Plot 1985, by Forestry Commission Tasmania
- Plot sites for 1982 ,1926 regrowth and 1730 *Eucalyptus regnans* stands are located in Wallaby Creek Melbourne Water Catchment and have been pre-selected by Melbourne Water and Monash University.
- Numbered trees within these plots will be measured for tree growth parameters: Diameter at Breast Height over bark (DBH_{ob}) and total tree height increment.
- DBH is a measure of tree diameter at breast height, the DBH tape is placed around the diameter of the tree to measure the diameter of the tree at breast height, breast height being 1.3 meters from the base of the tree (Forestry Commission Tasmania, 1985).
- The total tree height increment for standing trees requires the use of a sunto-clinometer, which measures the angle to the highest green leaf of the tree and with the known distance away from the tree these two measurements are then required to calculate the tree height using trigonometry (Forestry Commission Tasmania, 1985).

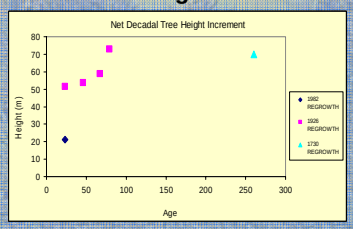
SITE DESCRPITION

- The field experiment conducted at Wallaby Creek Melbourne Water Catchment, which is a part of Kinglake National Park, is located 65km north of Melbourne on the southern most edge of the Hume Plateau on the Great Dividing Range.
- Major Bushfires passed throughout the area in 1730, 1851, 1898 1926, 1930 and 1982 and resulted in a multi-aged forest.
- *Eucalyptus regnans* grows at altitudes between 200 and 1000m and restricted to deep rich well drained krasnozem soil.
- *Eucalyptus regnans* is the dominant overstory species and understory species consists of wet sclerophyll broad mesophytic shrubs and small trees 8-25m tall, together with abundant tree ferns, ground ferns and mesophytic forbs (Ashton, 2000).

Tree Growth Parameters : Preliminary measurement of Diameter at Breast Height and Total tree height increment



The net decadal tree height increment demonstrates an increase of height with stand age. This is evidently shown in the 1926 stand, at 46 years old the tree height is 51m and increases to 72m at 79 years old. Therefore the height has increased by 21m over a 34 year period. The height of the 1982 stand at 21m is expected to increase with stand age. The height of the 1730 stand at 275 years old is 70m indicating the tree height has ceased. This is a common pattern in *Eucalyptus regnans* stands because when the stand reaches 150 years old height growth has ceased (Ryan and Yoder, 1997).

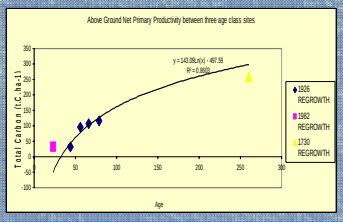


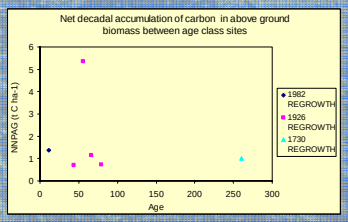
The net decadal increment for diameter at breast height shows an increase of diameter with stand age. This is evident in the 1926 stand, where at 46 years old, the DBH is 40cm and increases to 60cm at 79 years of age. Therefore the DBH increased by 20cm over 34 years. The 1982 stand had the lowest recorded DBH at 22cm at 23 years old, however this is expected to increase with stand age. The 1730 stand had the highest recorded DBH at 98cm at 275 years old.

Above Ground Net Primary Productivity

The Above Ground Net Primary Productivity shows an increase of NPP_{AG} with stand age. The NPP_{AG} for the 1926 stand shows a strong positive correlation of r^2= 0.8603 as NPP_{AG} increased from 31.75 t.C.ha^{-1} at 46 years old to 116 t.C.ha^{-1} at 79 years old. The logarithmic curve demonstrates that as the stand ages it increases and then at a certain age NPP_{AG} will stabilise. This trend should also be expected for the 1983 stand, at 23 years old it had the lowest recorded NPP_{AG} at 31.66 t.C.ha^{-1}.The highest recorded NPP_{AG} was for the 1730 stand, at 275 years old at 259 t.C.ha^{-1}.

The net decadal accumulation of carbon in above ground biomass varied between age class sites. The 1926 stand demonstrated a fluctuating pattern of carbon accumulation, at 44 y.o. the carbon accumulation was 0.755 t.C.ha^{-1}, however over 12 years at 56 y.o. the value was 5.5 t.C.ha^{-1}, this needs further investigation and the influence of tree mortality included. The 1982 stand had a carbon accumulation of 1.37 t.C.ha^{-1}. The 1730 stand at 250 y.o. had a carbon accumulation of 0.995 t.C.ha^{-1} averaged over the 250 year period.





Further work

- Quality Control of data.
- Sample certain age groups (1730 and 1926).
- Examine the effects of climate on productivity.
- Calculate the mortality rate for different age classes to determine the amount of biomass that was lost.
- Calculate and compare the Net Ecosystem Productivity for the different age classes.

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