Fire in the Landscape:

Forest Carbon Balance and Emission Management

Luba Volkova and Chris Weston

Melbourne School of Land and Environment, the University of Melbourne

STATE OF KNOWLEDGE *A PRIORI* ON FOREST C

What was known on Forest Carbon:

•C in overstorey trees; soil

Fragmented information on:

- Understorey (Project VESTA, "Redbook of WA);
- Coarse woody debris (Hollis et al, Keenan et al)
- Litter fall/ litter mass data

•Lots of research on highly productive forests (eg Mountain Ash, Alpine Ash)

STATE OF KNOWLEDGE *A PRIORI* OF FIRE EFFECT ON FOREST C

Planned Fire affects:

•Litter (fine fuels)

Fragmented information on:

- Understorey (Redbook of WA)
- Bark (Wombat Forest, Tolhurst)
  - •Coarse woody debris (mainly wildfires, Hollis et al)

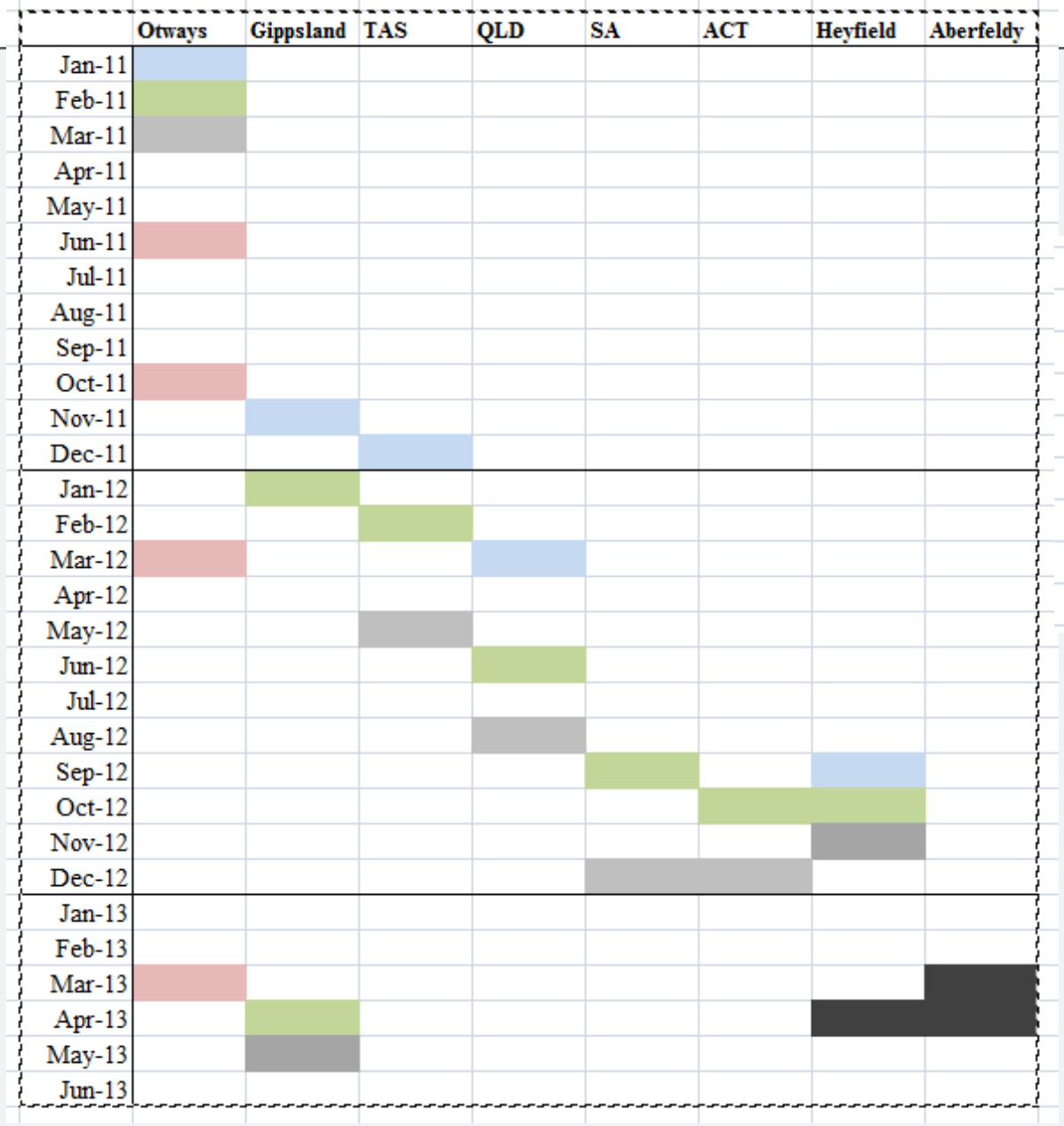
No comprehensive knowledge of all C pools in the forest;

Neither of fire effect on those pools

CHALLENGES TO ADDRESS

- How much carbon (C) is in the low productive forests and its distribution across C pools?
- How much C is lost in planned fire or wildfire
- Which C pools are affected by fire?
- What can be done to decrease C loss and emission?

PROGRESS OF THE RESEARCH



developing exp design/ study sites

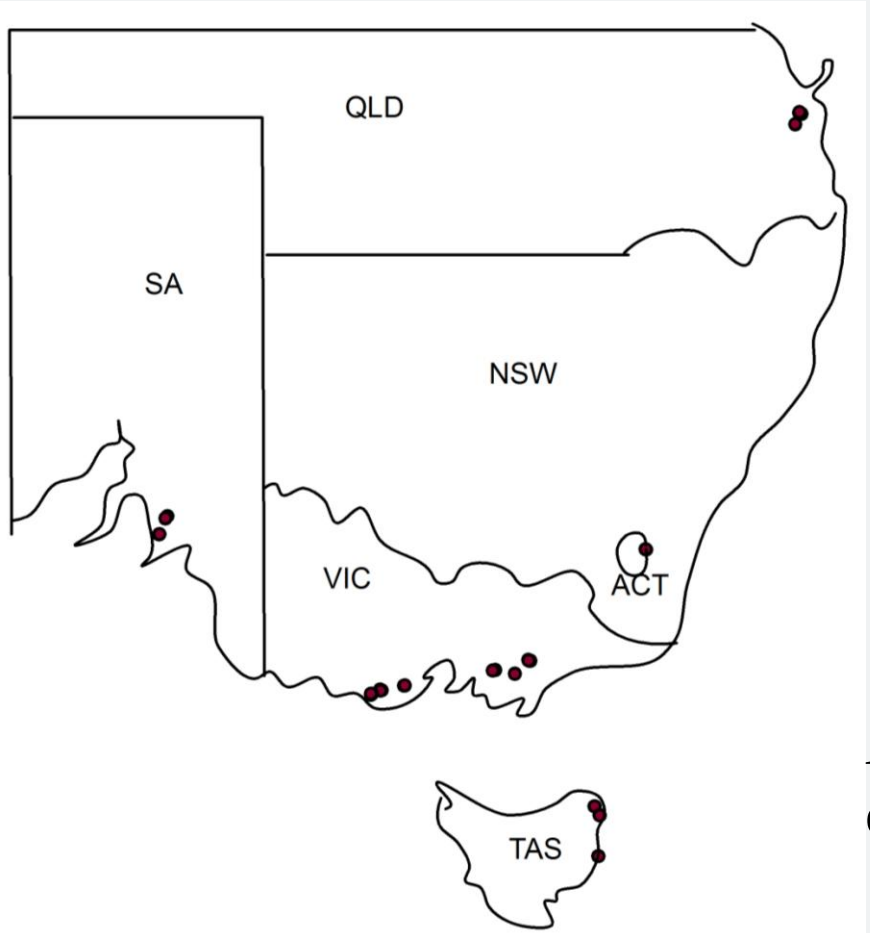
prefire measurements

after fire measurements

after wildfire measurements

fuel recovery measurements

PROGRESSION OF RESEARCH



61 plots were established across SE Australia, where:

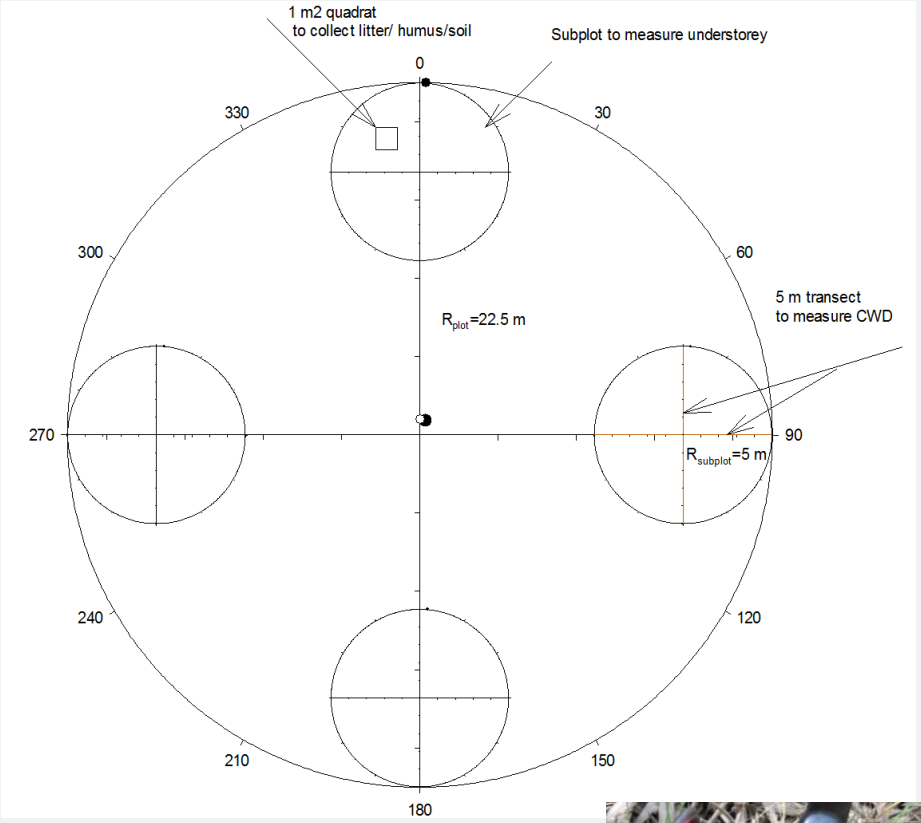
52 plots were set up to measure fire effect on forest carbon

38 plots were burnt in planned fire and re-measured afterwards

A total of **112 plots** were measured over lifetime of the CRC project

41+ people were trained and supervised during field campaigns

EXPERIMENTAL DESIGN TO MEASURE FOREST CARBON (IPCC DEFINITION)



- Circular plot of r= 22.5 m
- Using standard forestry inventory technique measure:
- Trees
- Ground cover
- Coarse woody debris
- Collect samples of litter, duff, soil
- Process and analyse samples for C and N

REPEAT THE SAME AFTER FIRE….

Photo: Googong study sites, ACT/NSW

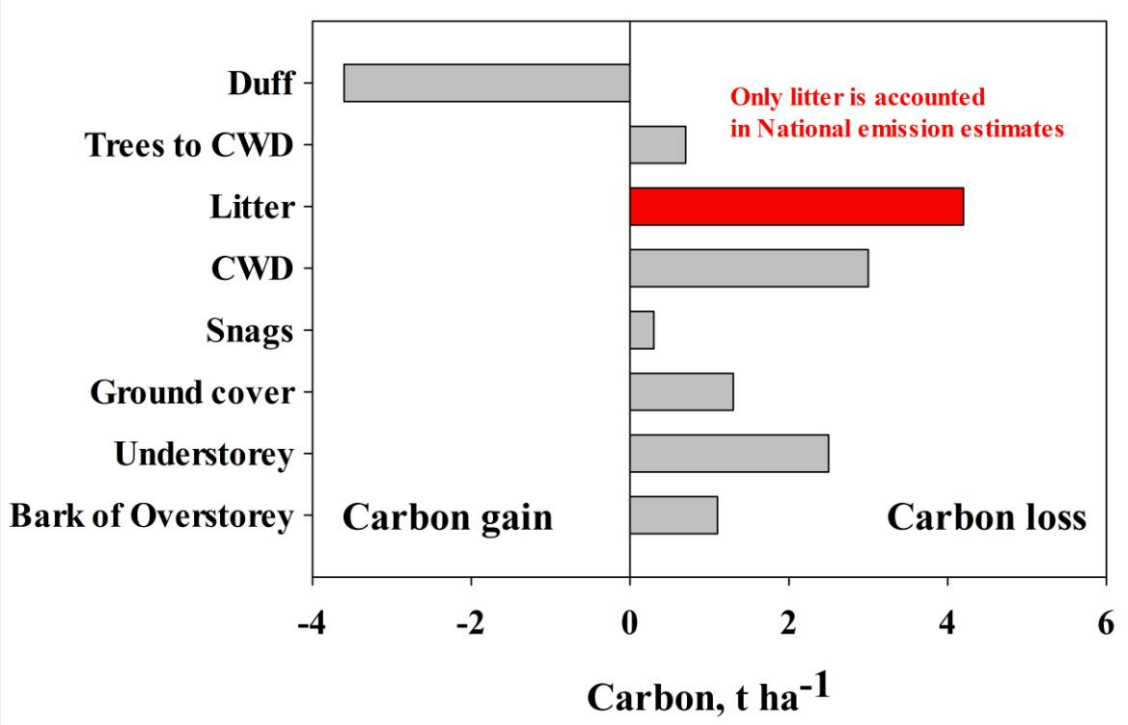
COLLECTION AND ANALYSIS OF DATA: IMPROVEMENT OF THE METHOD

- Better surface soil sampling protocol
- Increased number of transects for CWD
- Recognised need for better characteristics of fire, and litter moisture at burn

Carbon pool	Number of plots required		
	50% change	25% change	10% change
Overstorey	3	3	5
Understorey	4	7	30
Dead Standing trees	3	3	6
Coarse woody debris	8	23	131

Volkova and Weston (2013)

RESULTS: FIRE EFFECT ON FOREST C



Loss from all C pools =8 t Cha^{-1} (5% of total Forest C)

Fine fuel =~ 4 t Cha^{-1} (<2% of total Forest C)

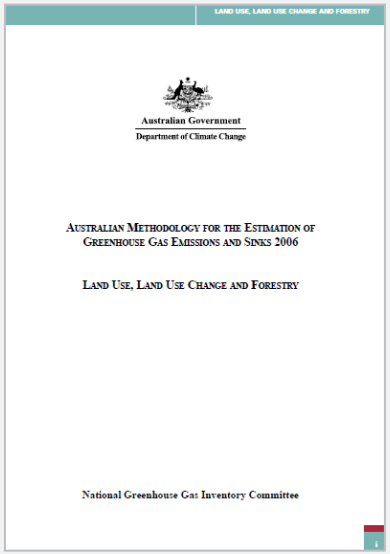
RESULTS: ESTIMATING EMISSION FROM PLANNED FIRE

$$\text{Emission}_{j\ gas} = \text{Fuel burnt} * \text{Emission Factor}_{j\ gas}$$

REF: Australian Methodology for the Estimation of Greenhouse Gas Emissions and Sinks, 2006

- Only fine fuels (dead leaf, bark and twig material less than 6 mm in thickness) are accounted in planned fire

- Fine fuel mass x 0.42= Fuel burnt



Fine Fuels (t C ha^{-1})

ACT	NSW	SA	VIC*	TAS	QLD
8.8	9.1	4.8	9.0	10.0	4.9

Data source: State Agencies, *Tolhurst 1994

UNDERESTIMATED EMISSION

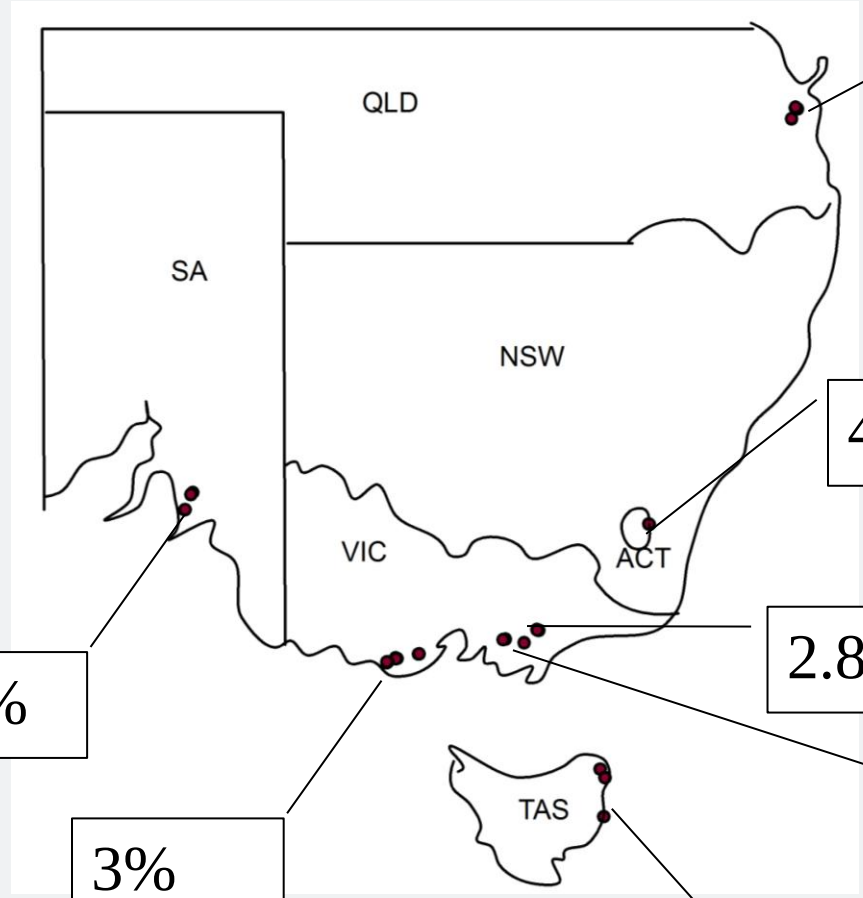
Loss from all C pools =8 t Cha^{-1} (5% of total Forest C)

Fine fuel =~ 4 t Cha^{-1} (< 50% of total lost C)

Most emitted C is derived from components not included in National emission estimates

30-50% of emission from other than fine fuels are not accounted Nationally…

SUMMARY: CARBON LOSS IN PLANNED FIRE AS % OF TOTAL FOREST C



2.7%

4%

2.8%

2.8%

5%

3%

3.5%

% loss of total forest Carbon (to 30 cm soil depth, IPCC definition)

3-5%

OUTPUTS: PUBLICATIONS

Published:

•Fire note #96;

• Journal article Volkova and Weston 2013, "Redistribution and emission of forest carbon...." *Forest Ecology and Management*,;

Articles in progress (to be submitted by the end of 2013):

- "Comparing emission and carbon loss in planned and wildfire"
- "Predicting Forest Net primary productivity"
- "Modelling carbon loss in fire, empirical study across SE Australia"
- " Fuel recovery after fire.."
- Fire Note from year 2 (was submitted , but still in line ...)

OUTPUTS: PRESENTATIONS

- Research Advisory Forum, 2011, 2012, 2013
- Poster at the International conference, Megafire Reality, USA, 2011
- Keynote speaker at QLD Biodiversity Forum, 2012;
- Research Forum at AFAC 2012; selected for RF at AFAC 2013
- End User meeting, 2013
- Contemporary Challenges of Managing Bushfire, 2013

WHAT WAS UNEXPECTED SOMETHING THAT SURPRISED US?

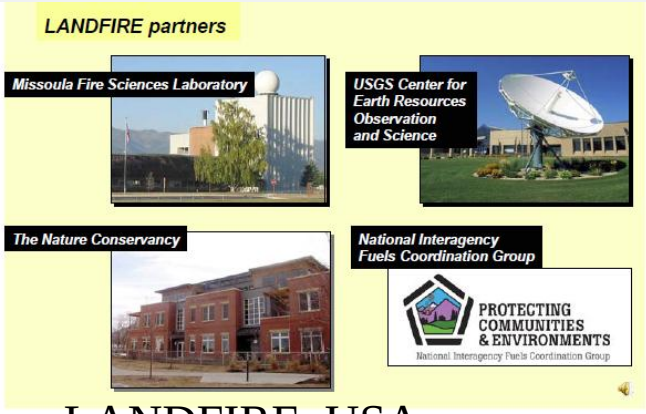
State of knowledge of fuels and managing fire in the landscape in Australia is so far behind other developed nations

☹

In 21 century Australia still doesn't have

Consistent and **comprehensive** data on vegetation and fuel characteristics across all States → *"Land managers do not have adequate data for making informed decisions and measuring their progress in reducing fuels"*

458 fuelbeds (all fuel types are accounted)



LANDFIRE, USA

HOW OUR RESEARCH HAS CONTRIBUTED TO OTHER RESEARCHES OVER THE 3-YEAR PERIOD

- Mick Meyer, CSIRO, in improving estimates of emission factors for south-eastern forests

- Malcolm Possell (BCRC/ Uni Sydney) in providing fuels from field sites to measure emission factors in controlled environment

- Our published data adds to FullCAM data set

- Setting up sites in Agencies areas of greater interests

CHALLENGES REMAIN

- Change national approach to emission estimates, include all fuels
- Need for State and forest type specific fuel beds
- Need for up to date emission and burning efficiency factors per fuel type
- Need for predicting all fuel strata (Important for modeling of emission, carbon, fire behaviour..)

WHERE TO NOW?

Submitted project proposal for new Bushfire and Natural Hazards CRC

Topic: Predicting entire fuel strata dynamics in SE Australian *Eucalyptus* forests

- Develop predictions of total fuel types and loads and link them to national fuel hazard ratings
- For a range of fire regimes measure and model the recovery of each fuel
- Incorporate fuel type and fuel load predictions into fire behaviour models

Proposed Team:

- Uni Melb Chris Weston & Luba Volkova
- CSIRO Andrew Sullivan & Stephen Roxburgh