PROGRAM D

EFFECTS OF BUSHFIRE SMOKE ON FIRE-FIGHTERS AND THE COMMUNITY

Fabienne Reisen, Steve Brown, Min Cheng, John Mahoney, Bill Tiganis
CSIRO-Manufacturing & Infrastructure Technology, Highett, VIC

Where there's fire there's smoke (and people)!

- Fighting fires is a workplace and the fire-fighter OHS must be protected
- Bushfire smoke in Australia – composition and the factors of influence (fuel type and load, fire intensity, weather etc) are unknowns
- Bushfire fighting practices in Australia – impact on exposure unknown
- Previous research limited (largely by USDA Forest Service)

Objective 1

Measure, evaluate and control the personal exposures of Australian bushfire fire-fighters to air toxics

- ⇨ Assess exposure levels to air toxics in regards to Occupational Exposure Standards (OES)
- ⇨ Identify key factors that determine exposure levels
- ⇨ Identify areas of unacceptable risks

⇨ Develop risk reduction strategies

Objective 2

Measure and evaluate the exposure of communities to bushfire smoke, in particular during extensive prescribed burning seasons

Bushfire Smoke – What is it?

- Complex mixture of toxic air contaminants (gases & particles)
- Key toxic species - literature review & experimental burns with different fuels

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Bushfire Air Toxics & Health Effects

- Carbon monoxide
- Aldehydes
- Volatile Organic Compounds (VOCs)
- Respirable particles

Aggravation of respiratory and cardiac conditions

Impaired lung function

Eye/nose/throat irritation

Carcinogens

How to Sample Air Toxics?

Criteria

- Comfortable, easy to wear, light weight
- Robust to withstand the harsh field conditions
- Specific to selected air toxics
- Supported by reliable chemical analyses

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Personal Monitoring Devices

Sampling Procedure

- **Quantitatively sample** bushfire air toxics in the **breathing zones** of randomly selected fire fighters
  - Key tasks
  - Fuel types
  - Fire types
- **Brief interview** at the end of each sampling
  Tasks and reactions to smoke

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Burns and Fires Attended

Location	Fire type	Burn area	Vegetation	Samples
NE Victoria	FRB	50-500 ha	Eucalypt	6
Dandenong, VIC	FRB	5 ha	Eucalypt	6
Deer Park, VIC	FRB	5 ha	Grassland	3
Ngarkat CP, SA	FRB/Exp	240 ha	Mallee heath	11
TWP, NT	Exp	3 ha	Tropical forest	6
Moondarra, VIC	Accidental			10
Kinglake, VIC	FRB	150 ha	Eucalypt	4
Kinglake, VIC	Slash burn	33 ha	Eucalypt	6
NE Tasmania	FRB	200 ha	Buttongrass, heath	4
NE Tasmania	Heap burn	140 ha	Eucalypt	4

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Personal Exposure Levels by Work Activity

1. Lighting – using a hand-held drip torch

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Personal Exposure Levels by Work Activity

2. Patrolling –
   - maintain the fire within the boundaries of the burn

Personal Exposure Levels by Work Activity

2. Patrolling –
   - Put out spot-fires (hose or hand-tools)



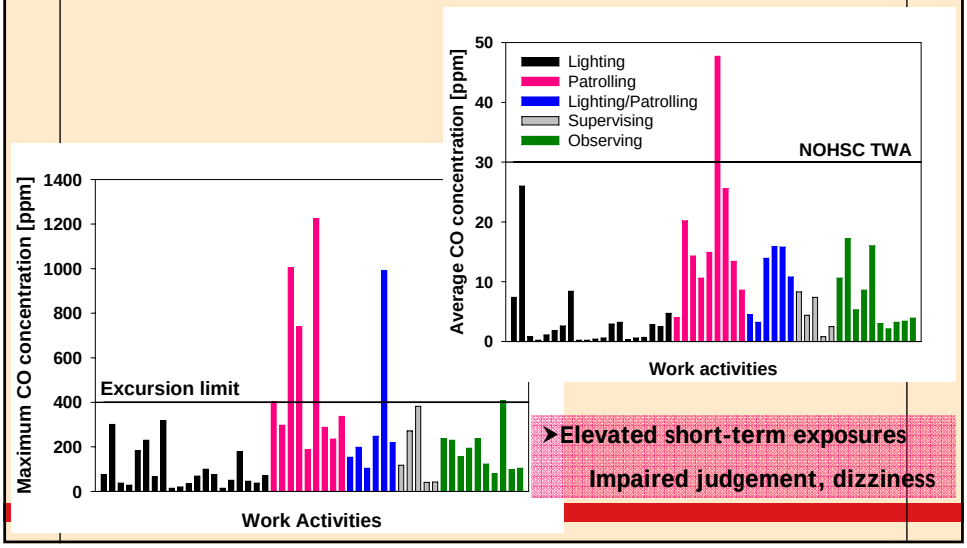


Personal Exposure Levels by Work Activity

3. Supervising

4. Observing – researchers

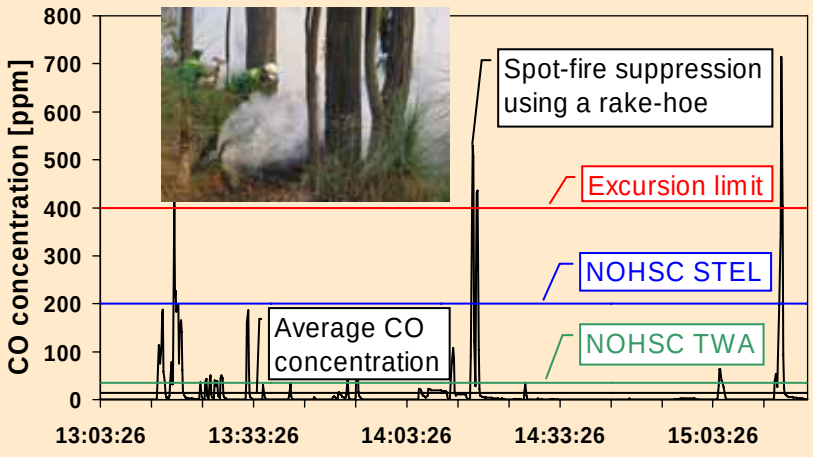
Carbon Monoxide Exposure Levels



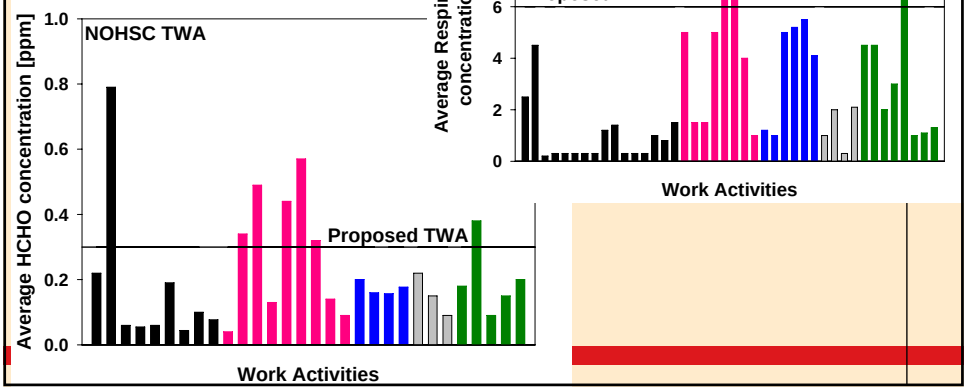
➤Elevated short-term exposures

Impaired judgement, dizziness

Data-logger Record of Firefighter's Exposure to CO

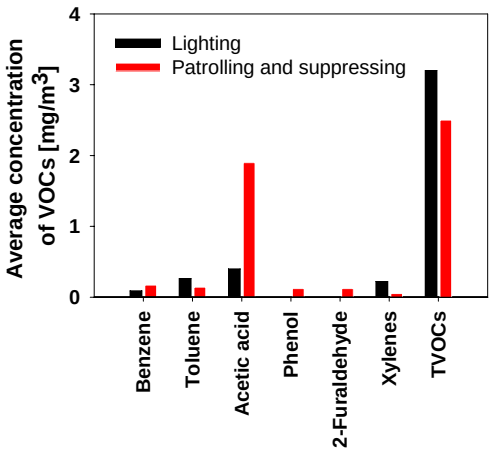


Personal Exposure Levels: RP and HCHO



Personal Exposure Levels to VOCs

- Major VOCs at higher levels for the patrolling crews
- Total VOC (TVOC) levels higher for the lighting crew
  - added presence of several alkanes (fuel used in drip torches)



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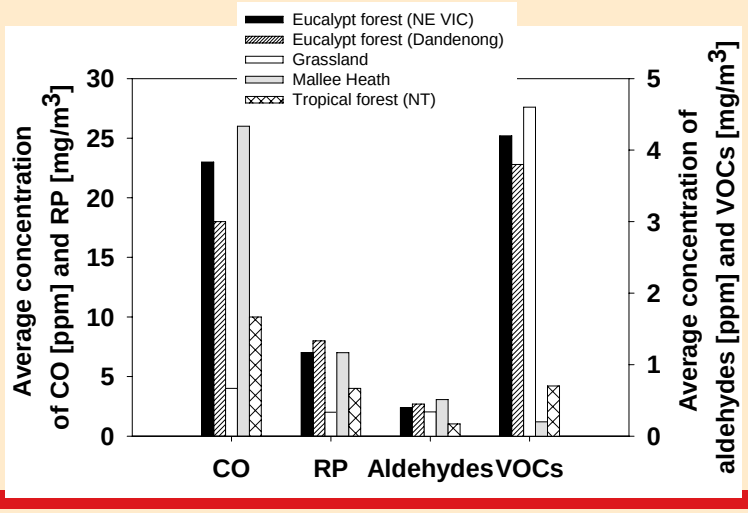
Exposure Levels by Fuel Type



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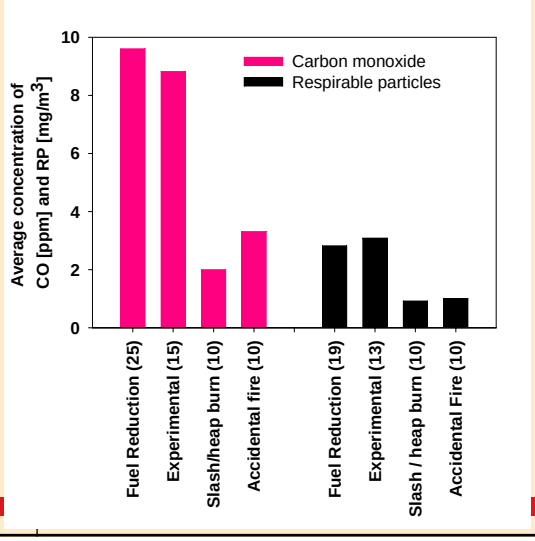
Exposure Levels by Fire Type



Fuel reduction burns

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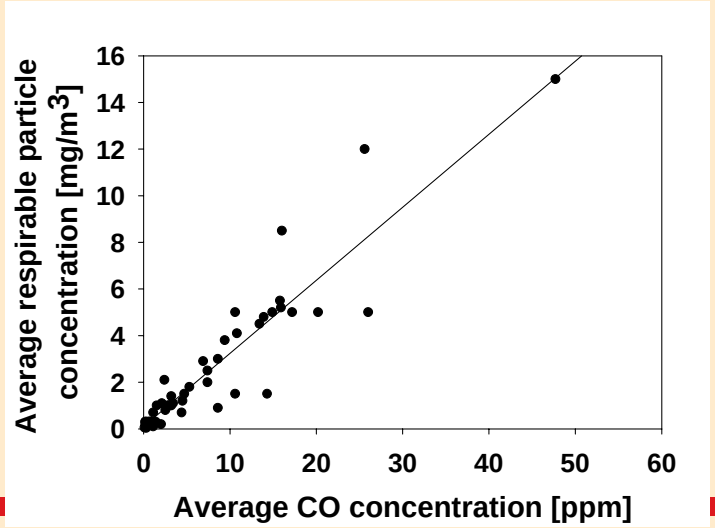
Experimental burns

➤

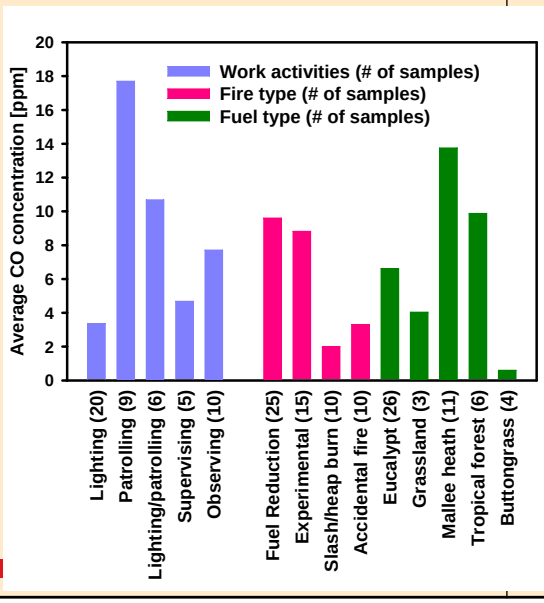
Slash/Heap burns

Pollutant Correlation



Summary

- Variability among exposure levels
- Higher exposures (sometimes exceeding occupational exposure standards) in certain tasks and with certain fuels.



SUMMARY

- CO – elevated short-term exposure levels
  - ➤ sensor, screening method
- Respiratory irritants - irritation, but also potential to cause long-term health effects
  - ➤Task rotation, face masks or respiratory protection
- Urban particles –health effects known; determine whether bushfire smoke particles (composition) are similar to urban particles and see whether similar health effects can be expected

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Community Exposure

Major pollutant: Particulate matter

NEPM PM_{10}: 50 μg/m³ (1 day)
NEPM $PM_{2.5}$: 25 μg/m³ (1 day)

Elevated PM levels associated with

- ➔ Coughing, wheezing, difficulty breathing
- ➔ Eye and nose irritation
- ➔ Increased hospital admissions for respiratory disease and heart problems
- ➔ Increased mortality in individuals with pre-existing cardiopulmonary diseases
- ➔ Decreased lung function among schoolchildren

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Community Impact from Bushfire Smoke

Location	PM_{10} (μg/m³)	Immediate increased medical impact
California (1987)	>150	Asthma: 40% COPD: 30%
Darwin (2000)	80	Asthma: 240%
Singapore (1997)	80	Asthma: 19% Rhinitis: 26%
Indonesia (1997)	**1600**	Asthma: 150%

NEPM PM_{10}: 50 μg/m³ (1 day)
NEPM $PM_{2.5}$: 25 μg/m³ (1 day)

THANK YOU

We thank the following agencies for their help and participation in the monitoring process:

DSE, CFA, CFS, DEH, NT Bushfire Council, Territory Wildlife Park, Forestry Tasmania, CSIRO Sustainable Ecosystems, ENSIS.