




PROGRAM D

→ **EFFECTS OF BUSHFIRE SMOKE ON FIRE-FIGHTERS AND THE COMMUNITY**

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PROGRAM D : Program 7 : Presentation Title

→ **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



## Bushfire Air Toxics & Health Effects



Aggravation of respiratory and cardiac conditions

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

Impaired lung function

Carcinogens



Eye/nose/throat irritation

→ **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



→ **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

## → 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

→ Personal Exposure Levels by Work Activity

1. Lighting - using a hand-held drip torch



→ Personal Exposure Levels by Work Activity

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



→ Personal Exposure Levels by Work Activity

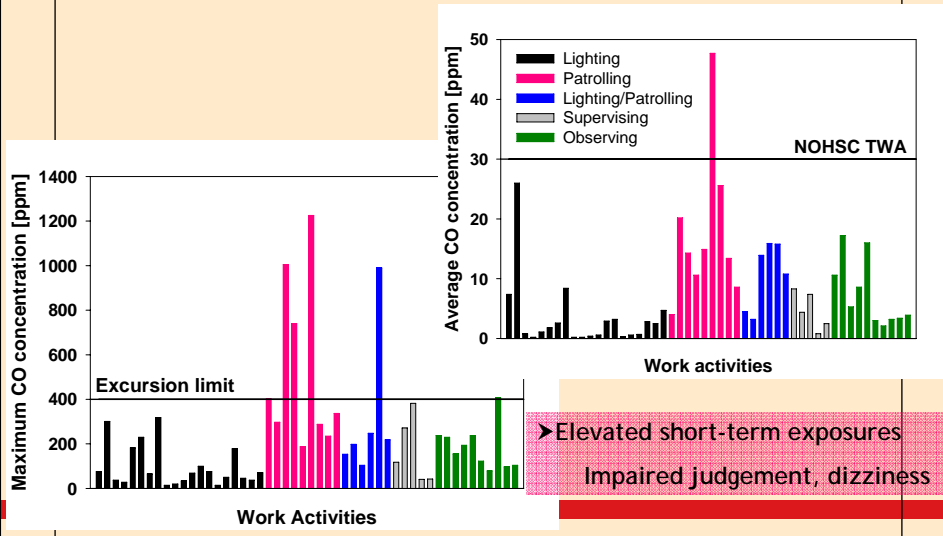
- 2. Patrolling -
  - Put out spot-fires (hose or hand-tools)



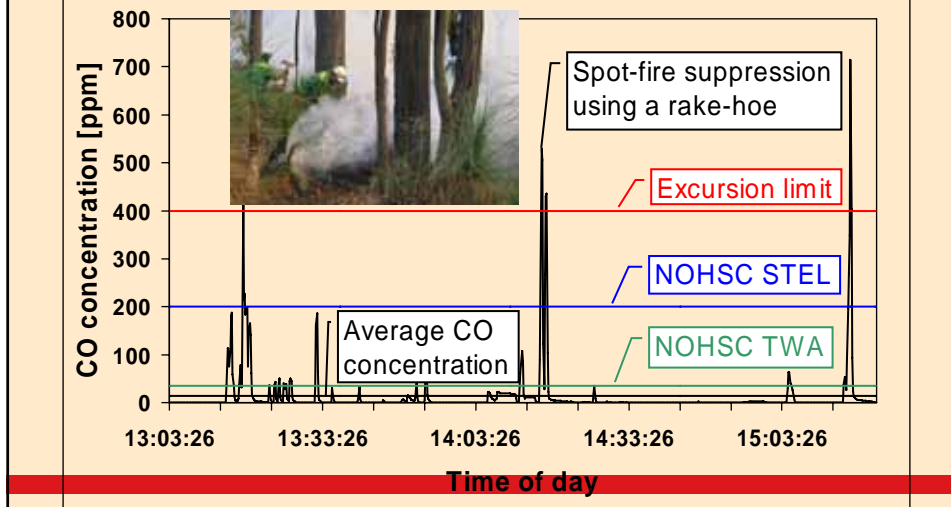
→ Personal Exposure Levels by Work Activity

- 3. Supervising
- 4. Observing - researchers

## → Carbon Monoxide Exposure Levels



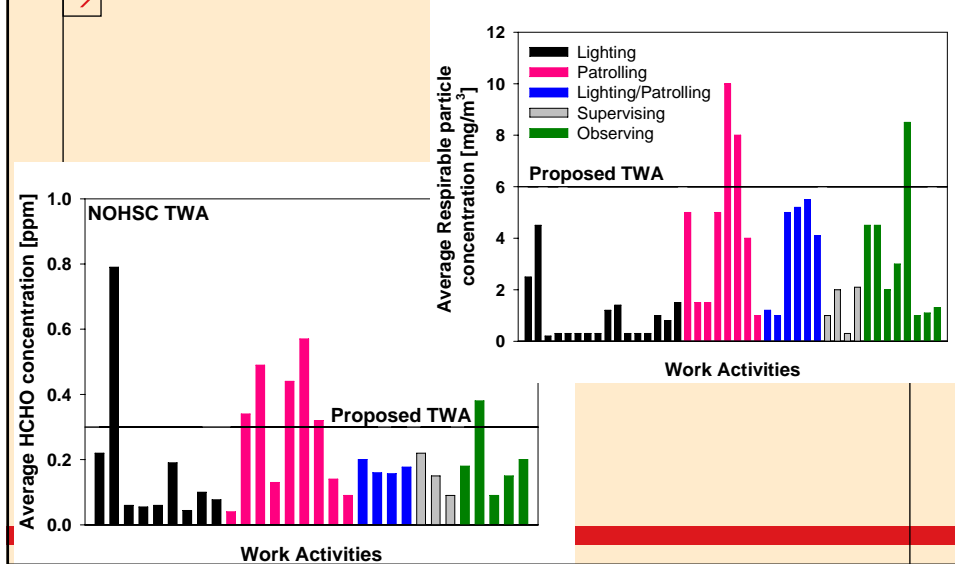
## → Data-logger Record of Firefighter's Exposure to CO





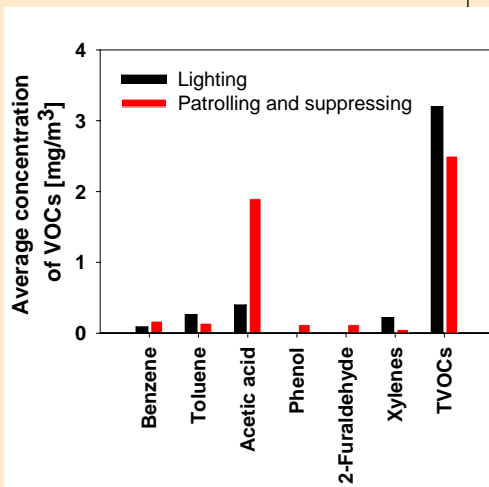


## Personal Exposure Levels: RP and HCHO



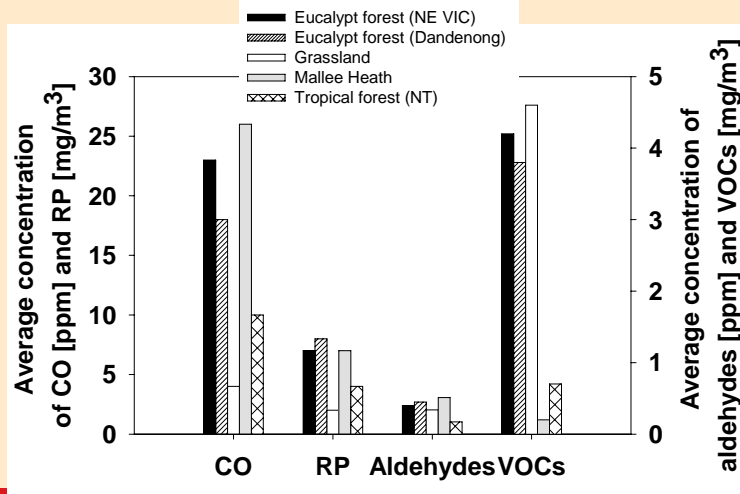
## Personal Exposure Levels to VOCs

- 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)

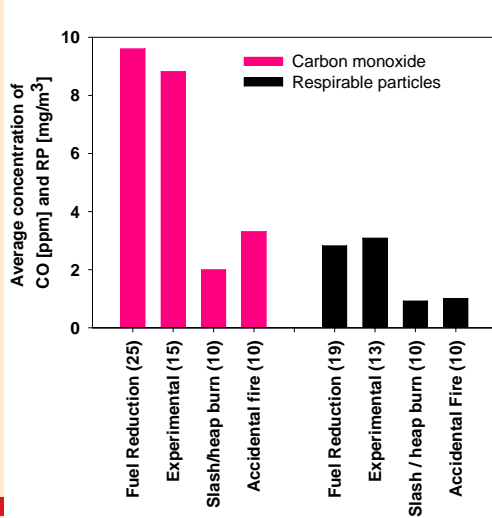




## Exposure Levels by Fuel Type



## Exposure Levels by Fire Type



Fuel reduction burns



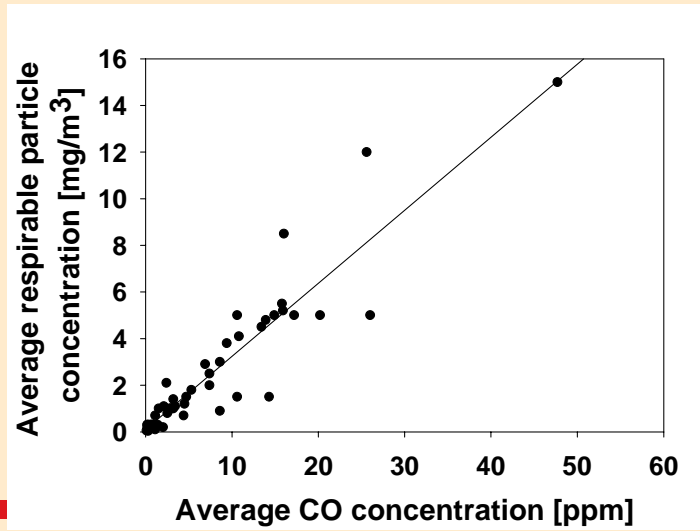
Experimental burns



Slash/Heap burns

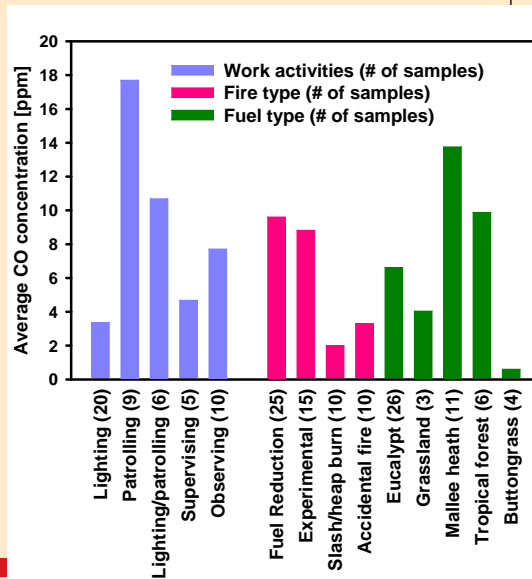


## Pollutant Correlation



## 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

→ **Community Exposure**



→ **Major pollutant: Particulate matter**

NEPM PM<sub>10</sub>: 50 µg/m<sup>3</sup> (1 day)  
 NEPM PM<sub>2.5</sub>: 25 µg/m<sup>3</sup> (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

→ **Community Impact from Bushfire Smoke**

Location	PM <sub>10</sub> (µg/m <sup>3</sup> )	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<sub>10</sub>: 50 µg/m<sup>3</sup> (1 day)**  
**NEPM PM<sub>2.5</sub>: 25 µg/m<sup>3</sup> (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,  
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