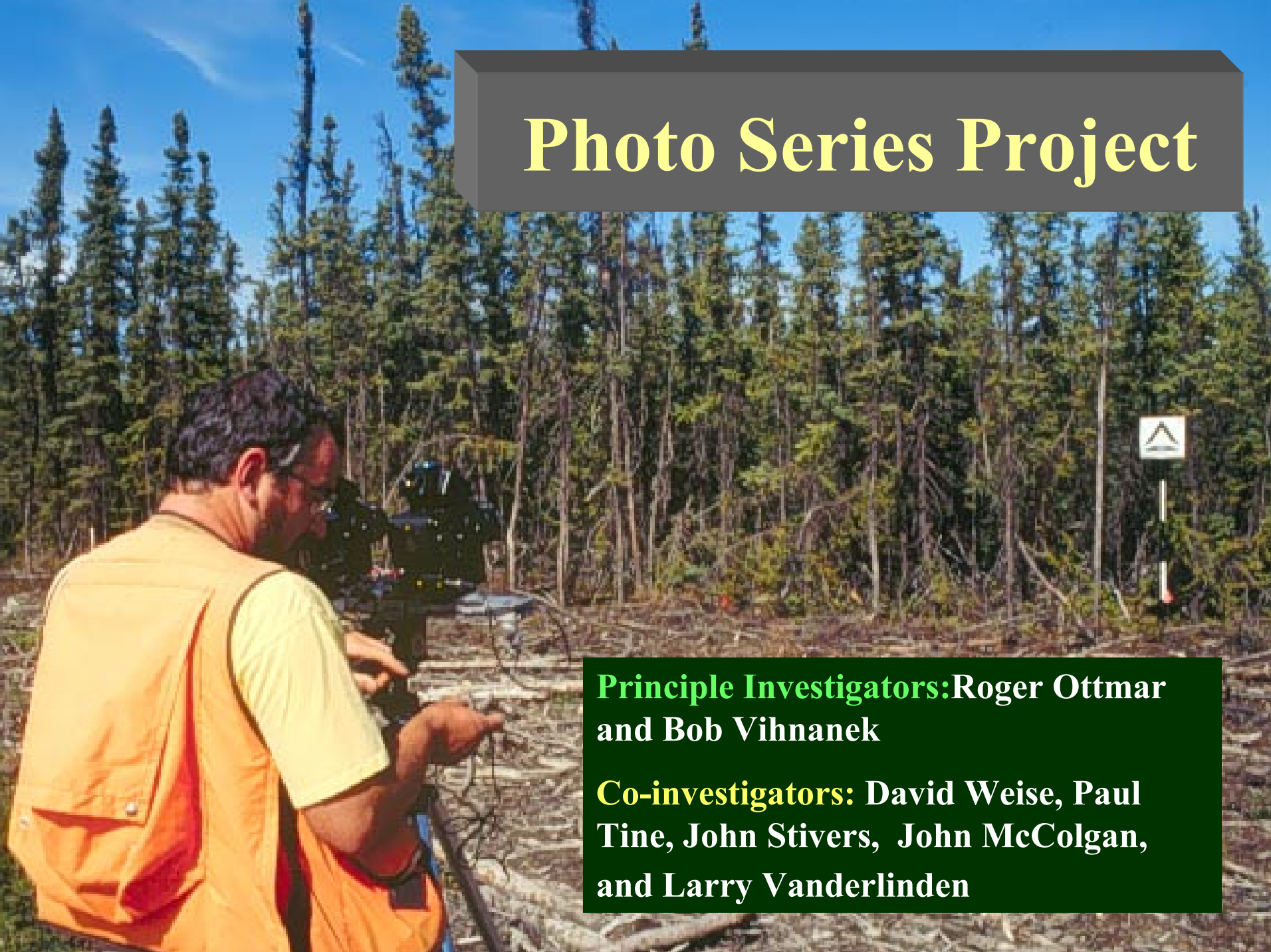


Photo Series Project

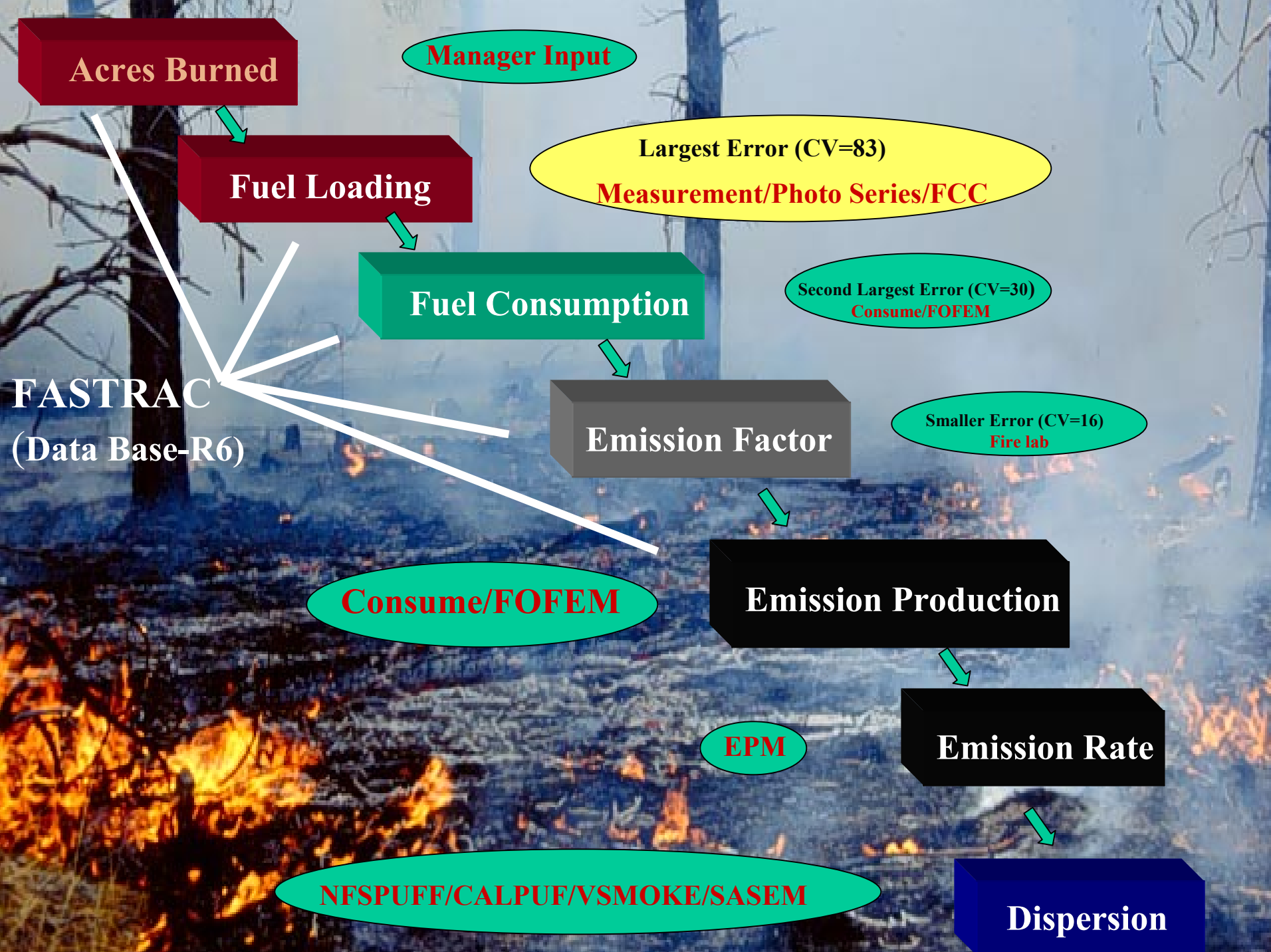
Principle Investigators: Roger Ottmar and Bob Vihnanek

Co-investigators: David Weise, Paul Tine, John Stivers, John McColgan, and Larry Vanderlinden

Joint Fire Science Plan Program Package

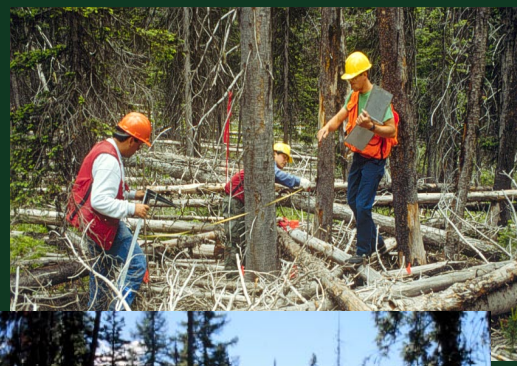
FERA 1999-2003

- Consume 3.0 –6 new fuel types (emphasis on shrubs)
  - ✓ Photo Series Phase II-6 new fuel types
  - ✓ Fuel Characteristic Class—National System
- Emission Production Model (EPM)
  - ✓ Smoldering/field verification
- Air Quality and Visibility at Risk
  - ✓ Atmospheric science products
- Rainbow Series—Fire effects on Air


Acres Burned
Manager Input
Fuel Loading
Largest Error (CV=83)
Measurement/Photo Series/FCC
Fuel Consumption
Second Largest Error (CV=30)
Consume/FOFEM
FASTRAC
(Data Base-R6)
Emission Factor
Smaller Error (CV=16)
Fire lab
Consume/FOFEM
Emission Production
EPM
Emission Rate
NFSPUFF/CALPUF/VSMOKE/SASEM
Dispersion

Fuels Data Collection

- Measuring (most accurate/time consuming)
  - line intersect
  - clip/weighing
  - measuring/biometric equations
- Photo series (good alternative to measuring)
- Fuel Characteristic Class (good when complete)
- Assign fuel model (fair)
- Remote sensing (poor at this time)
- Guess (often used)



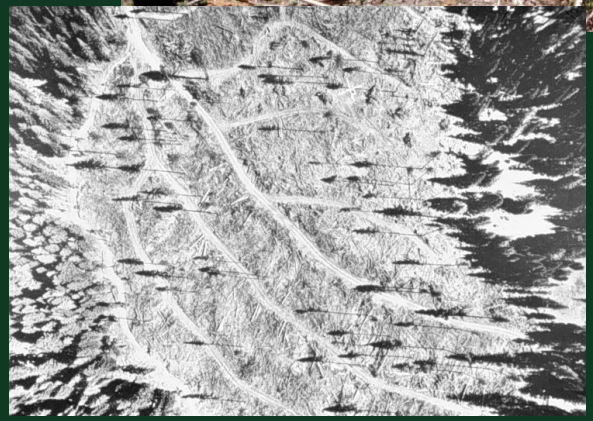
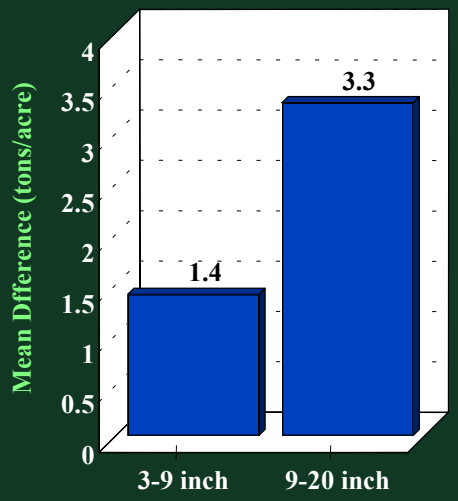


Photo Series Accuracy and Efficiency

Large Woody Fuels

- Transect and photo series significantly different
- Generally results in small overestimates



Time Comparison

- Photo series inventory takes 95% less time than a fuels inventory using the line intersect method.

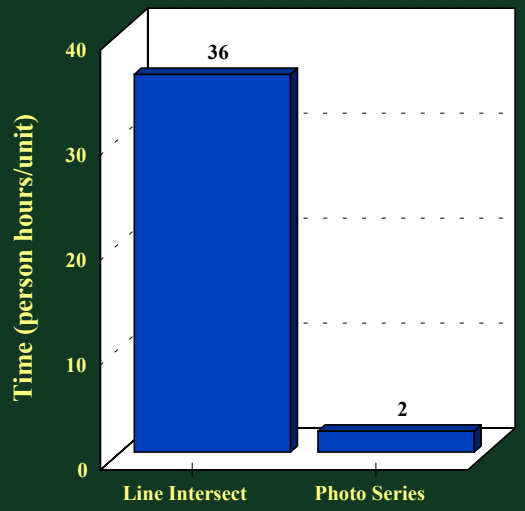


Photo Series Project—Phase II

Objective

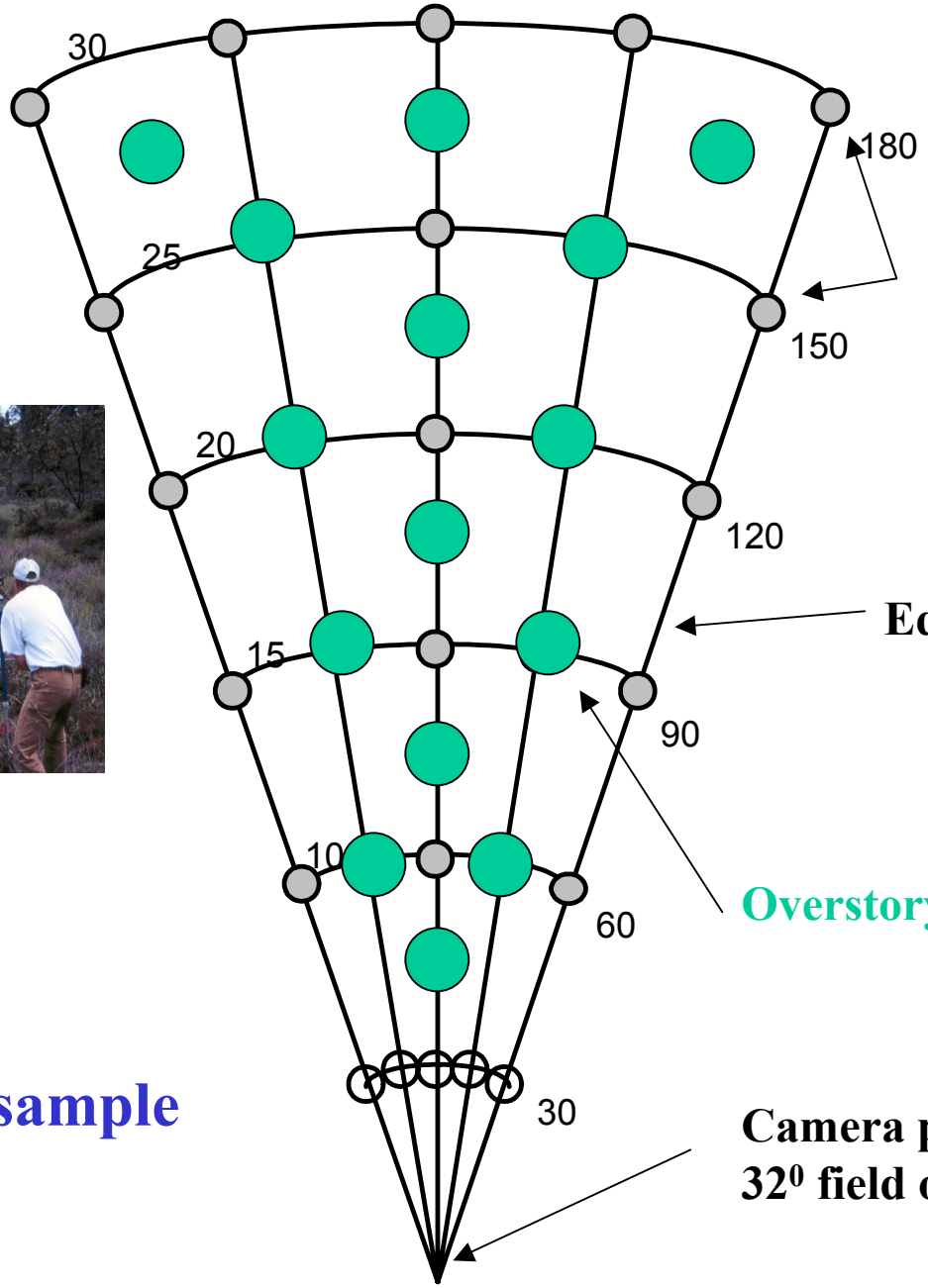
- To compile a sequence of single and stereo photographs with accompanying vegetation characterization data that will provide a means for quantifying and describing existing fuel properties for 6 new natural fuelbed type

  - ✓ Natural fuels
  - ✓ Not limited to fire managers
  - ✓ Link to remote sensing and fuel characteristic classes

Cooperators and Supporters

- USFS: R6, R8, R5, R9, R2, R3, R4, R10
- BLM, NPS, USFWS, AFS, BIA, AWCG
- PSW, DOD-Army
- Wisconsin DNR, Hawaii DNR, Alaska DNR
- Nature Conservancy

How do we start?



Line intercept and clipped plot locations

Edge of sample area

Overstory and shrub plots

Camera point
32^0 field of view

Photo series sample area layout

How do we photograph??

Photo Series Phase II

Variables Measured

- GPS location/aspect/slope
- SAF covertype/site disturbance history
- Woody loading by size and rot class
- Litter/duff/moss/lichen depth ad bulk density
- Mineral soil exposure/soil type
- Fuel depth
- Herb&shrub loading/height/dominant/co-dominant
- Tree species/diameter/height/dominant/co-dominant
- Live and dead stems per acre by diameter class
- Seedling density
- Canopy layers,canopy cover, height to crown base

Natural Fuels Photo Series Phase I Fuel Types Completed

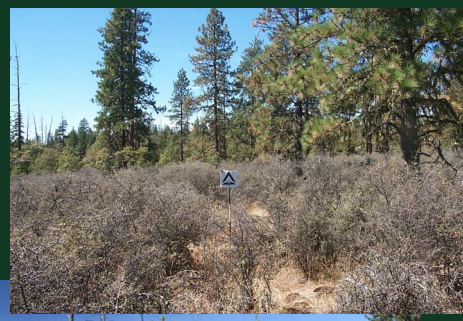
Supported by DOI (1995-2000)

- **PNW:** mixed conifer; juniper; sage; grass (printed—NFES 2580)
- **Alaska:** black/white spruce (printed—NFES 2581)
- **Midwest:** red/white pine; tall/short grass; oak/hickory (printed--April)
- **Southeast:** long leaf pine; pocosin; marsh grass (at printer—Oct.)
- **Rockies:** lodgepole; aspen; gambel oak (at printer—Oct.)
- **Southwest:** pinyon/juniper; sage; chaparral (contracting for printer)

Where Have We Sampled For Photo Series Phase II?

Photo Series—Phase II

- Mixed conifer/brush (southwest Oregon-12)
- Hardwood/pine transition (South-8)
- Shrub/grass/ woodland part 1 (Hawaii-15)(DOD)
- Jack pine (northcentral-17)
- Mix, birch/aspen/spruce (Alaska-17)
- Shrub/grass/woodland part 2 (Hawaii-15)(R-5)
- Deciduous oak/savanna (southwest/PNW-4, 10)
- Fill in gaps (pinyon/juniper, sage, palmetto, marsh grass-4, 8)

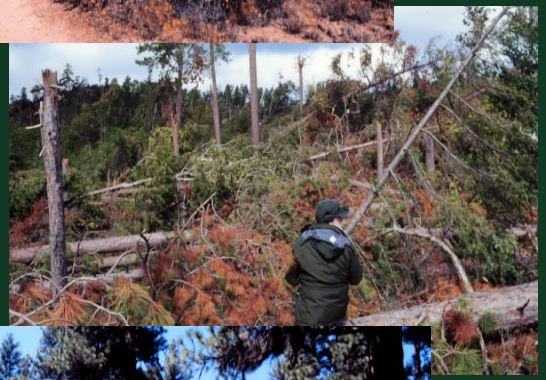


Completed

Ongoing

Suggested Future Photo Series

- Desert (southwest)
- Interior chaparral
- Mature DF/hemlock (west coast)
- Blowdown/ice (northcentral,east/south)
- Tundra (Alaska)
- Mixed conifer (southwest)
- Salt cedar brush (southwest)
- Evergreen oak savanna (southwest)
- Spruce/fir (northcentral, northeast)
- Invasives (interior west)
- Restoration



Printing and Distribution

- **Hawaii grassland and woodland will be it's own series--December 2001**
- **Alaska (hardwood/spruce), South (hardwood/conifer), North Central (jack pine), PNW (conifer/shrub), west (oak/savanna) and fill in gaps may be addendums or own series?? December 2002, maybe sooner??**
- **Need to negotiate if Great Basin Cache will print and distribute**

Photo Series: Problems or Delays

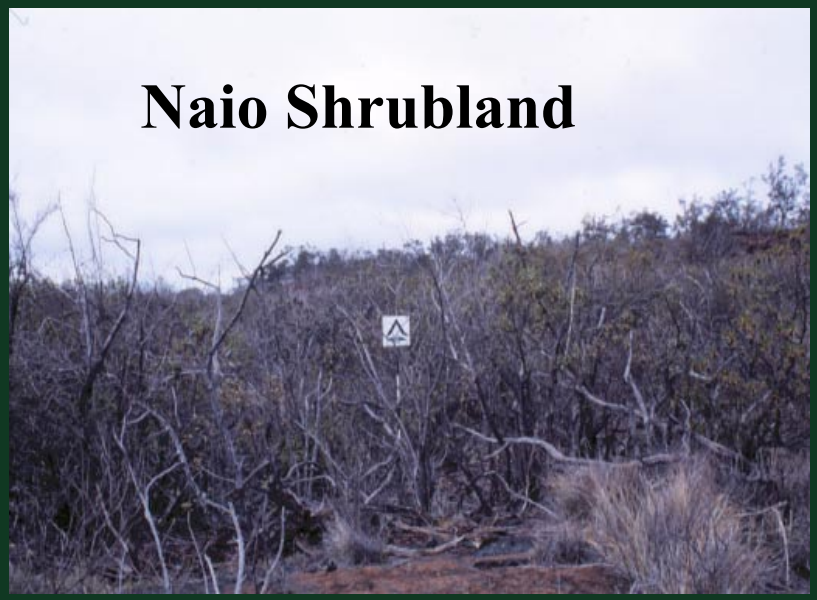
- At this time we are on schedule and within budget
- From past experience, printing could delay the final distribution of the products.
- Managers have expressed the need for additional photo series in over 10 additional fuel types.

Alaska: hardwood/spruce.

West: mixed conifer with shrub

Southeast: hardwood/pine transition

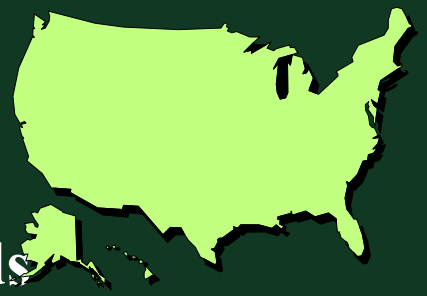
Hawaii



West: Deciduous Oak Savanna

Northcentral: Jack Pine

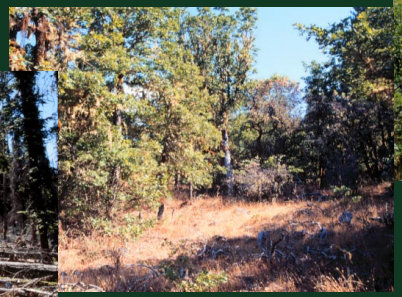
A Fuel Characteristic Classification—National System



Objective:

Develop a system for classifying all wildland fuelbeds according to a set of inherent properties necessary to predict fire behavior and fire effects.

Principle Investigators: Roger Ottmar, David Sandberg, and Geoff Cushon



Cooperators and Supporters

- **BLM, USFWS, BIA, NPS, AFS**
- **USDA Forest Service: all Regions, WO**
- **RMRS, PSW, PNW, NE Research Stations**
- **DOD, Florida DNR, Nature Conservancy**

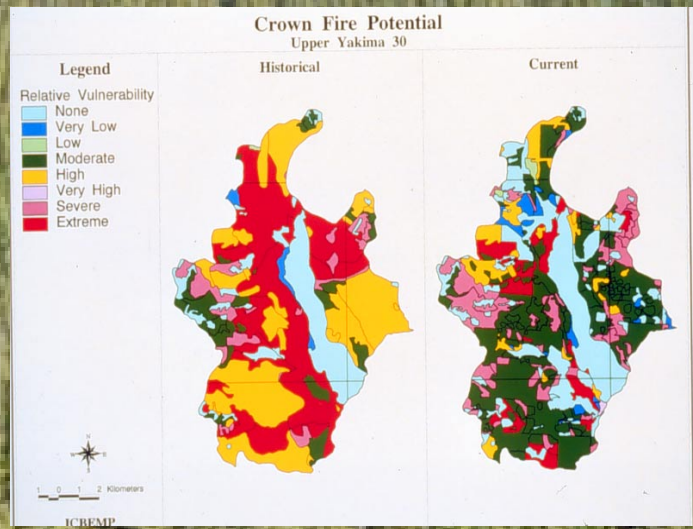
Original Fuel Classification

Current Fuel Models

- Simple and adequate
- Original fuel models did not account for many fuelbed categories of concern to managers and scientists
  - ✓ large woody fuels
  - ✓ forest floor
- Not well suited for:
  - ✔ inferring physical fuelbed properties from vegetation cover or remote sensing signatures
  - ✔ next generation of fire effects and fire behavior modeling

Fuel Characteristic Class System

- With the development of fire effects models such as Consume and FOFEM, large landscape assessments such as the ICRB and GCVTC, and the need for assessing carbon pools, a robust set of fuel characteristic classes that included all fuelbed stratum and categories was needed.



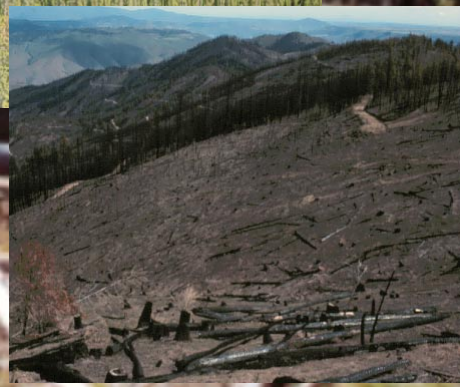
Early Fuel Characteristic Class System

- 192+ fuel condition classes built for current fuelbeds in eastern Oregon for FETM inputs and ICRB assessment
- Photo series and expert knowledge
- Included:
  - ✔6 vegetation types (PP, MC, LP, WJ, Shrub, Grass)
  - ✔4 age categories (B, IM, M, OM)
  - ✔activity categories (Natural, Activity)
  - ✔3 fuel loading categories (L, M, H)
- Fuel loading, litter/duff depth, fuel depth, tree densities
- Scaled to NFDRS

Limited Coverage

Inferred fuelbed categories

Did not account for all disturbance

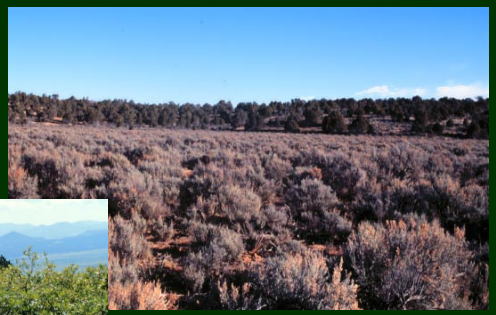


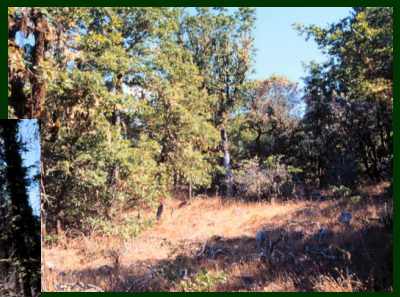
Any and All Fuelbeds

Desert grass, Piled logging slash, Tropical forests, Tussock tundra, Bug kill, Muck soils….

Range of Variability

Presence, Abundance, Arrangement, and Continuity of fuelbed components





All Fuelbed Strata (Layers): The vertical position in a fuelbed complex that defines a more-or-less independent combustion environment.

Tree Canopy Stratum

Canopy

Snag

Ladders

Shrub Stratum

Shrubs

Needle Drape

Low Vegetation Stratum

Grasses Sedges

Forbs

Woody Fuel Stratum

Sound Wood

Rotten Wood

Piles and Jackpots

Stumps

Litter Fuel Stratum

Litter

Lichen

Moss

Ground Fuel Stratum

Duff

Basal Accumulation

Categories: various fuels within a stratum according to their combustion characteristics

All Combustion Stages

Tree Canopy Stratum

Shrub Stratum

Low Vegetation Stratum

Litter, Moss, Lichen

Woody Fuel Stratum

Ground Fuel Stratum

Fuelbed Characteristics Important to Model:

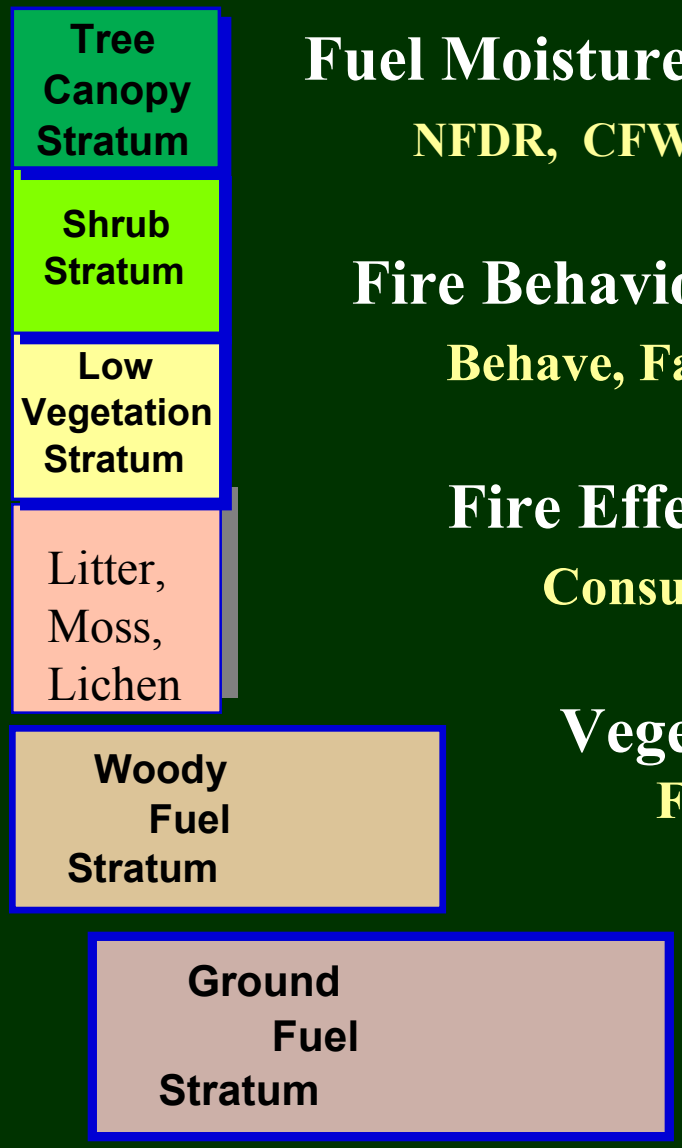
Crown Fires

Surface Flames

Flame and Smolder and Residual

Smolder and Residual

All Possible Model and Decision Inputs:



Fuel Moisture and Danger Rating

NFDR, CFWI, Live Fuel, Organic Soils

Fire Behavior

Behave, Farsite, Crown Fire, (Smolder)

Fire Effects

Consume, FOFEM, Burnup, EPM, Mortality

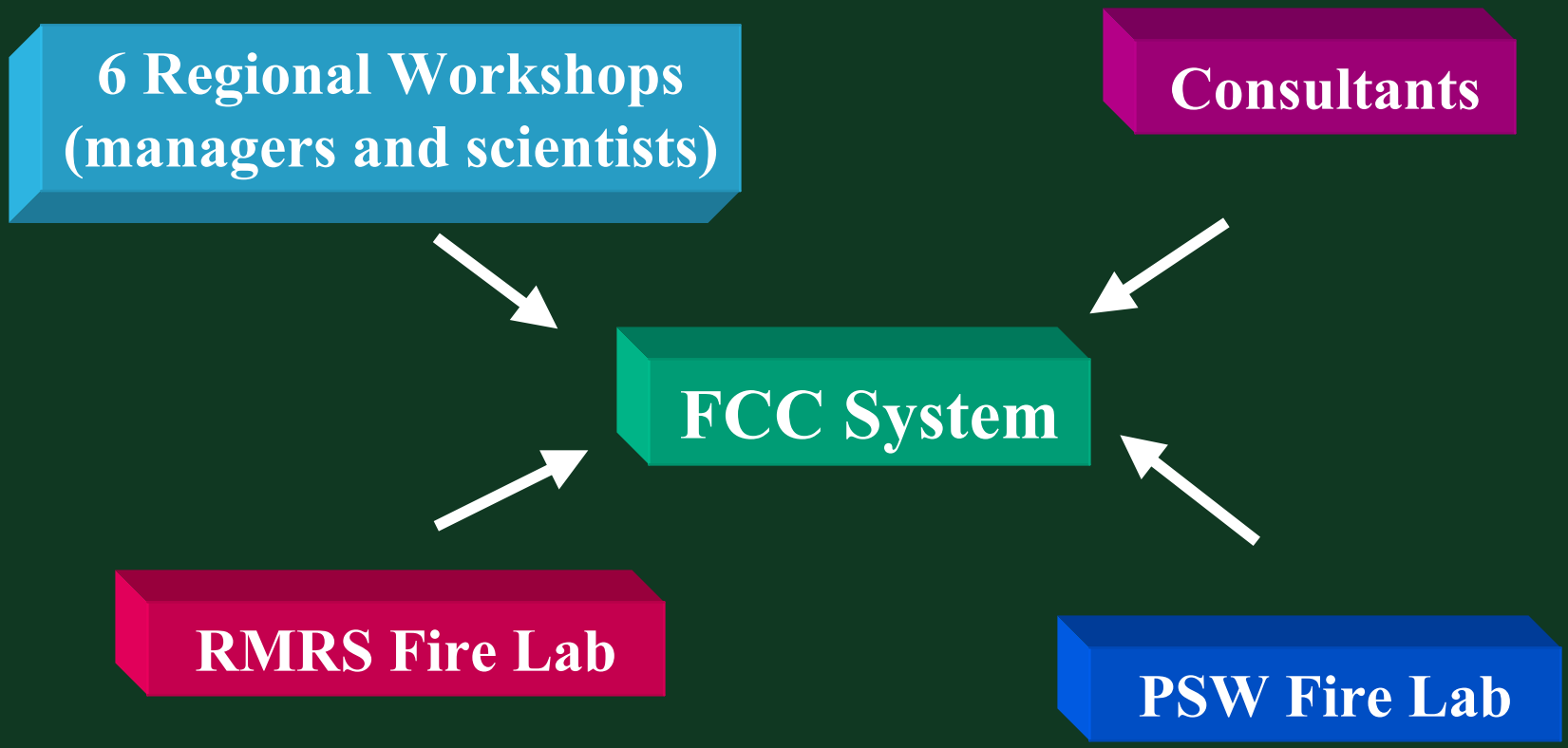
Vegetation Dynamics

FVS/FFE, MC1,

Analytical Models

FETM,

Collaborative Process



Fuel Characteristic Class Logic

General Fuelbed Information

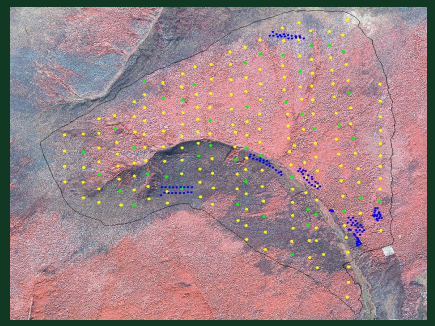
Remote Sensing

Vegetation Classification

- Ecoregion
- Vegetation Physionomy
- Change Agent

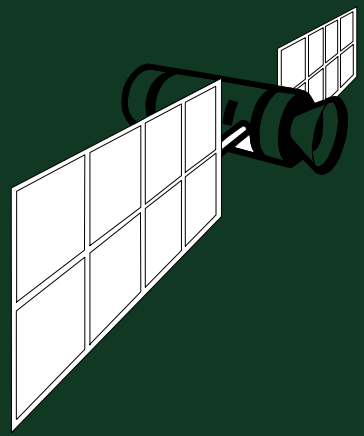
- Cover Type
- Structure class
- Fire regime
- Condition class

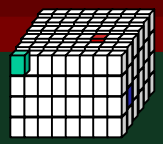
Optional



Default

Fuel Characteristics from Assigned stylized FCC





Fuel Characteristic Class Logic

Remote sensing/veg classification

General Fuelbed Information

- Ecoregion
- Vegetation Physionomy
- Change Agent
- Cover Type
- Structure class
- Fire regime
- Condition class

Optional

Increased Precision

Vertical position

Fuelbed Stratum

Fuelbed Categories

Biological origin and combustion characteristics

Physiognomy

Used to characterize the fuels in each category

Gradient Variables

Quantify the fuel present

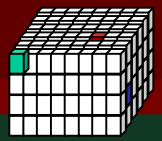
Default

Default

Default

Default

Fuel Characteristics/ Assigned stylized FCC

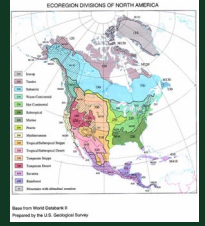


General Fuelbed Information

Remote sensing/veg classification

Question:	User Input:
Ecoregion	Temperate Steppe
Vegetation Physiognomy	Conifer Forest
Change Agent	Prescribed Fire
Cover Type	Interior Ponderosa Pine
Structural Class	Old Forest Single Story
Fire Regime	Not Altered
Condition Class	#1

Optional

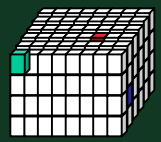


Default??

Yes

No

192



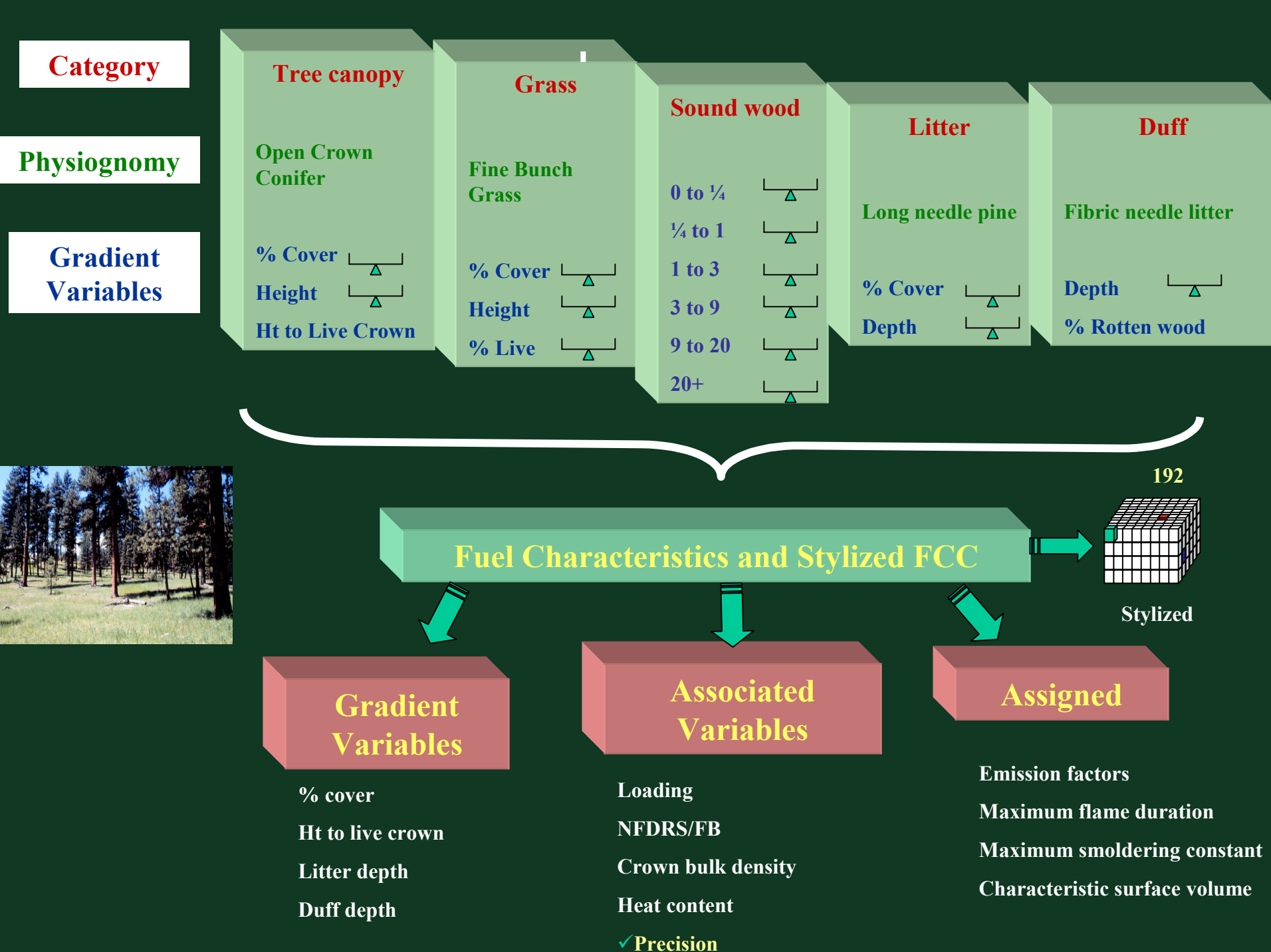
Stylized FCC

Fuel Stratum

- ✓ Tree Stratum
- ~~Shrub Stratum~~
- ✓ Low Vegetation Stratum
- ✓ Woody Fuel Stratum
- ✓ Moss, Lichen, Litter Stratum
- ✓ Ground Fuel Stratum

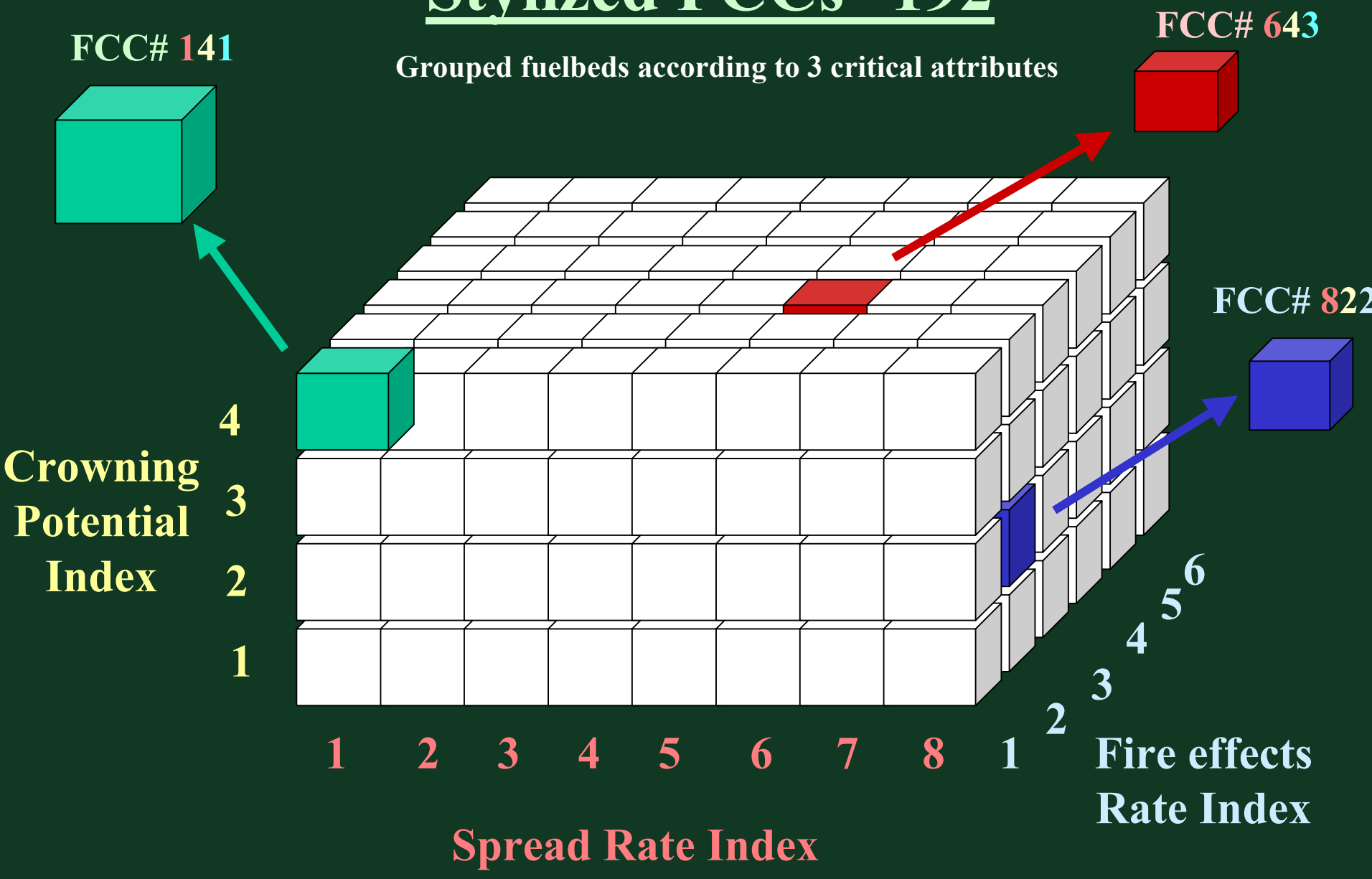
Fuelbed Categories

Tree Stratum	Low Vegetation Stratum	Woody Fuel Stratum	Moss, Lichen, Litter Stratum	Ground Fuel Stratum
✓ Tree canopy	Shrubs	✓ Grass/sedge	✓ Sound wood	Moss	✓ Duff
Snags	Needle drape	Forbs	✓ Rotten Wood	Lichen	✓ Basal Accumulation
Ladder fuels			✓ Stumps	✓ Litter	
			Piles		


Category
Physiognomy
Gradient Variables
Tree canopy
Open Crown Conifer
% Cover
Height
Ht to Live Crown
Grass
Fine Bunch Grass
% Cover
Height
% Live
Sound wood
0 to ¼
¼ to 1
1 to 3
3 to 9
9 to 20
20+
Litter
Long needle pine
% Cover
Depth
Duff
Fibric needle litter
Depth
% Rotten wood
192
Fuel Characteristics and Stylized FCC
Stylized
Gradient Variables
% cover
Ht to live crown
Litter depth
Duff depth
Associated Variables
Loading
NFDRS/FB
Crown bulk density
Heat content
✓Precision
Assigned
Emission factors
Maximum flame duration
Maximum smoldering constant
Characteristic surface volume

Stylized FCCs--192

Grouped fuelbeds according to 3 critical attributes

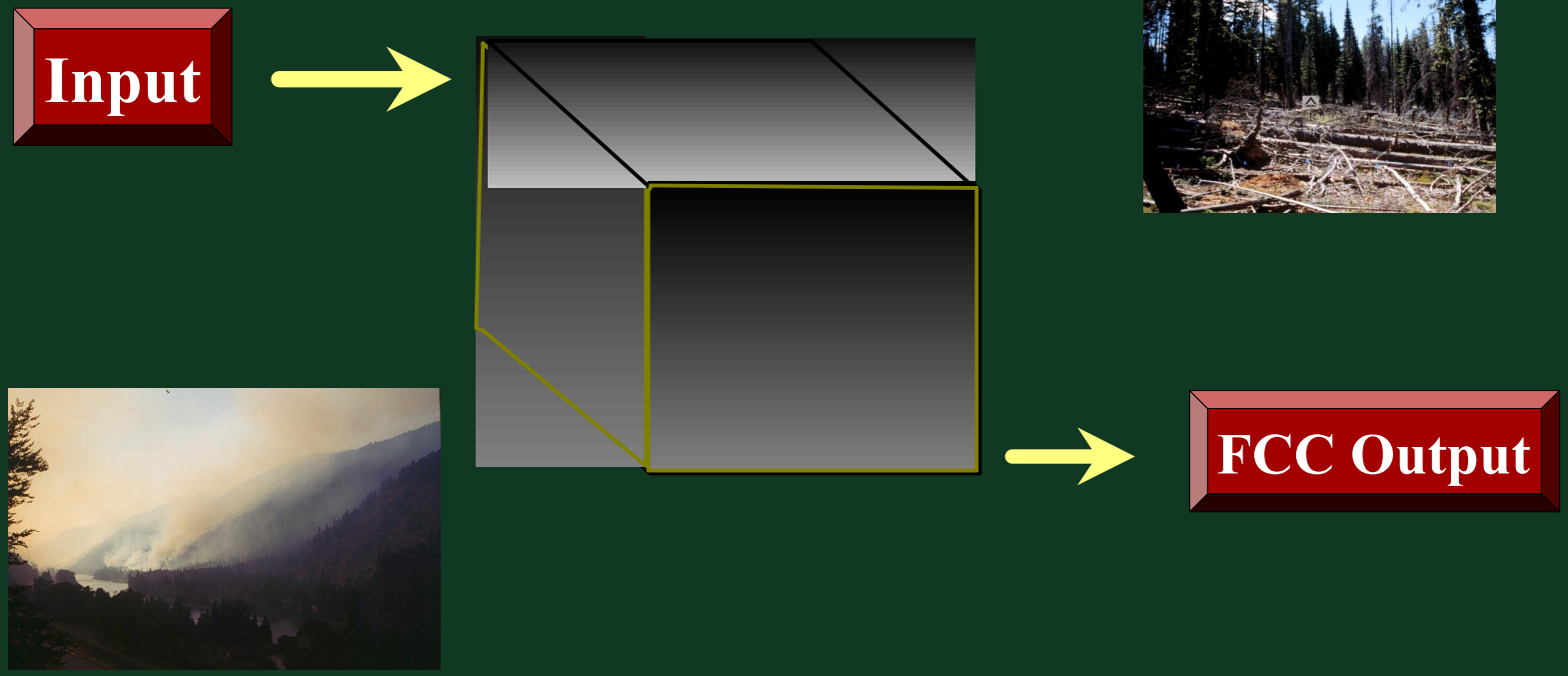


System Summary for Users

- For Users who know abundance of each type of fuel, the FCC system will calculate refined quantitative estimates of fuel characteristics needed to drive fire models.
- For all other users, the FCC system will first predict the abundance of each type of fuel based on general information.
- For both types of users, the FCC will use calculated fuel characteristics to assign one of 192 FCCs.

Fuel Characteristic Class System

✔ The internal workings will be complicated, but the operation of the system will be simple.



Summary of FCC System

A Fuel Characteristic Class is a quantitative description of a fuelbed or fuelbed stratum

Flexible, Robust FCC System

All: Fuelbeds
Fuelbed Components
Combustion Stages

Still a Work in Progress

completed:
- Initial Design
- Literature
- Workshops (5)

underway:
- Data Library/ Collection
- Database Engineering
- Workshops (1)
- User Interface application

Current Users of FCC

- FETM
- FOFEM
- FVS
- Consume
- Testing fuels treatment trade-off models
- R6 condition class landscape mapping
- ICRB Assessment

FCC Project Problems and Delays

- No problems or delays
- Within budget
- The ability to link with fire effects and fire behavior models has been incorporated into the FCC design. Two models (Consume and FVS) will be physically linked. Additional FCC linkages to other models is not part of this project and will have to be considered for future work.

The End