PROGRAM D

ASSESSING THE IMPACT OF BUSHFIRE SMOKE ON THE FIRE GROUND

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Objective:

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

Background:

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

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Fire ground – a hazardous environment

RISK = HAZARD x EXPOSURE

Occupational Exposure Standards:

Air inhaled at work should not contain chemical agents at concentrations that produce adverse effects on health, safety or well-being

⇨Assess quality of working environment
⇨Identify areas of unacceptable risks
⇨Develop risk reduction strategies

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Occupational Exposure Standards

- TWA concentration
  - 8-hr working day, 5-day working week
- STEL concentration
  - not exceed 15 min, not be repeated > 4 times/day, separated by at least 60 min
- Adjustments
  - longer shifts
  - heavy or strenuous work (↑ lung ventilation rate)
- Complex nature of bushfire smoke
  - No standard specific to bushfire smoke particles
  - Interactive health effects

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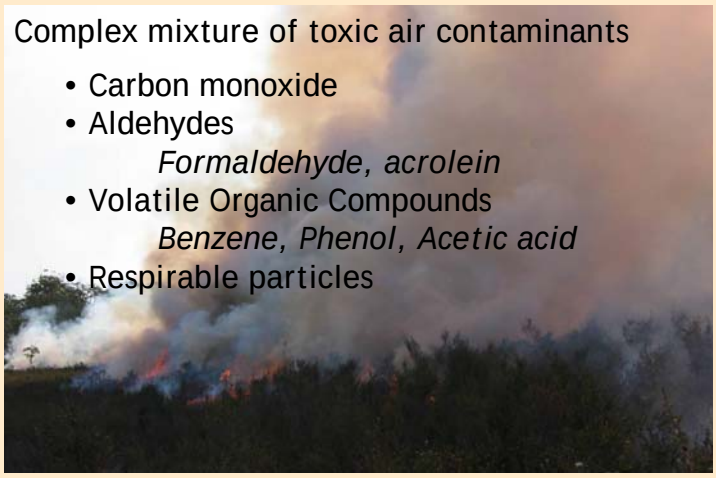
HAZARD - Bushfire Smoke

Complex mixture of toxic air contaminants

- Carbon monoxide
- Aldehydes
  Formaldehyde, acrolein
- Volatile Organic Compounds
  Benzene, Phenol, Acetic acid
- Respirable particles



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Bushfire Air Toxics & Health Effects

Short-term

Eye/nose/throat irritation

Long-term

Impaired lung function

Aggravation of respiratory and cardiac conditions

Carcinogens

EXPOSURE - How to Sample Air Toxics?

- **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 Fire Attended

Bushfire - Moondarra

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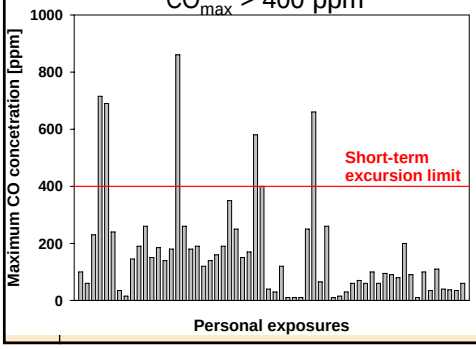
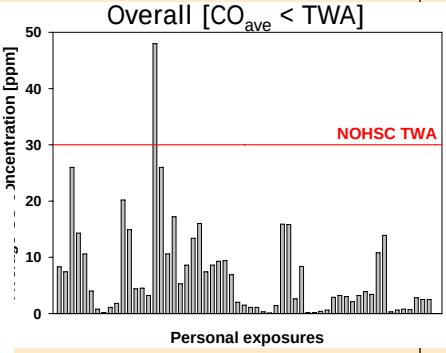
Personal exposures to CO

COHb levels depend on $[CO]_{air}$, exposure duration, ventilation rate, pre-level

CO_{max} > 400 ppm



Overall $[CO_{ave}$ < TWA]



- Headaches, dizziness, fatigue, nausea
- Effects on performance of tasks requiring vigilance

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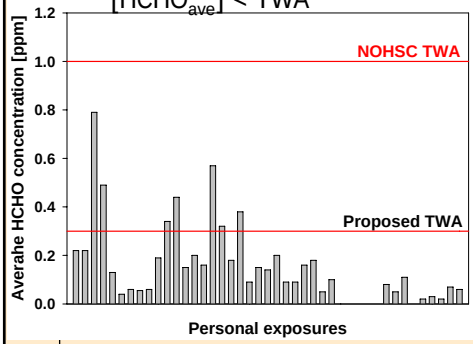
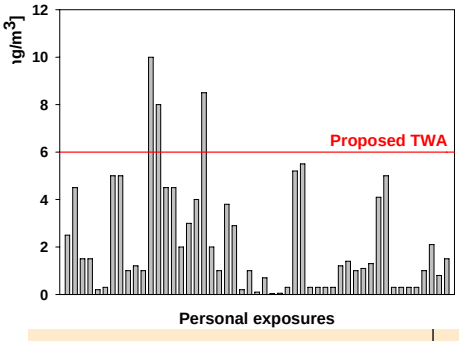
Personal exposures to respirable particles & formaldehyde

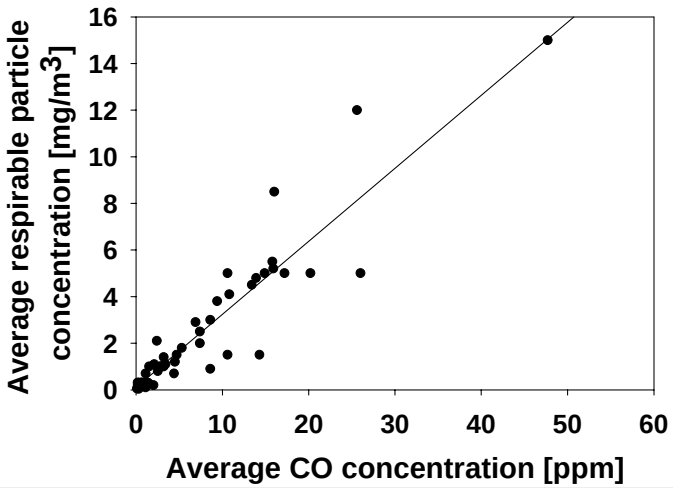
$[HCHO_{ave}]$ < TWA





No standard for bushfire smoke particles – composition unknown

Pollutant Correlation



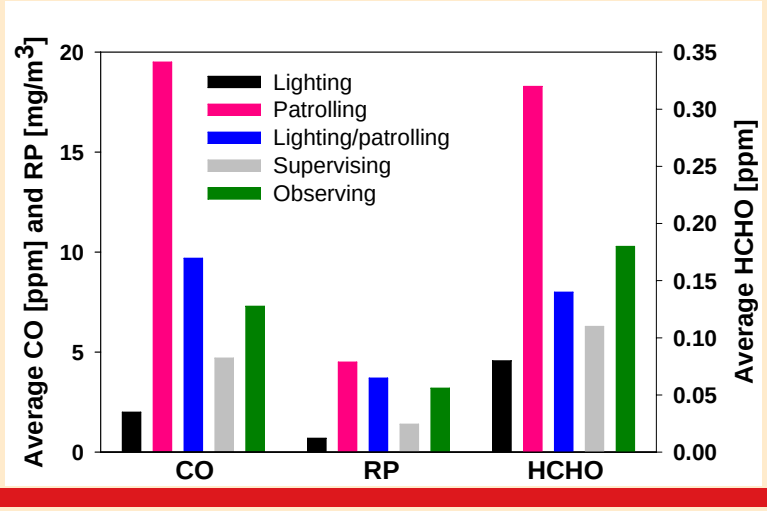
Work Activities

1. Lighting

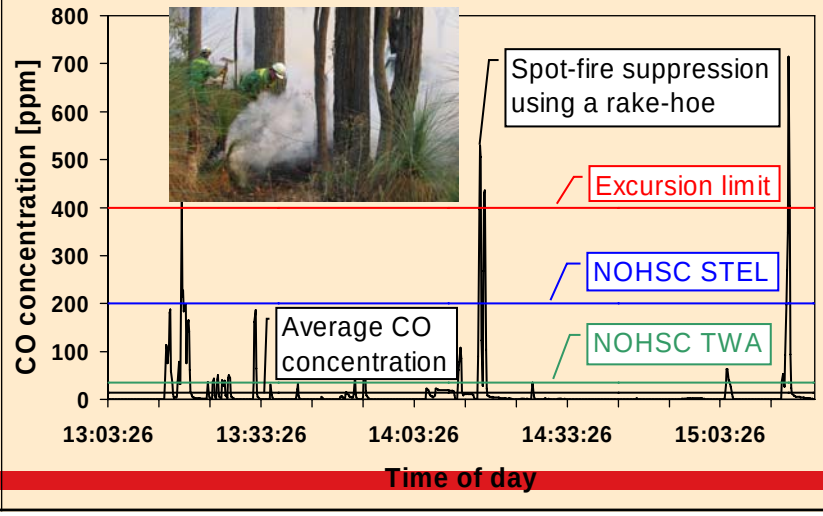
2. Patrolling – including putting out spot-fires (rakehoe or hose)

3. Supervising
4. Observing (researchers)

Personal exposure levels by work activity

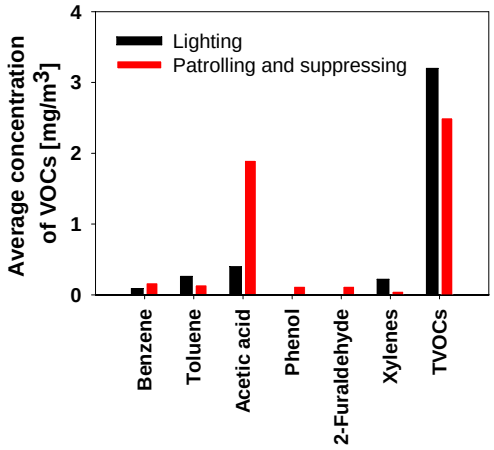


Data-logger Record of Firefighter's Exposure to CO



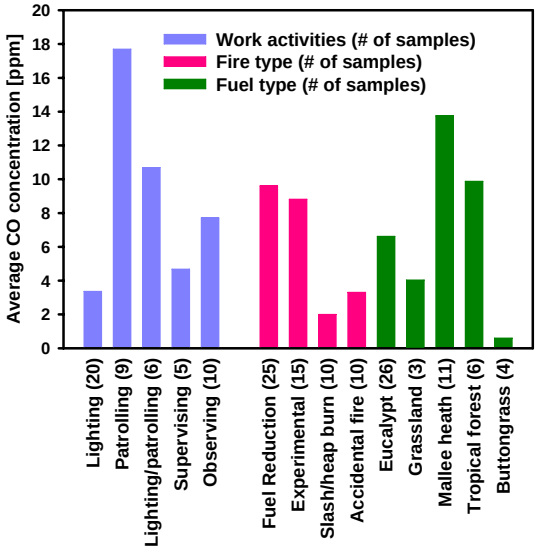
Personal Exposure Levels to VOCs

- [VOC] < OES
- 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)



Summary

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



Control strategies

- CO – elevated short-term exposure levels
  - ➤ Sensor, task rotation (mix low/high exposure tasks), hazard awareness training
- Respiratory irritants (respirable particles and aldehydes) - irritation, but also potential to cause long-term health effects
  - ➤Task rotation, face masks or respiratory protection

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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.