Fuel Consumption and Flammability Thresholds in Shrub-dominated Ecosystems

Joint Fire Science Program

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Outline

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- ► Progress
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Background/Rationale

- ► All fire effects are related to fuel consumption
- ► Most research in slash and forested types
- ► Focus is mostly on fire behavior prediction
- ► Shrub types are common in the west and east
  - 100+ million acres of sage, chaparral, oak brush, pine flatwoods
  - many large wildland fires in 2005 were in shrub types
  - extensive (and increasing) prescribed burning

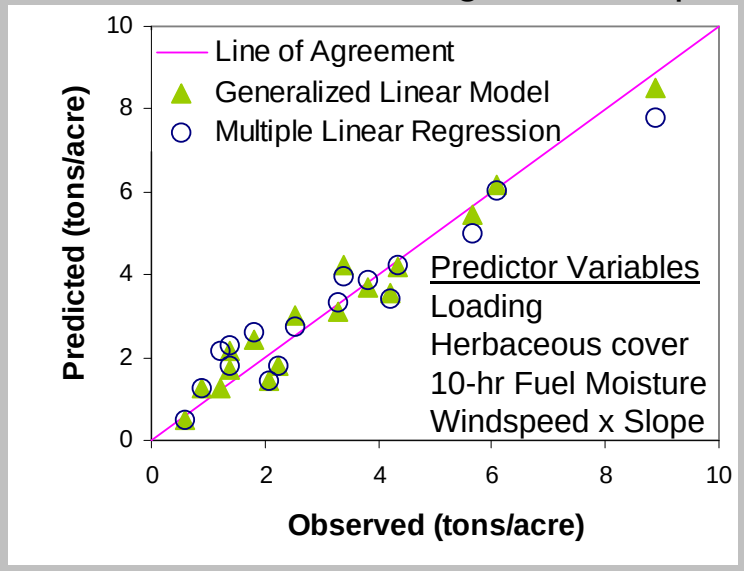
Purpose

Model fuel consumption in shrub-dominated ecosystems

Objective

► Develop a predictive model of fuel consumption based on environmental conditions and fuel characteristics for three different ecosystem types

Observed v. Predicted Sage Consumption



Big Sage

Chaparral

Pine Flatwoods

Primary Deliverable

- ► Incorporate models into CONSUME 3.0
- ► Empirical models grounded in physical science
- ► Field-based measurements on operational prescribed fires

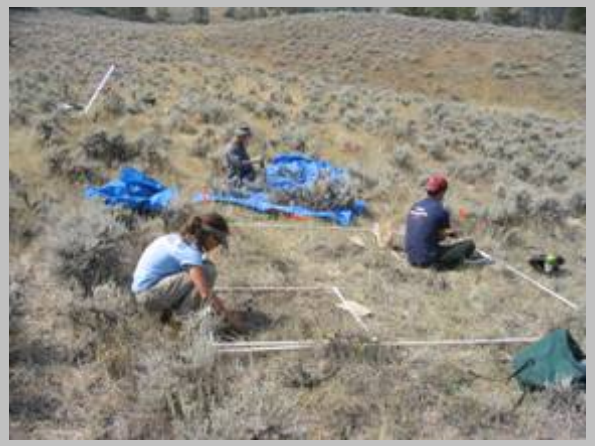
CONSUME

- Useful given currently available/accessible data
- A tool to improve prescribed fire planning and implementation
- Prescription development
  - Will it burn?
  - Go-no-go conditions
  - Patchiness/mosaic
  - Vegetation change
  - Fuel change
  - Fire hazard change
  - Emissions

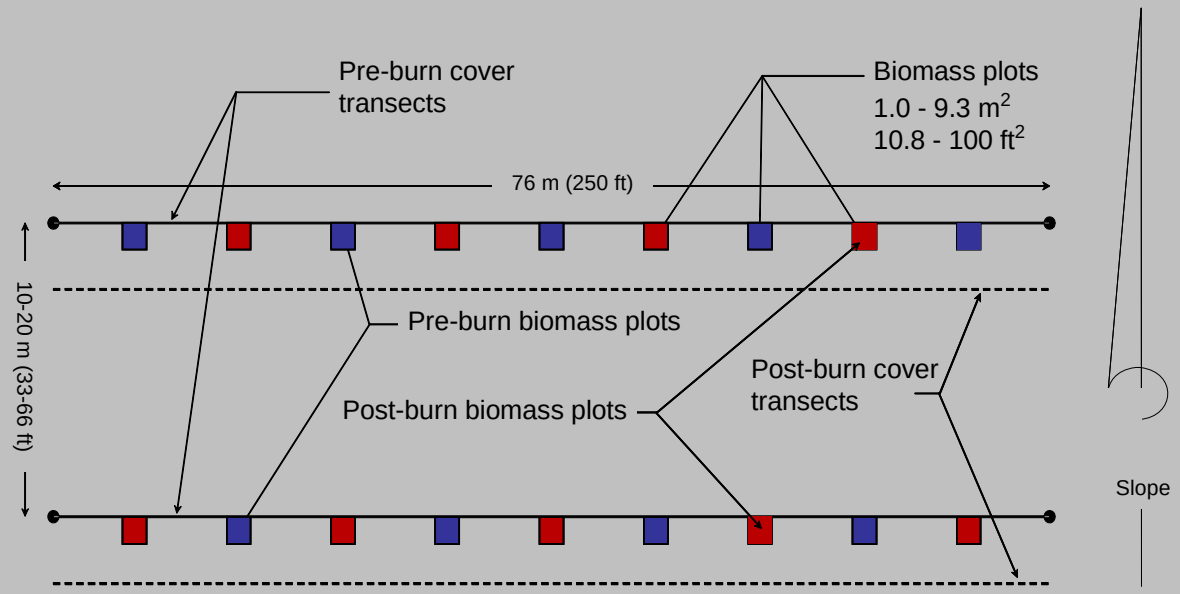
Study Areas/ Ecosystem Types

- Big Sage (*Artemisia tridentata*)
  - Interior West and Great Basin
  - Spring and Fall
- Pine Flatwoods (Palmetto/Gallberry)
  - Florida and Georgia
  - Dormant and growing season
- Chaparral (Chamise to-date)
  - Southern California
  - Separations

Methods



- ~1/4 ha (1/2 acre) sample area
- Pre- and Post-burn biomass in plots
- Cover and burned area on transects
- Consumption = average pre-burn mass – average post-burn mass



Variables measured

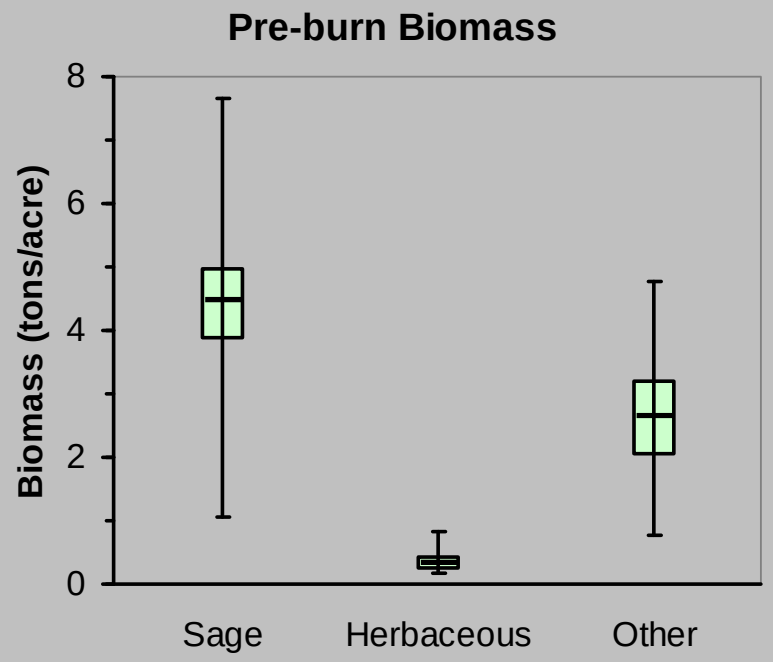
- ► Pre-burn
  - Biomass loading by size class and status (and species)
  - Cover by species
  - Height
  - Slope
- ► Day of Burn
  - Season (spring/fall or dormant/growing)
  - Temperature
  - Relative Humidity
  - Windspeed
  - Live and Dead Fuel Moisture
  - Lighting Pattern
- ► Post-burn
  - Biomass loading remaining/reduced
  - Percent area burned

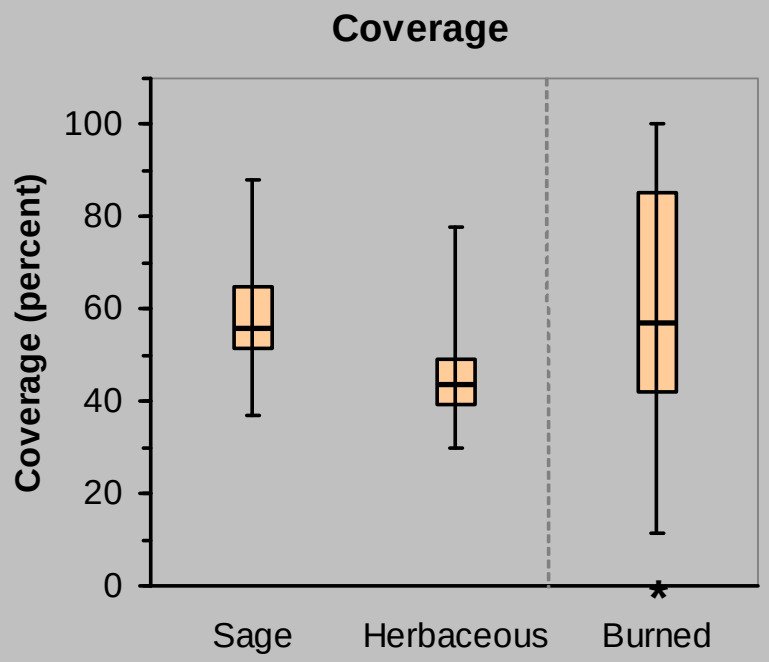
Progress

Field inventory and prescribed fires in big sage, pine flatwoods, and chaparral

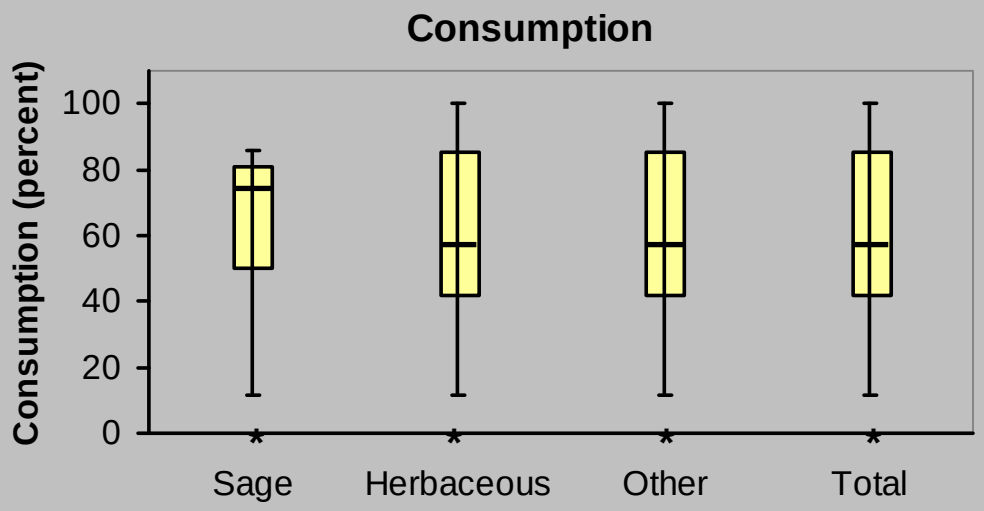
- Big Sage
  - 13 sets of plots since 2004 – 3 pending
  - Consumption and loading equations
- Pine Flatwoods
  - 27 sets of plots since 2003
  - 100% success rate
  - Results being compiled for cooperators
- Chaparral
  - 2 sets of plots in 2005
  - Focus of sampling for 2006

Results – Big Sage Site Data

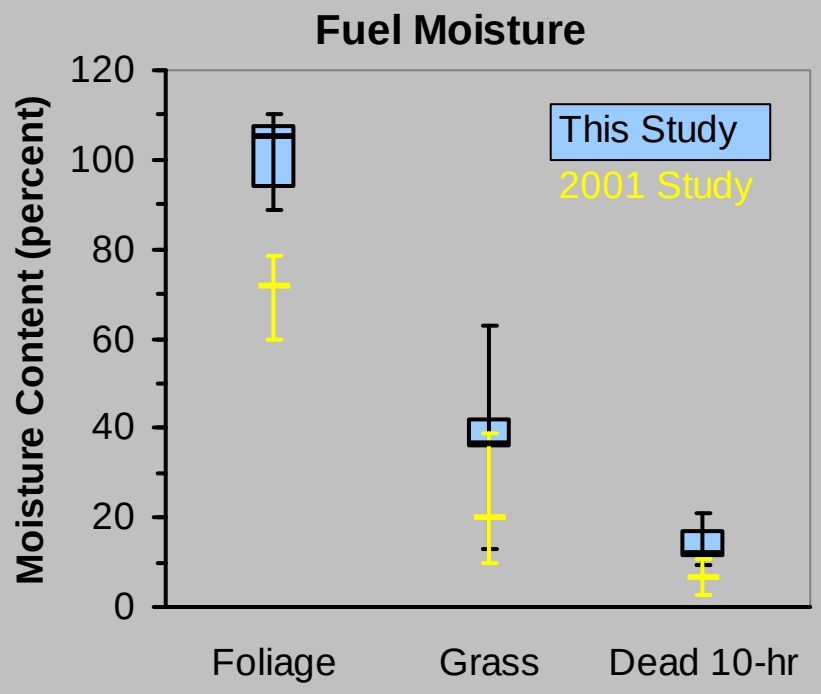


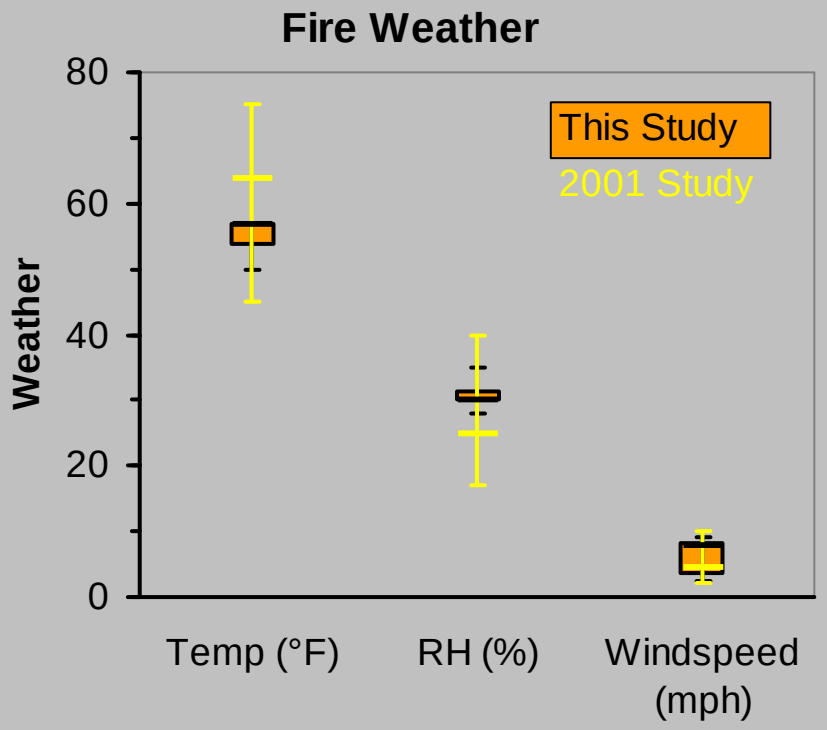


- ► Range of conditions
- ► Plots 0-100% blackened
- ► Several sets of plots did not burn over



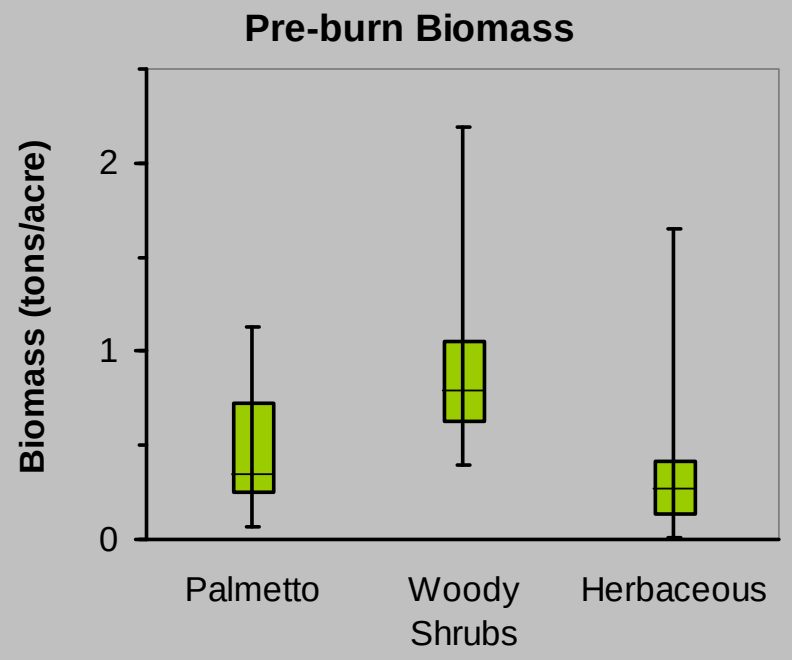
Results – Big Sage Fuel Moisture & Weather

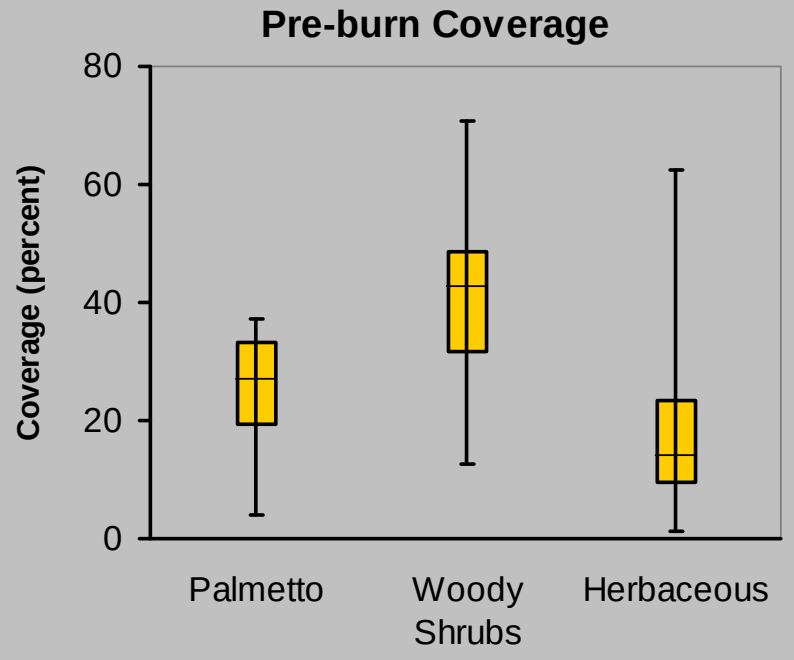




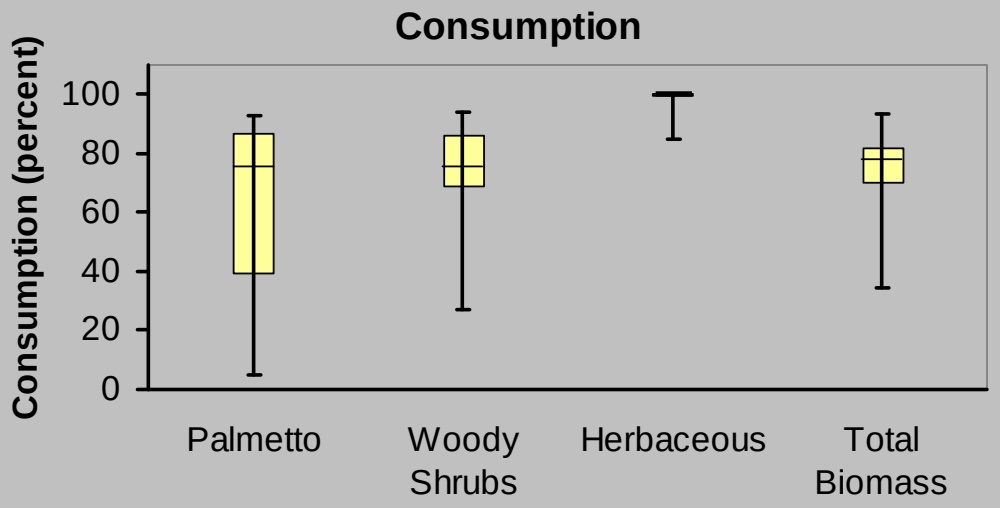
- ► Successfully expanded the range of burning conditions
- ► Recent burns occurred under:
  - Higher fuel moisture conditions
  - Cooler, more humid, but slightly windier conditions

Results – Pine Flatwoods Site Data

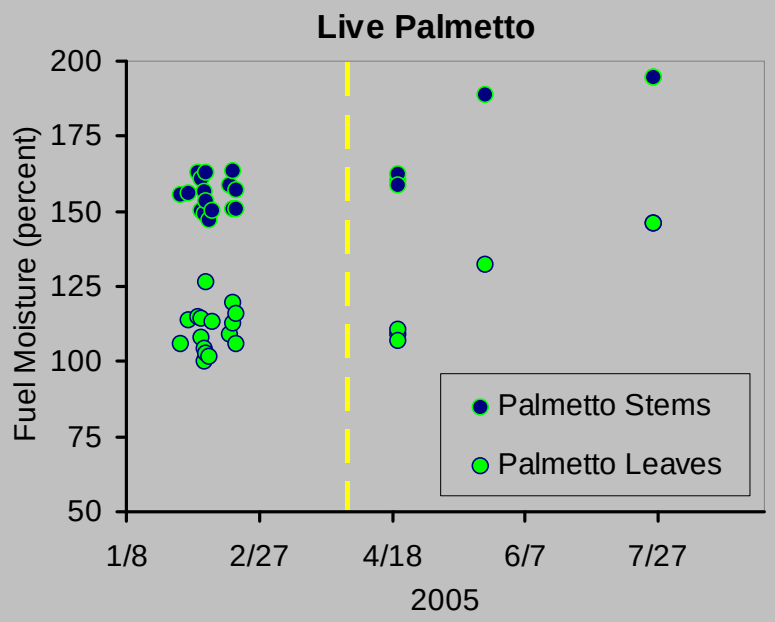


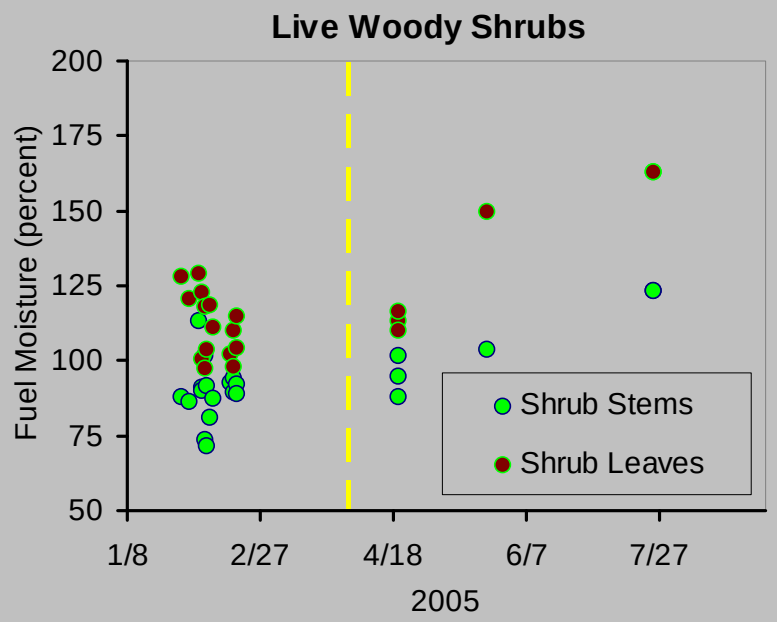


► Range of starting conditions and a range of effects (consumption)



Results – Pine Flatwoods Live Fuel Moisture





- ► Palmetto moisture reflects differences in site
- ► Woody shrub moisture reflects differences in site and species
- ► Start of growing season not reflected in live fuel moisture until ~May

Results – Chaparral Separations

► All species are almost entirely live biomass

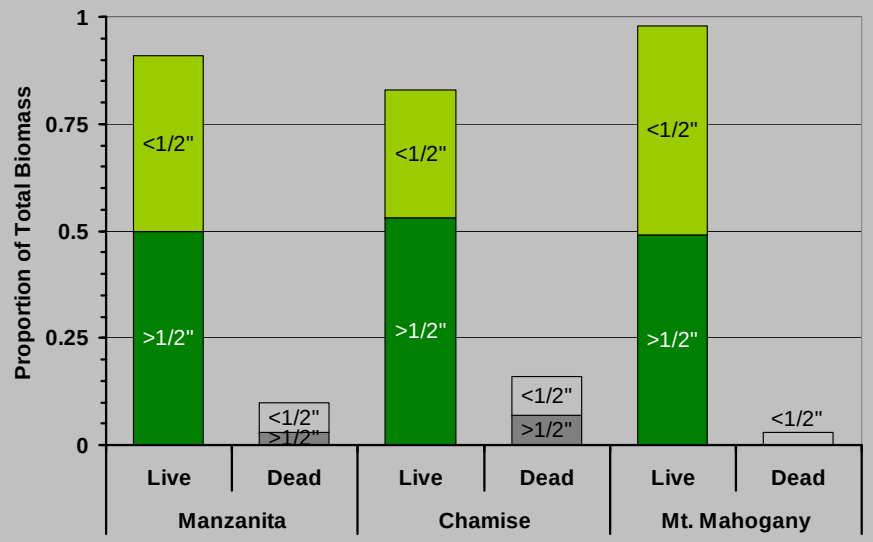
► Percentage of total that is foliage and <1/4” diameter:

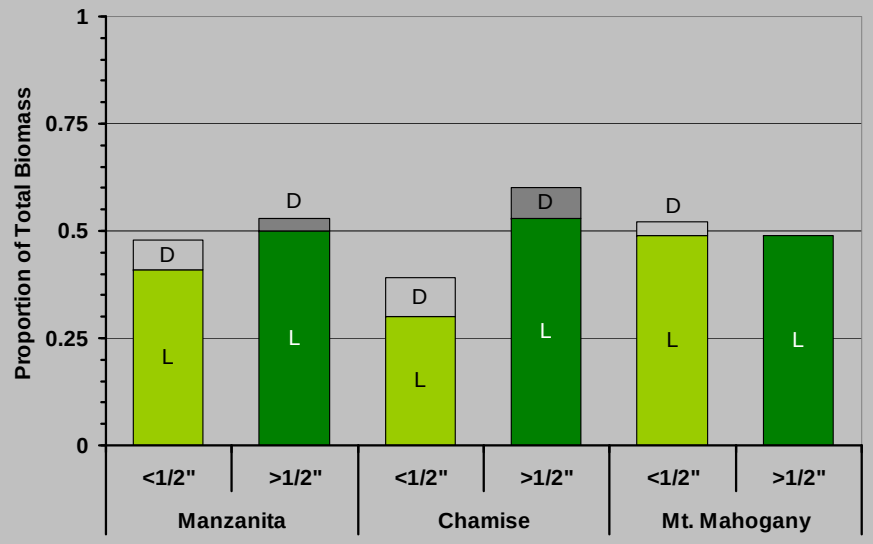
- Manzanita: 36%
- Chamise: 28%
- Mt. Mahogany 39%

► More than half of plant biomass is >1/2” diameter

► Only material less than approx. 3/8-1/2” consumed

► n=4 for each species





Science Delivery and Application

- ► Consume 3.0 released October 2005
- ► Contains sage consumption equations

Project Status

- ► On time (so far)
  - • Chaparral burns are tough
- ► Within budget
  - • Very efficient operation in the Southeast

Future Plans

- ► A few additional sage and flatwoods sites
- ► Focus on chaparral in 2005/2006
- ► Analyze data, develop equations, update Consume, publish results

Cooperators and Acknowledgements

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