



**Fire and Environmental Research
Applications Group (FERA)
Pacific Northwest Research Station**

Website: www.fs.fed.us/pnw/fera

- **Dr. David (Sam) Sandberg--Team Leader**
- **Dr. Sue Ferguson--Atmospheric Scientist**
- **Roger Ottmar--Research Forester**
- **Bob Vihnanek--Forester**
- **16 professionals/technicians/students**

Fuel Consumption Project



- **Principle Investigators:** Roger Ottmar, David Sandberg, Bob Vihnanek

Joint Fire Science Plan Program Package 1998



FERA 1999-2003



- ✓ **Fuel Consumption –6 new fuel types (emphasis on shrubs)--Ottmar**
- ✓ **Photo Series Phase II-6 new fuel types--Ottmar**
- ✓ **Fuel Characteristic Class—National System--Ottmar**
- **Emission Production Model (EPM)--Sandberg**
 - **Smoldering/field verification**
- **Air Quality and Visibility at Risk--Ferguson**
 - **Atmospheric science products**
- **Rainbow Series—Fire effects on Air--Sandberg**

Fuel Loading

The diagram is a vertical flowchart with five stages: Fuel Loading (dark red), Fuel Consumption (green), Emission Factor (grey), Emission Production (black), and Dispersion (dark blue). Green arrows point downwards between stages. A red line highlights the Fuel Loading and Fuel Consumption stages. The background is a photograph of a forest fire with smoke and flames.

Largest Error (CV=83)

FCC & Photo Series Projects

Fuel Consumption

Second Largest Error (CV=30)

Consumption Project

Emission Factor

Smallest Error (CV=16)

Emission Production

Dispersion

Fuel Consumption Project

Objective

- Develop new; modify and improve existing fuel consumption models for fuel types where there is:
 - ✓ Limited knowledge
 - ✓ Increased wildland fire expected
 - ✓ Emphasis on shrubs
- Consume 3.0/user manual/training package



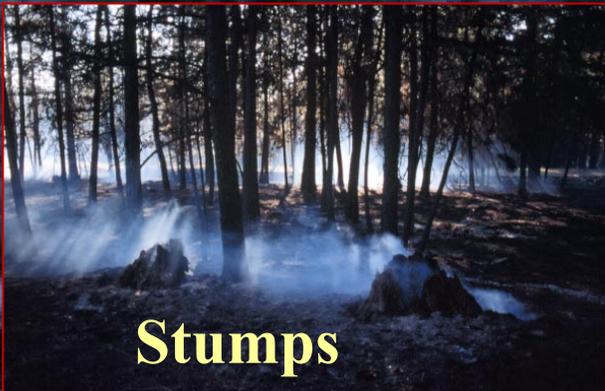
Assessed managers, scientists, and literature where the gaps existed



Rotten Logs



Stumps



Basil Accumulation





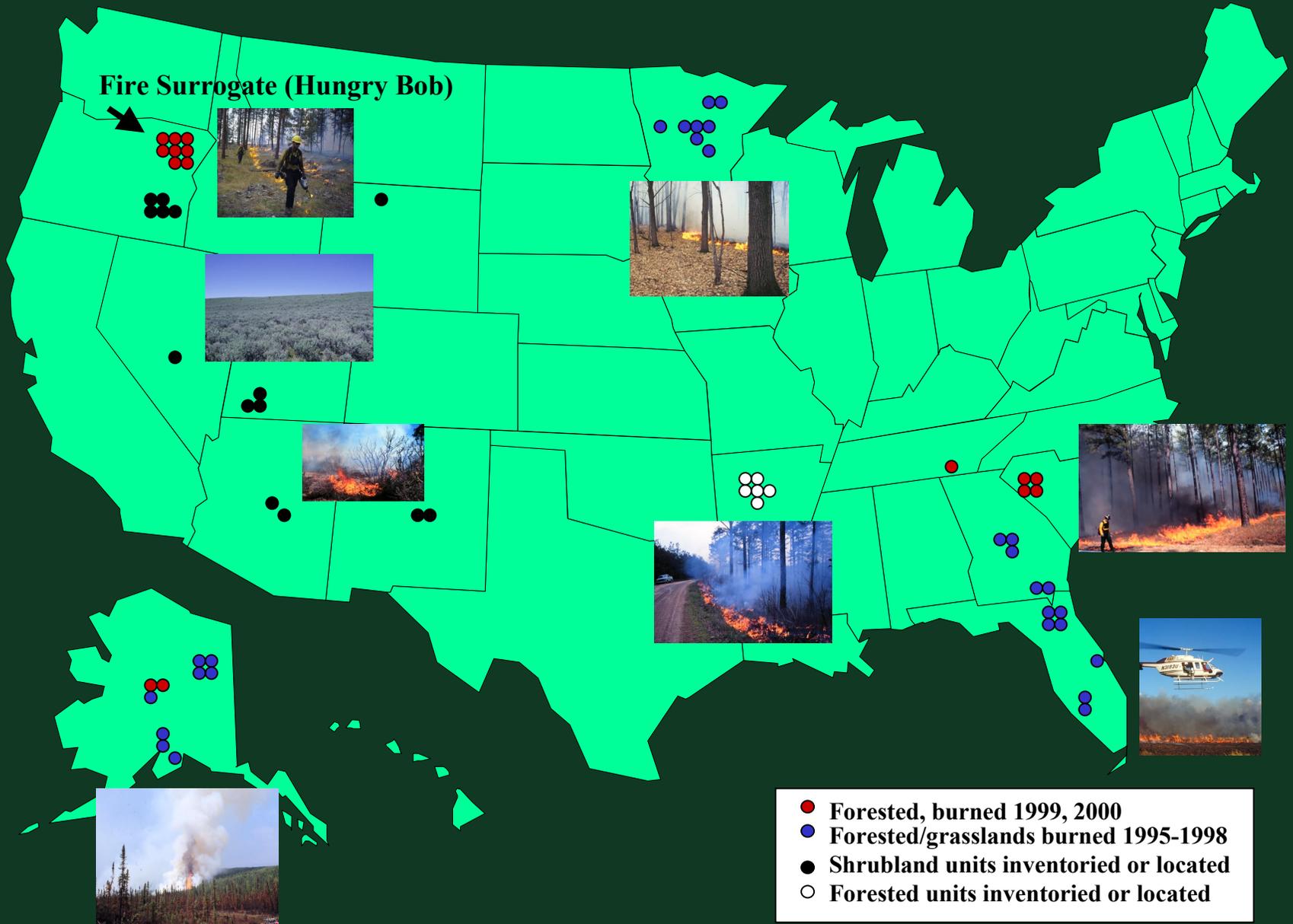
Southern Pine/Hardwood

Cooperators and Supporters



- **USDA FS-R6, R8, R2, R3, R9**
- **BLM, USFWS, NPS, AFS**
- **Private land owners**

Fuel Consumption Project Sites



Fuel Consumption Project

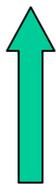
Fuel types

- Ponderosa pine (PNW, INT)
- Black and white spruce (Alaska)
- Hardwood/pine transition (South)
- Sagebrush (SW,PNW,INT,Rockies)
- Chaparral (coastal&interior, SW)
- Pinyon/juniper (SW,PNW)
- Mixed conifer/shrubs (PNW)
- Hardwood/litter (South)
- Tundra (Alaska)

■ ■ Priority/data collected



Forested Units



N

Forest Floor Consumption (16)

Surface Material Depth (8)

Dead and Woody Material Transects (3)
•10-hour = 10 ft each
•100-hour & 1000-hour+ = 66 feet

Understory Plots (10.76 ft² each)
•Grass
•Herb
•Low shrub
•Lycopodium

Leaf Area Index
(at 0.3, 1.7 & 4.5 ft high)

Pre

Post

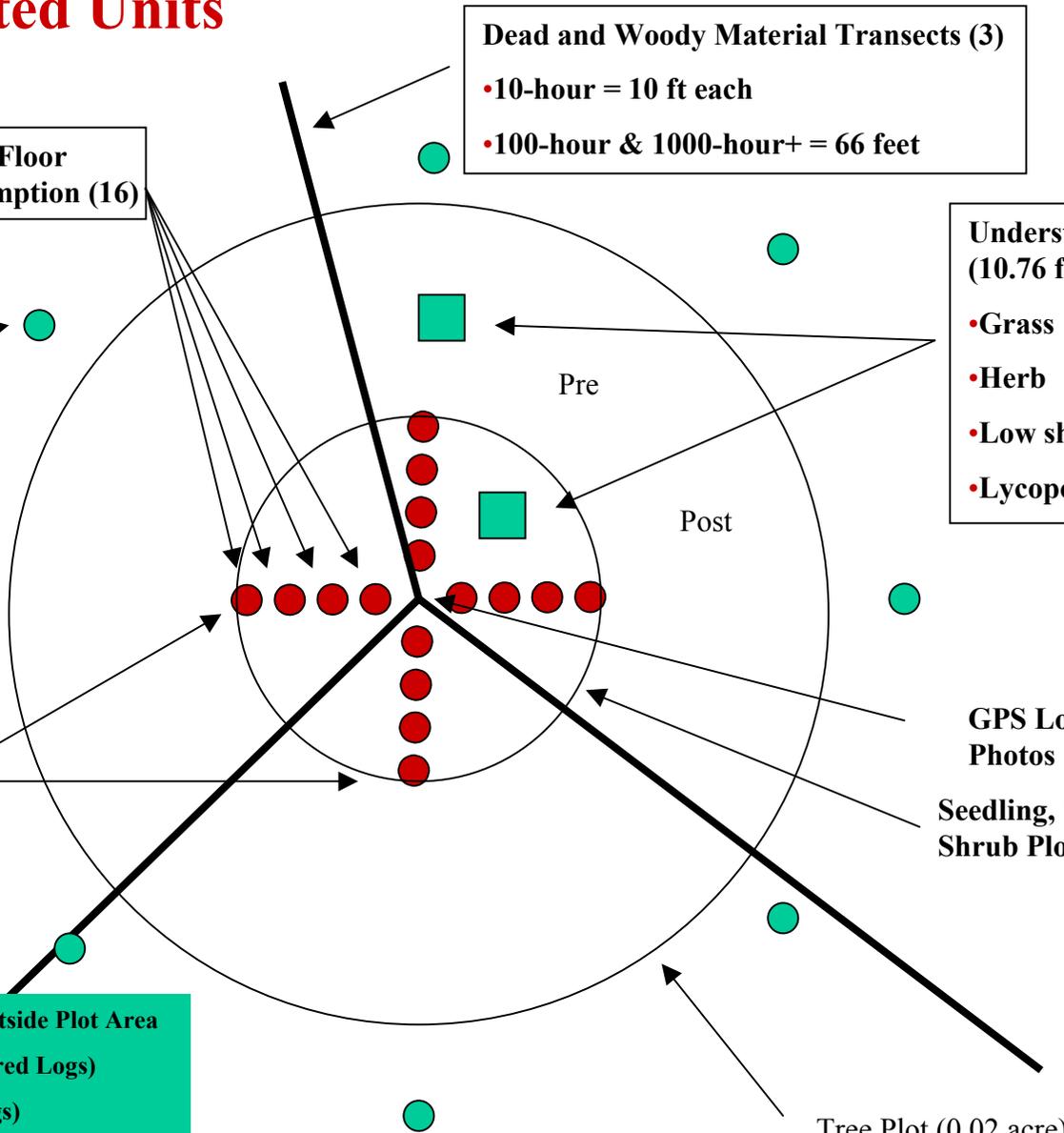
GPS Location and Plot Photos

Seedling, Small Tree and Tall Shrub Plot (0.005 acre)

Tree Plot (0.02 acre)

Randomly Chosen Locations Outside Plot Area

- Woody Consumption (from Wired Logs)
- Percent Char (From Wired Logs)
- Forest floor moisture Content
- Forest Floor Bulk Density
- Fuel Moisture





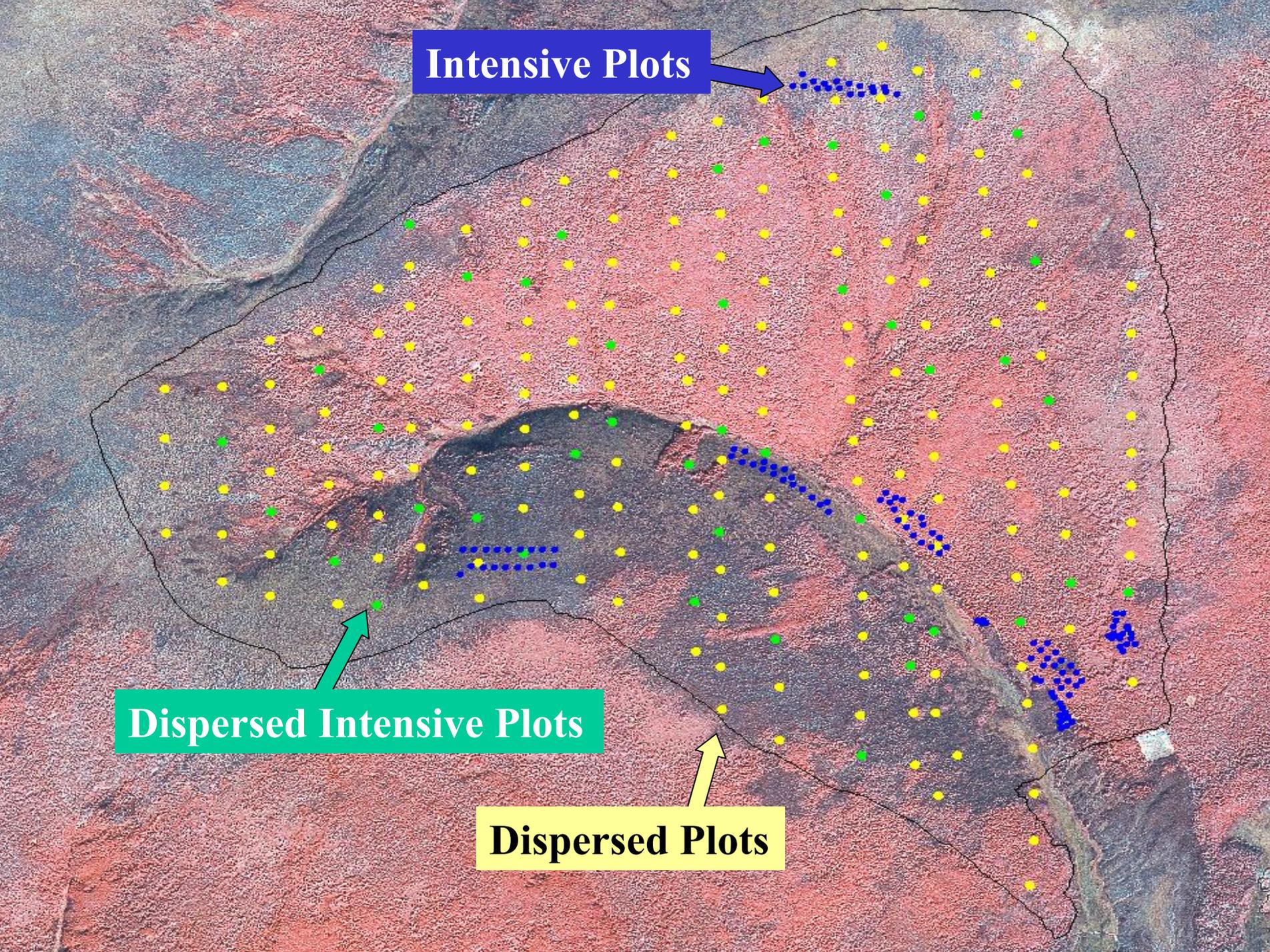
Intensive Plots



Dispersed Intensive Plots



Dispersed Plots



Spruce Fuel Type Example (Alaska)

Fuel Category: Moss Layer

- 8 units
- Moderate moisture regime
- Double variable algorithm
 - ✓ 10-hour fuel moisture
 - ✓ preburn forest floor depth



Comparison of Forest Floor Reduction

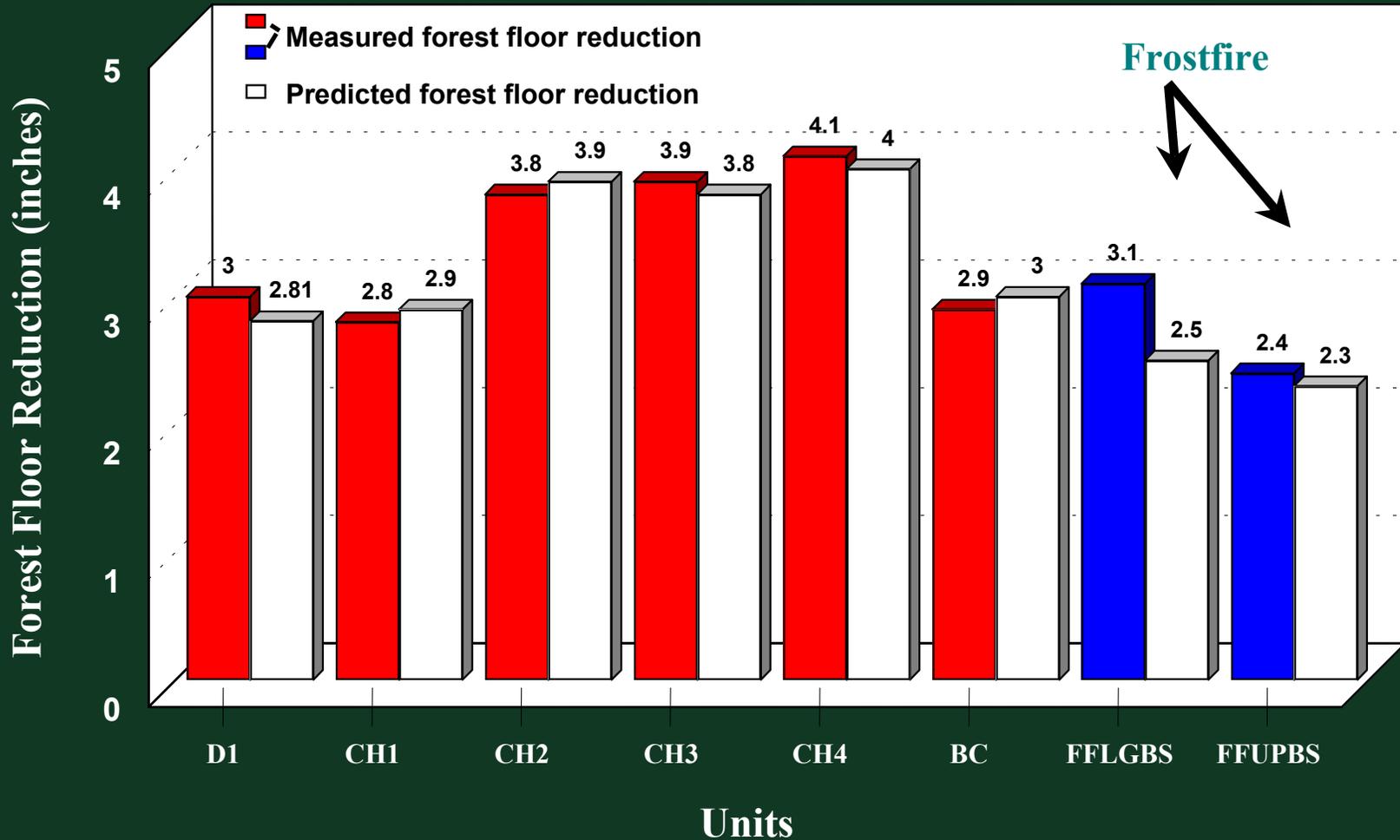
Algorithm: $Y = 4.946 - 0.1796 X_1 + 0.1112 X_2$
 $r^2 = 0.94$

Where:

Y = forest floor reduction (inches)

X_1 = 10-hour fuel moisture content (%)

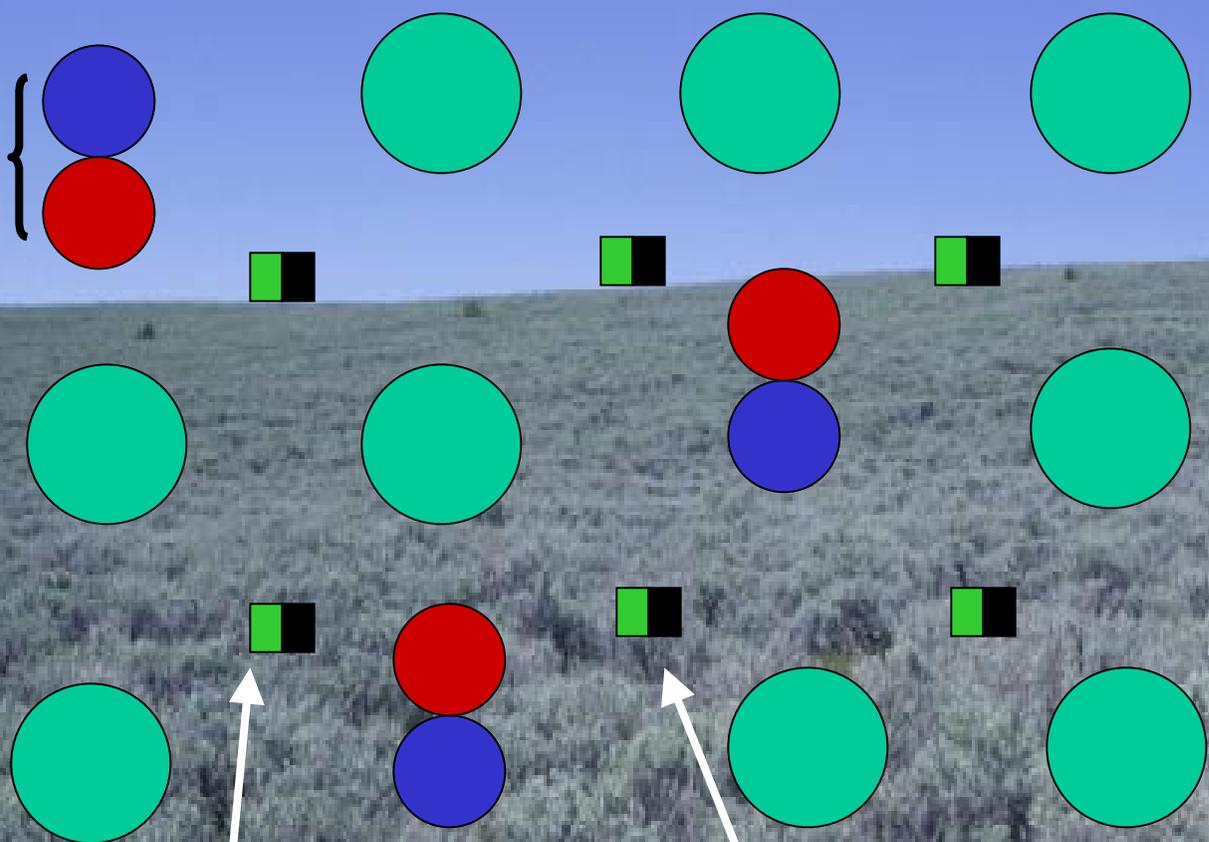
X_2 = forest floor preburn depth (inches)



Shrub Units

Pre and Post Shrub clip plot
(1.5 meter diameter)

Shrub measurement plot
(3 meter diameter)



1 chain

Herbaceous/grass preburn clipplot (1 meter square)

Herbaceous/grass postburn clipplot (1 meter square)



Consume 2.1

USDA- Forest Service
Pacific Northwest Research Station
Seattle Forestry Sciences Lab
Fire and Environmental Research Applications
4043 Roosevelt Way N.E.
Seattle, Washington 98105
Tel: (206) 553-7815

<http://www.fs.fed.us/pnw/fera>

Consume 3.0



- **Features**

- **Windows based**

- **Consumption**

- **pp,mc,lp,sp,improved grass/shrub/general U.S.**
 - **Flaming/smoldering by fuelbed stratum**
 - **Emission reduction**
 - **Emissions (PM, PM₁₀, PM_{2.5}, CO, CO₂, CH₄, NMHC)**
 - **New FCC defaults**
 - **Link to EPM and other models**
 - **User manual/training**
 - **Release 2003**



Fuel Consumption Project Summary

Develop new; modify and improve existing fuel consumption models for fuel types where there is limited knowledge and increased wildland fire is expected

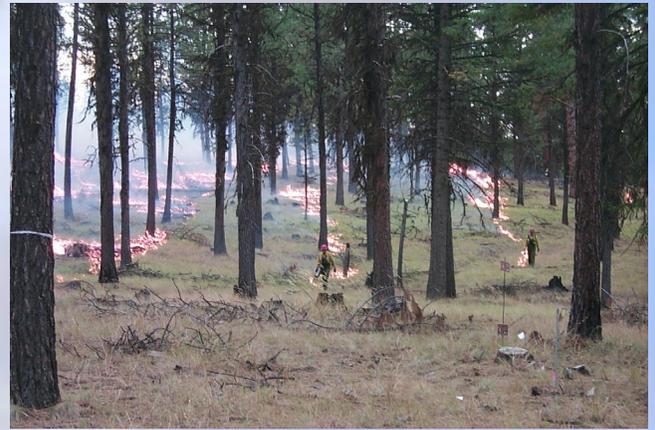
- **FY1999 and 2000: 2 boreal forest; 5 southern forests, and 9 PNW pine prescribed burn units. Established 5 sage units.**
- **FY 2000-2001: Final analysis of 1995-1998 grass and pine burns in southeast and north central, Alaska boreal.**
- **FY2001: Locate and inventory 20 additional shrub sites scheduled for burning in 2001, system design specification contract for Consume 3.0 will be awarded.**
- **FY2001-2003: Complete data collection, finalize model development. Complete Consume 3.0, user manual and training package. Begin distribution of training package.**



Problems and Delays

- The extended fire season during the latter part of FY 1999 and 2000, moratorium on prescribed burning, monument status, and threatened species has slowed our progress in the shrub types. This may jeopardize our proposed completion date of 2003 for Consume 3.0 specific to shrub fuelbeds.
- Within budget at this time.





The End

