

# Wildland Fire Fighter Activities

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# Outline

- Background
- Wildland Fire Fatality Data
- Non-fatal Injury/Illness
- Wildland Fire Exposures
- Wildland Fire Fighting Respirator Use
- USFS/NIOSH Collaborative Data Analysis

Photo Courtesy of George Goyles and the US Forest Service

# Background

- Fire fighting is a high-risk occupation requiring considerable physical and psychological demands
- 2001-2012: 104 US fire fighter line of duty deaths each year
- Two primary modes of fire fighting
  - Urban/structural
  - Non-urban/wildland or wildland fire fighting
- Different mechanisms and techniques used for each mode
- Each pose unique risks and hazards to the worker



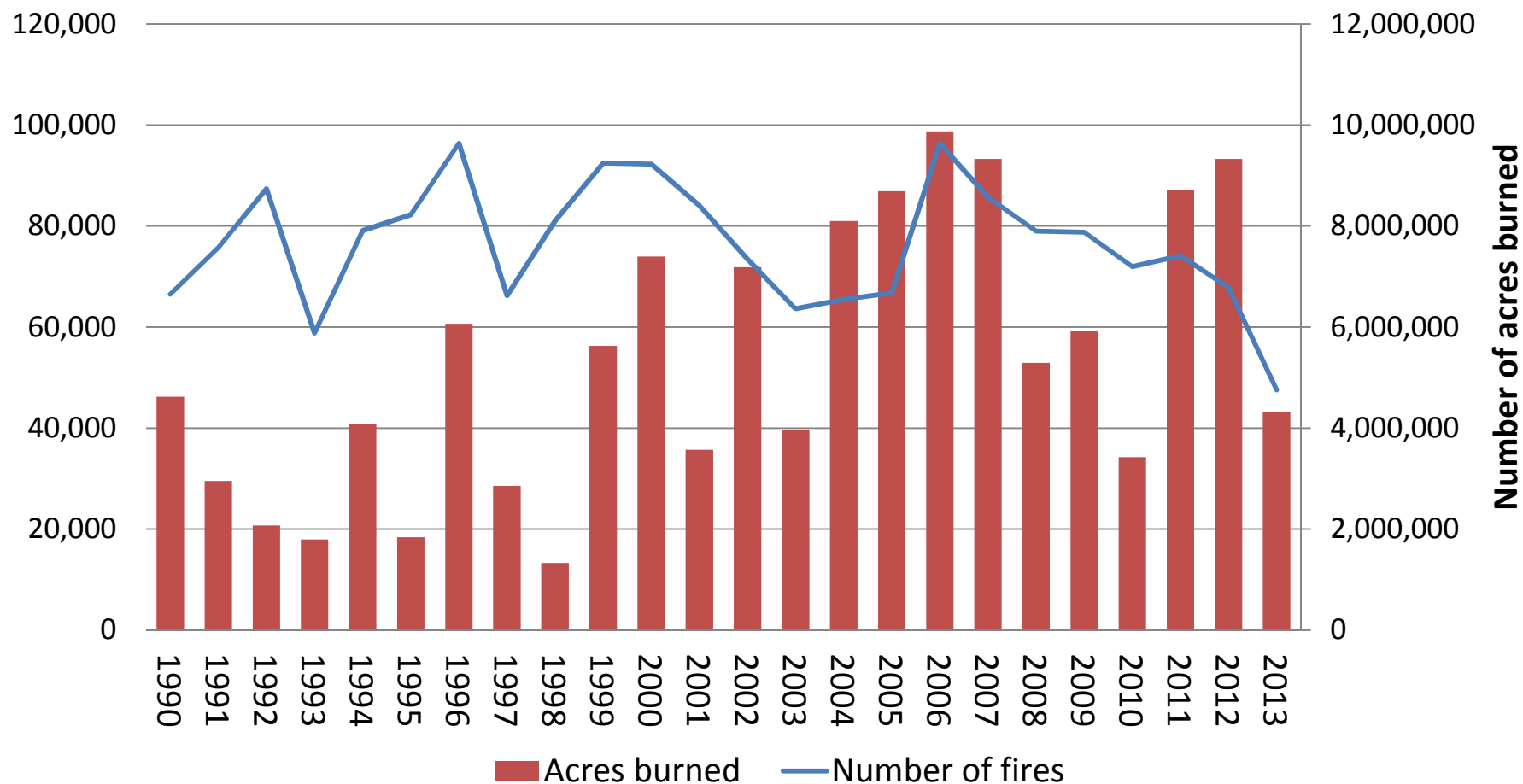
Photo Courtesy of Mike Kaiser, US Forest Service

# Wildland fire

- **Any non-structure fire in the wildland**
- **Three types of wildland fire**
  - Wildfire, wildland fire use and prescribed fire
- **Wildland fires typically occur in the ‘wildland’ or the ‘wildland-urban interface’ (WUI)**
  - Wildland
    - An area in which development is essentially non-existent
  - WUI
    - The line, area or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels

Source: National Wildfire Coordinating Group (NWCG) Glossary of Wildland Fire Terminology

# Wildland fire acreage burned and number of fires, 1990-2013



Data courtesy of National Interagency Fire Center (NIFC)

# Wildland Fire Fighters (WFFs)

- **Types of fire fighters**
  - Aerial
    - Smoke jumpers
    - Helicopter/tanker crew and pilots
  - On the ground
    - Handcrews
    - Engine crew
    - Dozer/heavy equipment operators
    - Single resources
    - Structural protection
  - Managers/Supervisors/Overhead
    - Incident Command Personnel
    - Support Staff



Photo Courtesy of George Goyles and the US Forest Service



- **AGENCIES INVOLVED**

- Federal Wildland Fire Protection
- State Wildland Fire Protection
- Local Wildland Fire Protection
- Contractors
- Prison Crews
- National Guard



- **Varying jurisdictions, roles, responsibilities, missions, training and cultures**

# Wildland Fire Fighters (WFFs)

- **Types of employment**
- **Demographics**
  - Gender
  - Age
- **Experience level**
- **Employment requirements**
  - Physical fitness
  - Medical
  - Training



Photo Courtesy of George Goyles and the US Forest Service



# OSH Data and Research Challenges

- High risk population
- Very limited data on this worker population
- Often grouped with 'regular' fire fighters
- Size of the workforce is unknown
  - Transient/seasonal population
  - Largely volunteer
- 'Cowboy'
- OSH surveillance & research soup
  - Fatality surveillance systems differ
  - Varying/somewhat inconsistent injury/illness/exposure datasets
- Limited 'health effects' research
- Historically, limited interest from some of the worker/fire manager community
- Politically charged

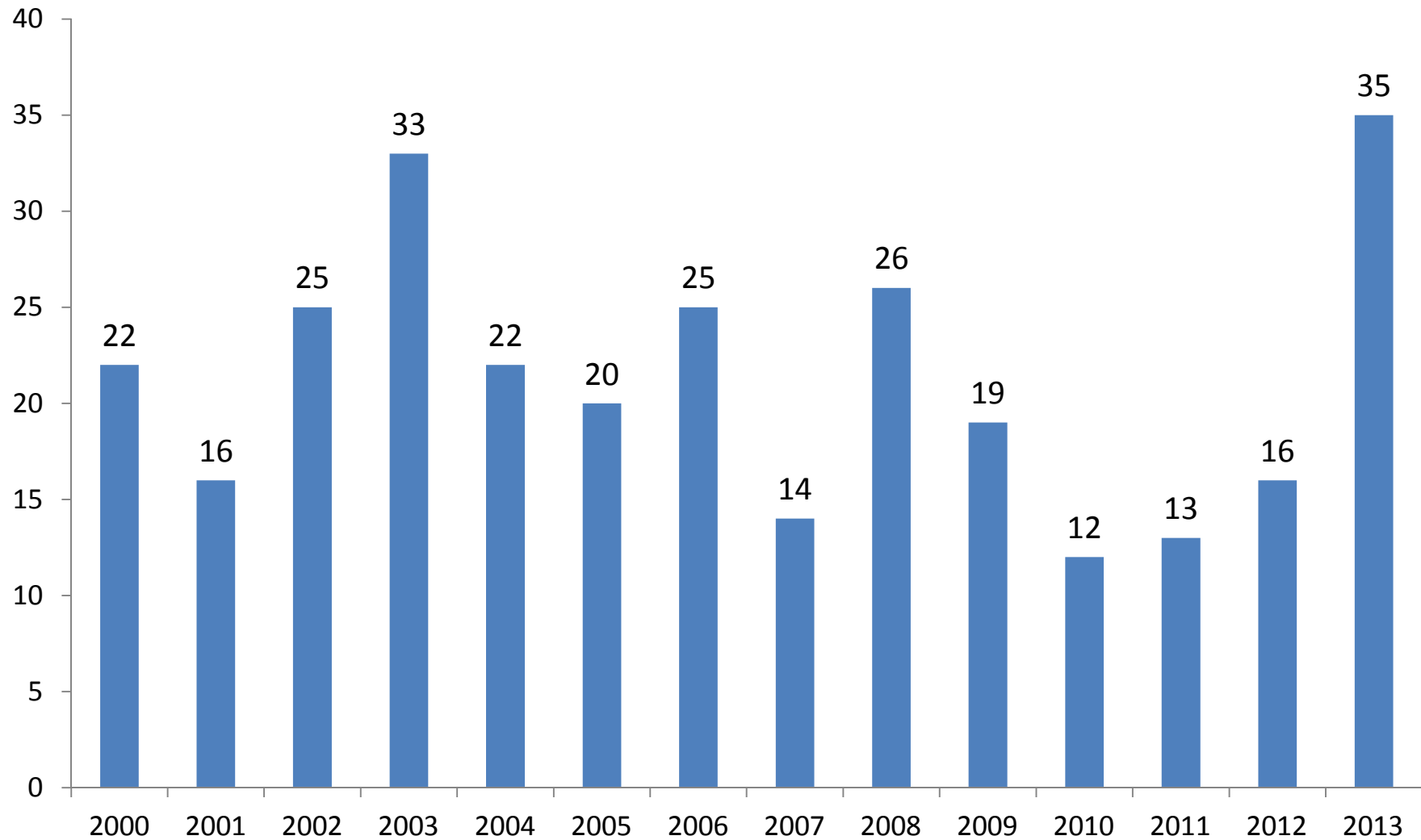


# Progress since 2012

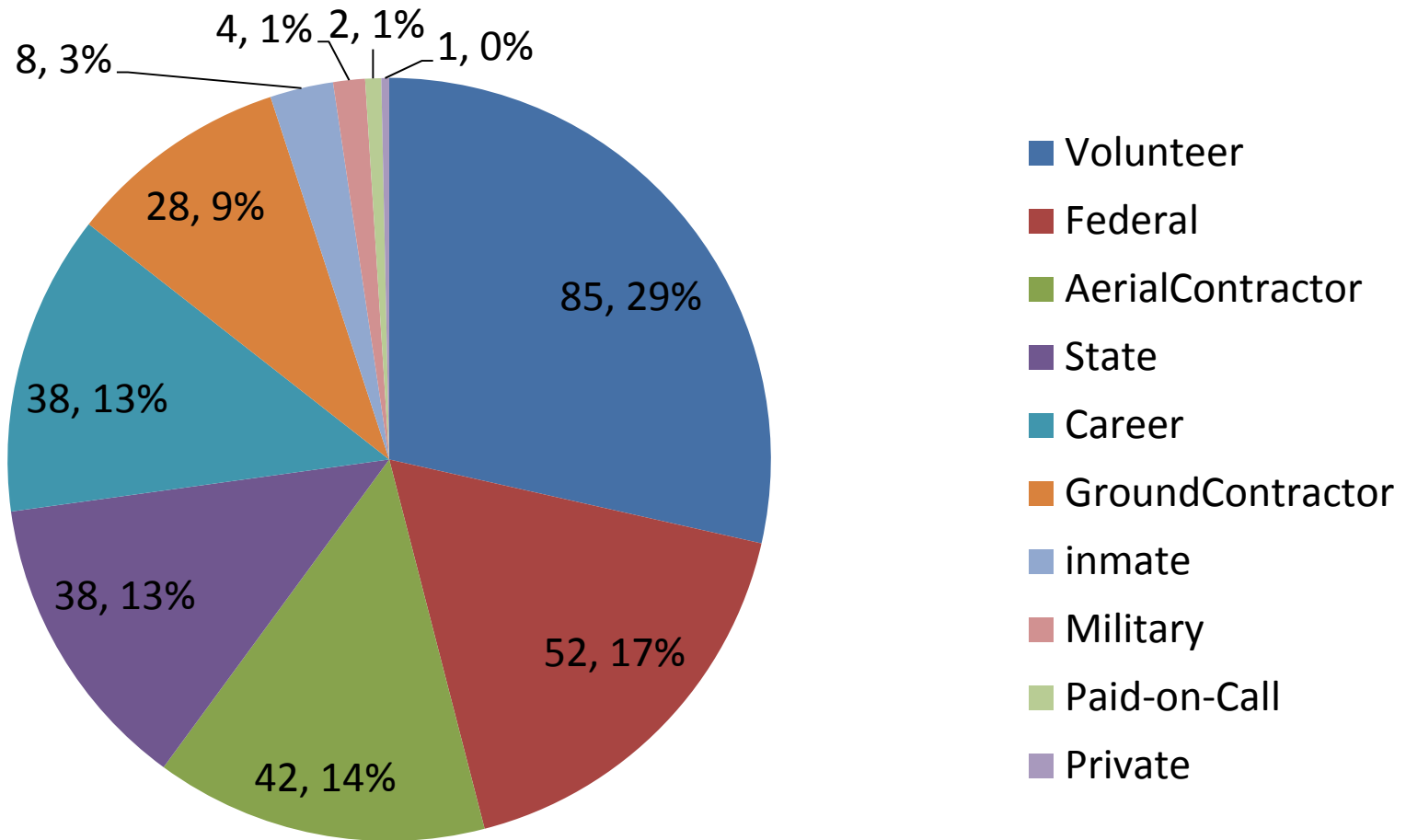


- United States Forest Service
  - January 2014: Data Use Agreement signed with USFS Technology and Development Centers (TDC)
    - 4 years of exposure data (2009-2012)
  - May 2014: General Research MOU developed with USFS TDC
  - August 2014: ROSS National Interagency Fire Center (NIFC) dispatch records
- Department of Interior
  - Safety Management Information System (SMIS)
- Fatality Data Analysis Project
- Communication documents and professional publications

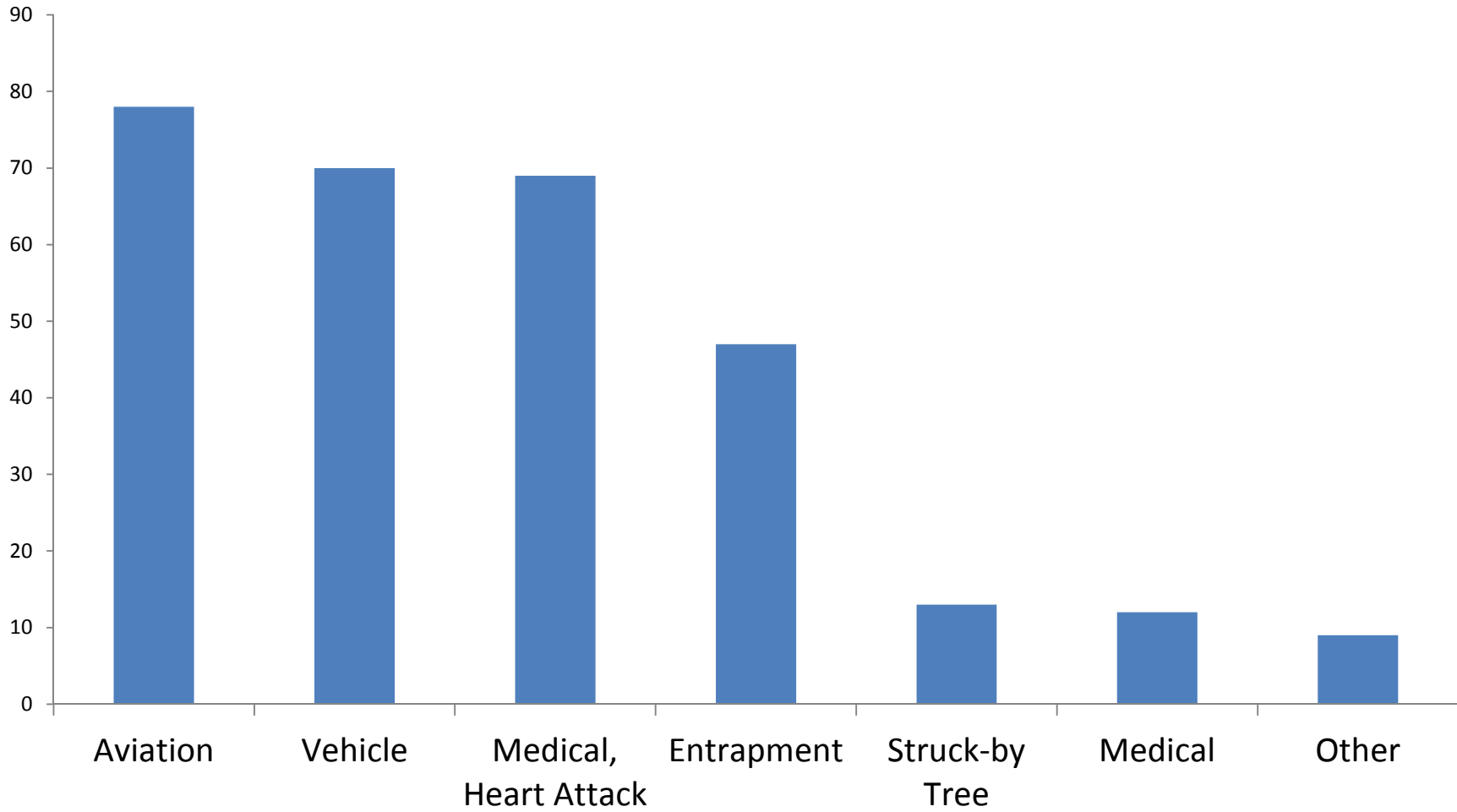
# Number of wildland fire related fatalities



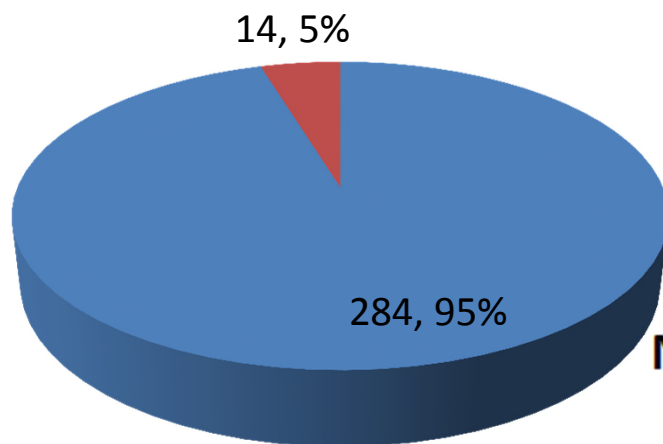
# Number of wildland fire related fatalities by type of employment, 2000-2013



# Number of wildland fire related fatalities by type of incident, 2000-2013

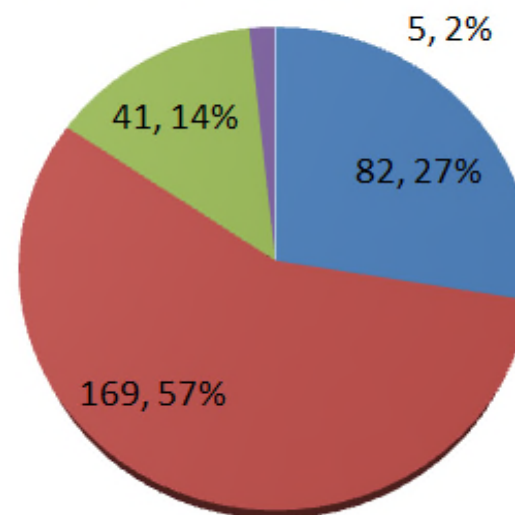


## Number and percent of wildland fire related fatalities by gender, 2000-2013



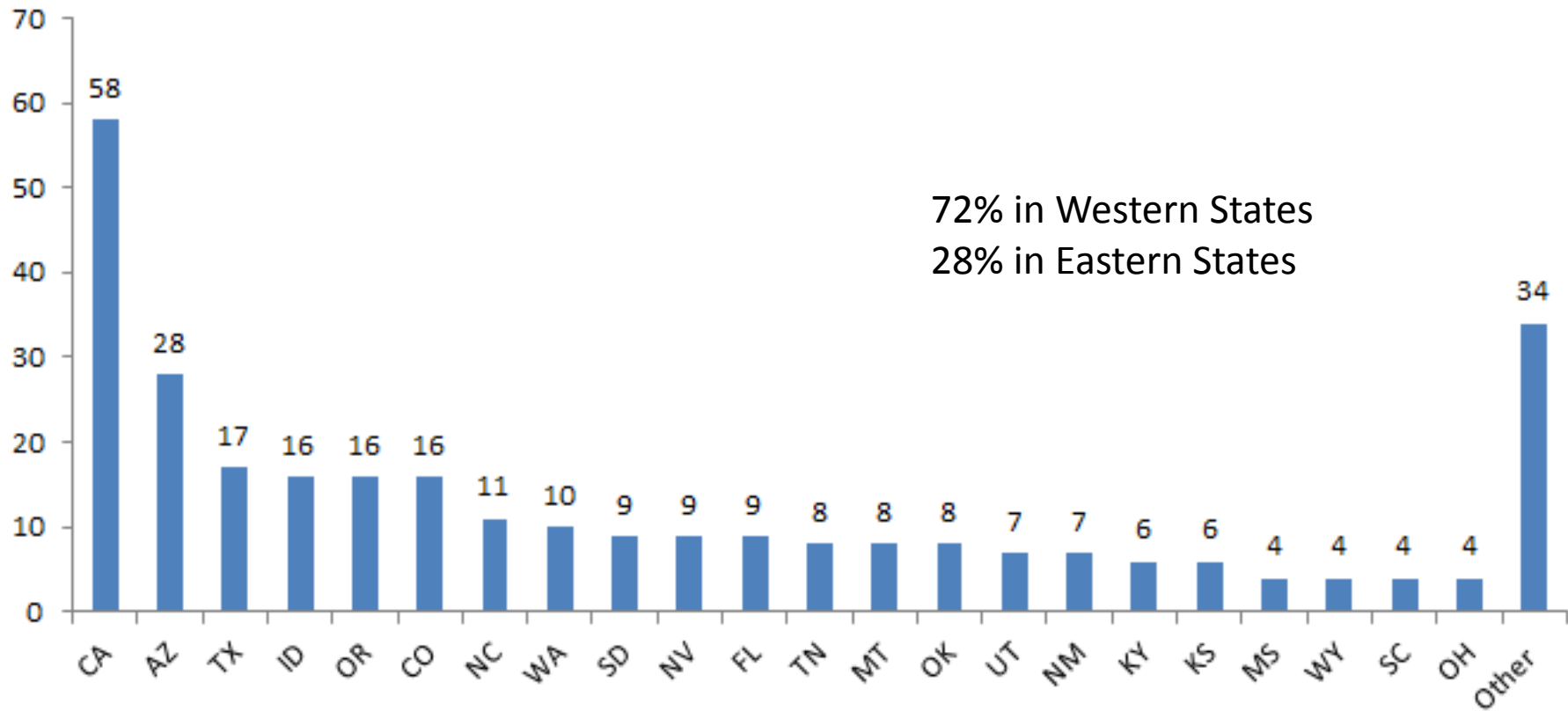
■ Male ■ Female

## Number and percent of wildland fire related fatalities by age, 2000-2013

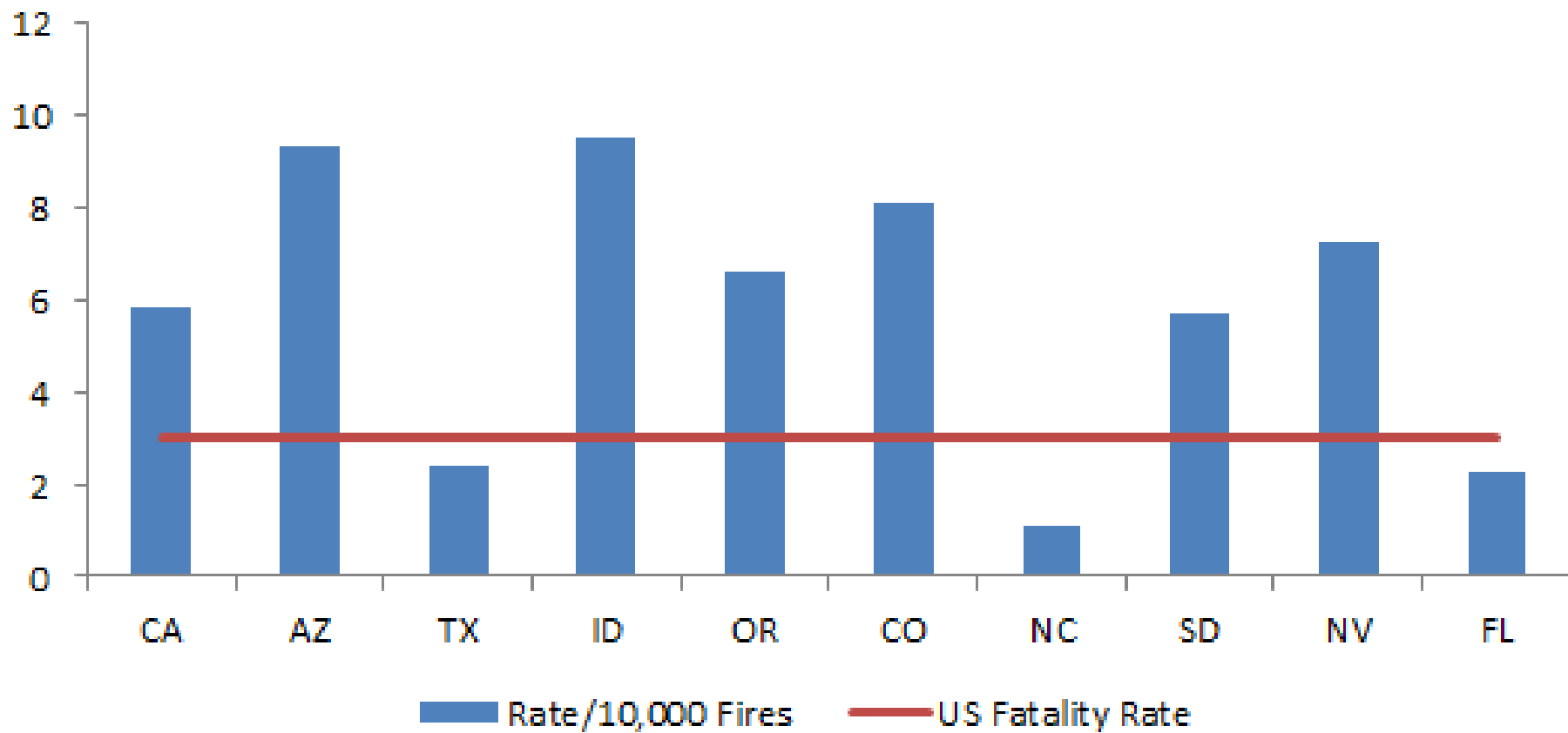


■ <30 ■ 30-59 ■ ≥60 ■ Unknown

## Number of wildland fire related fatalities by State, 2000-2013



# Wildland fire fatality rate/10,000 reported fires, by State, 2002-2013





# Non-Fatal Injury Data

- **Limited surveillance data**
  - Based on information from the DOI 'SMIS' surveillance system
    - Most common injuries due to slips/trips/falls and contact with equipment/tools/machinery
    - Most common type of injury is sprains
    - Injuries occurring later in the wildland fire season were likely to be more severe than those occurring in the early season
  - Review of medical records at large fires
    - More experienced and specialized fire fighting teams had lower injury incidence
    - Engine crew workers suffered the most injuries
- **Limitations**
  - Under-utilization and quality of data

# Other health concerns

- Heat-related illness
- Rhabdomyolysis
- Respiratory illnesses
- Total worker health
  - Work organization and stress
- Long term health effects
- Noise/hearing loss
- Cardiovascular disease
- Exposure to
  - Naturally occurring asbestos (NOA)
  - *Coccidioides* (Valley Fever)



Photo courtesy of Todd Wyckoff, New Jersey State Forestry Service

# Wildland Fire (WLF) Exposures

# Unique Environment

- **WLFs vary in size, scale, impact**  
2012 - 67,000 fires & 9 million acres
- **Large WLF suppression workforce**  
34,000 federal workers & an estimated 307,000 total employees
- **Variety of potential toxic combinations in smoke particulates and fire gasses**  
CO, Benzene, Sulfur Dioxide, Free Radicals, PM, CO<sub>2</sub>, Aldehydes and Nitrogen Oxides. (Ward, 1991)



Photo Courtesy of George Goyles and the US Forest Service

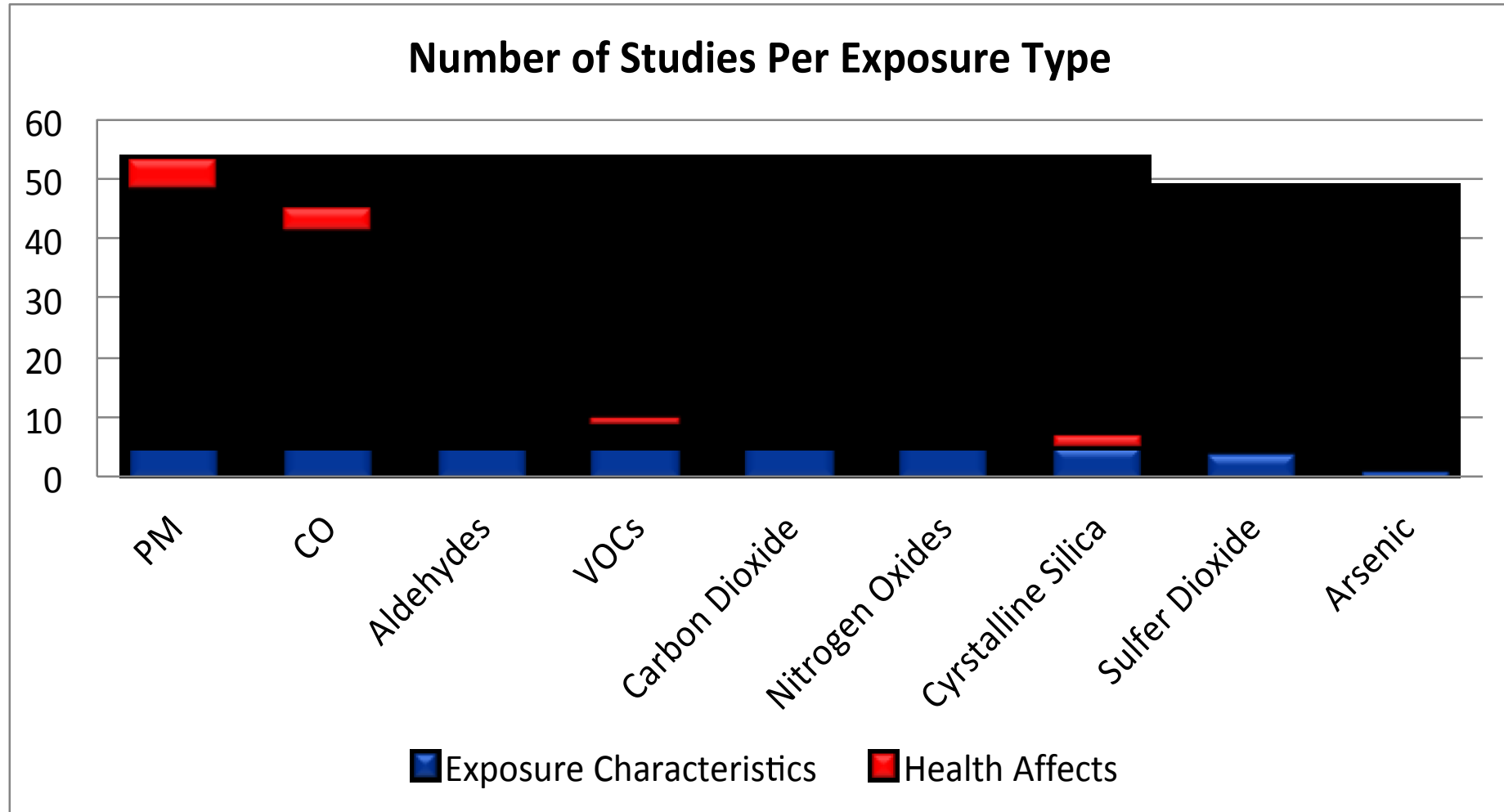
# A Population at Risk

- **Concentrations and fluctuations of CO depend on a variety of potential variables**
  - Fuel type, task, work rate, geography, meteorological factors, etc.
- **Short Term Health Affects**
  - Headache, fatigue, nausea, dizziness and confusion
  - URI and seasonally decreased lung function
- **Long Term Health Affects**
  - Long term \*\*chronic exposure health effects not well characterized
  - Cancer and cardiovascular disease
  - Work is being conducted by USFS



Photo Courtesy of George Goyles and the US Forest Service

# To Date: 85 Identified WLF Occupational Exposure Studies



# Wildland Fire Fighting Respirator Use

## Analysis of NFPA 1984 Standard for Respirators used in Wildland Fire- Fighting Operations

# Premise of the 1984 Standard Analysis

- Since the publication of the NFPA 1984 Standard on Respirators for Wildland Fire-Fighting Operations 2011 edition, there have been no submissions from manufacturers for a NIOSH certified respirator.

Therefore;

- There are currently no approved air purifying respirators (APR) or powered air purifying respirators (PAPRs) available for use during wildland fire fighting operations that comply with the NFPA 1984 Standard-Rev.



# Key Findings

	STRENGTHS/ OPPORTUNITIES	CHALLENGES/THREATS
<p><b>INTERNAL FACTORS</b> Attributes of NFPA, NIOSH or other WLF management agencies</p>	<ul style="list-style-type: none"> <li>Universally Regarded as a well written and an acceptable standard for respirator guidelines</li> <li>NFPA guidelines for the standards development process accredited by ANSI were followed</li> </ul>	<ul style="list-style-type: none"> <li>The NFPA guidelines for standards development were operationalized ineffectively.</li> <li>Standard was previously proposed, but not developed due to the use of preferential administrative controls.</li> <li>Lack of adequate representation on TCs during NFPA 1984 Standard-Rev development.</li> <li><b>Lack of Consensus on the need for the use of a respirator in WLF</b></li> <li><b>The USFS is in the process of developing and implementing a training program that uses admin controls and tactics.</b></li> <li><b>There is autonomous implementation of standards and protocols among differing WLF agencies.</b></li> <li><b>Manufacturers do not currently believe there is a profitable market for a WLF respirator.</b></li> </ul>
<p><b>EXTERNAL FACTORS</b> Attributes of the Environment</p>	<ul style="list-style-type: none"> <li>Consensus among the WFF community that hazardous exposures exist and must be addressed.</li> <li>Little new technology would need to be developed to produce a NIOSH certified respirator that complies with NFPA 1984 Standard-Rev</li> </ul>	<ul style="list-style-type: none"> <li><b>Respirator's negative physiological impact during prolonged work shifts</b></li> <li><b>Additional research needed on situational respirator use and performance requirements.</b></li> <li><b>Respirator's full-face piece fit it issues and packing weight for wildland firefighters in the field</b></li> <li><b>The need for long-term health effects studies for WLF</b></li> </ul>

# Two Key Recommendations

- In the absence of a certified respirator and research validating its use in this unique worker environment, administrative controls should immediately be implemented by all wildland fire management agencies to reduce inhalation exposures from wildland fire fighting operations.
- The standards development process must address how the standards process is operationalized to ensure that due process, openness, balance and consensus are adequately addressed.

# USFS/NIOSH Collaborative Data Analysis

# USFS Data Profile

- USFS / NIOSH collaboration on analysis of 2009 – 2012 WFF exposure dataset
  - Individual WFFs, ICPs and spike camps were monitored
  - PBZ and ambient air samples were collected and analyzed for CO, PM<sub>4</sub>, and SiO<sub>2</sub>
  - Numerous predictor variables were collected including
    - Location
    - Experiential variables (crew type, years and type of experience, job/rank and # of days of fire)
    - Subjective smoke exposure \*\*intensity rating
    - Task/ activity
    - Fire behavior
    - Fire type, and
    - Meteorological variable (wind speed, wind direct, temperature, etc.)

# USFS Data Collection

- Study designed by Tim Reinhardt and carried out by George Broyles, a WFF and researcher with the San Demas Technology and Development Center.
- Data were collected by USFS field researchers using pencil and paper collection sheets, then scanned and transferred to individual excel files.
- Individual files were used for exposure calculations and synthesized into larger yearly summary files.
- NIOSH performed QA/QC on the summary files.

# Data Analysis Agenda

- Characterize exposure variability and exceedances using SETG Interim OELs
- Identify similar exposure groups for CO, PM4 and SiO<sub>2</sub>
  - Task/Activity, crew type, job/title (squad), region, fuel model, fire behavior, meteorological variables, experiential variables (years of experience)
- Examine relationship between subjective smoke exposure and objective measures of CO and PM4
- Examine the CO/PM correlation in various fuel models/geographic regions & Develop a statistical model that explains as much of the observed variability in outcome exposure variables as possible

# Wildland Fire Examples

# Questions?





# Fireline construction during Inversion



**Direct/Indirect  
fireline  
construction  
no inversion**



# WFF hiking to fireline



# Wildland fire engine operations

driving, operational  
break and monitor



# Digging fireline With dozer



Photo Courtesy of George Goyles and the US Forest Service

# References

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