# *What affects flame spread success?*

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# Objectives

- **Present results from several studies in live fuel beds**

- **Discuss fuel bed characteristics influencing successful propagation**

- **Stimulate discussion**

# Some lab studies using "live" fuels

- **Cohen and Bradshaw (1986)**

- **Weise et al (1989)**

- **Zhou et al (2003-2006)**

- **SERDP burns (MFSL 2009)**

# Cohen and Bradshaw

- Fuel beds of < 6 mm chamise 20-45 cm deep, MC 50-70%

- Line ignition, no wind and no slope

- Increasing depth and decreasing bulk density – successful spread

- 1 m/s wind - successful

# Weise et al

- **Burning piles: MC 50-144%; no wind**

- **Consump: 3 – 88 %**

- **Correlation between MC and consumption = 0.08**

| Species | Consumption (%) |
|---------|-----------------|
| Chamise | 48 |
| Scrub Oak | 35 |
| Manzanita | 23 |
| Ceanothus | 13 |

# Vertically arranged fuel beds

- **Chamise/scrub oak**
- **β = 0.009**
- **Ht = 0.6 m**
- **MC = 13%**
- **Consumption = 9%**

# Vertically arranged fuel beds

- **Chamise/scrub oak**
- **β = 0.018**
- **Ht = 0.6 m**
- **MC = 14.5%**
- **Consumption = 23%**

# Horizontally arranged fuel beds

- Chamise1 7/7/2004
- $\beta = 0.012$
- Ht = 0.2 m
- MC = 58%
- Consumption = ~70

# Horizontally arranged fuel beds

- Chamise2 3/6/2003

- β = 0.010

- Ht = 0.4 m

- MC = 80%

- Wind = 2 m s$^{-1}$

# Horizontally arranged fuel beds

- Chamise3 4/24/2006
- β = 0.013
- Ht = 0.2 m
- MC = 66%
- Slope = 50%

# Horizontally arranged fuel beds

- Chamise4 4/24/2006

- β = 0.013

- Ht = 0.2 m

- MC = 66%

- Slope = 60%

# Vertically arranged fuel beds

- **Chamise5 1/23/06**

- **β = 0.01**

- **Ht = 0.5 m**

- **MC = 58%**

# Vertically arranged fuel beds

- **Chamise6 1/23/06**

- **β = 0.01**

- **Ht = 0.5 m**

- **MC = 58%**

- **Wind = 2 m s$^{-1}$**

# Predicting fire spread success

- **Logistic model – 236 horizontal chaparral fuel beds**

- **119 Y, 117 N**

- **Variables used: Wind speed, Loading, Moisture Content, Slope, Air temperature**

- **For probability of spread set to >0.5:**
  - **108 of 119 Y**
  - **60 of 117 N**
  - **71% overall correct**

# Predicting fire spread success

- Applied logistic model to 106 vertical chaparral fuel beds

- 27 Y, 79 N

- For probability of spread set to >0.5:
  - 27 of 27 Y
  - 15 of 79 N
  - 40% overall correct

- Could not fit logistic to vertical fuel data

# Thoughts

- Can predict fire spread in horizontal fuel beds reasonably well

- Packing ratios higher than observed in field

- Much less success getting fire spread in vertical fuels in fuel beds with comparable packing

- Wind would seem to be important, but data don't support this statistically