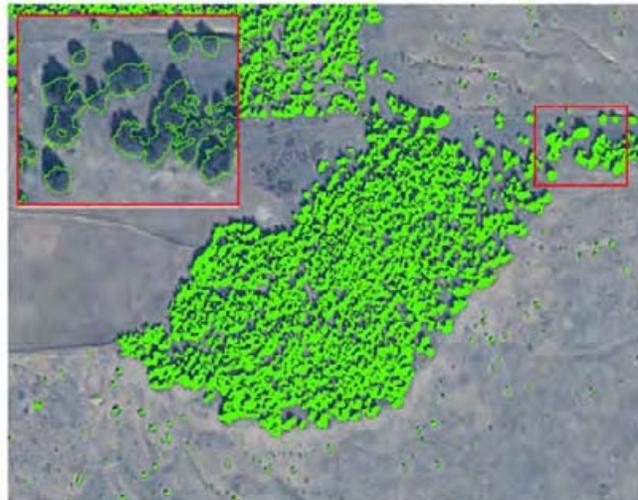
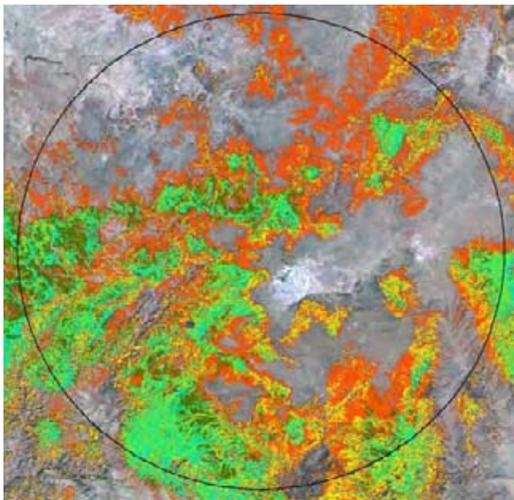




WOODY BIOMASS SUPPLY ASSESSMENT OF BEETLE-KILLED TREES



NAEMI Biomass Short Course
Oxford Suites - Spokane, Washington
May 16, 2006

Jason W. San Souci
Director, Geospatial Applications
NCDC Imaging

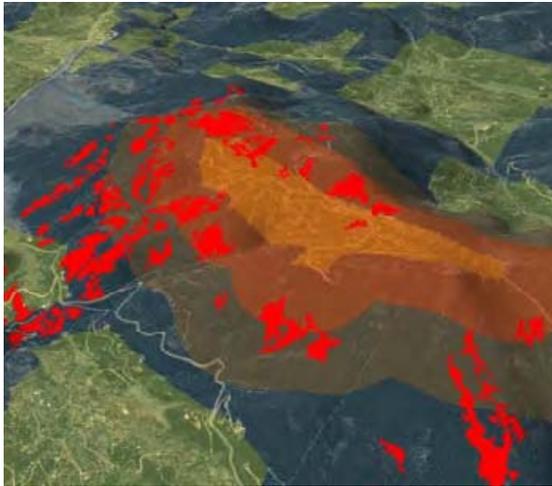
A New Age of Planning



Native Communities Development Corporation
Satellite Imaging & Mapping Division



NCDC Imaging



- NCDC is an Indian-Owned, Non-Tribal Colorado Corporation
 - DigitalGlobe Business Partner
 - ESRI & VLS Authorized Training Partner
 - Specializes in the use of high resolution imagery and advanced remote sensing technology
- Wildfire/All Risk Assessment (NIMS)
 - Forest Composition Analysis
 - Insect/Disease Assessment
 - Invasive Species Assessment
 - Biomass Resource Assessment
 - Watershed/Wetlands Assessment
 - Emergency Response Planning
 - E9-1-1 Base Mapping

Dahl Environmental Services



Native Communities Development Corporation
Satellite Imaging & Mapping Division



- Dahl Environmental Services, LLC is a natural resource consulting firm and member of:



- Society of American Foresters (Certified Foresters)
- Association of Consulting Foresters

- Biomass Resource Assessments
- Integrated Forest Management Plans
- Community Wildfire Protection Plans
- Forest Health Assessments
- Insect/Disease Management Plans
- Fire Management Plans
- Land Use/Stewardship Planning
- GIS Solutions



Overview

- **Goal**

- Use NCDC Imaging's Remote Sensing ("RS")/Geographic Information System ("GIS")-based method for estimating existing forest biomass resource (standing volume) from multiple resolution satellite imagery using innovative technologies

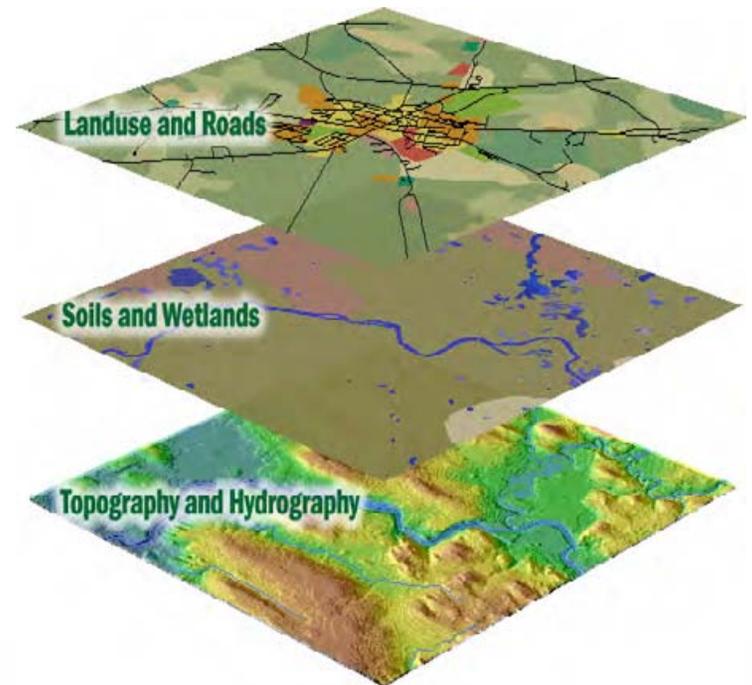
- **Primary Objective**

- Produce accurate and reliable estimates of available aboveground mixed conifer, beetle-killed timberland biomass using:
 - Digital Satellite Imagery
 - Advanced Remote Sensing Analysis
 - Geographic Information System ("GIS")
 - Global Positioning System ("GPS")
 - Standard Field Forestry Cruising Methods



Input Data Layers

- Raster Layers
 - Landsat 7 ETM+ Medium Resolution Satellite Imagery (“L7”)
 - 30 meter resolution (8 bands)
 - QuickBird High Resolution Satellite Imagery (“QB”)
 - 2 foot resolution (4 bands)
 - Digital Elevation Models
 - 10 Meter (QB) and 30 Meter (L7)
- Vector Layers
 - Crown Cover Mapping
 - Beetle-Killed Crowns
 - Forest Cover Type and Density
 - Exclusion Areas
 - Slope Exclusion Zones (>30%)
 - Inventoried Roadless Areas
 - Special Designated Areas
 - Land Ownership



Crown Mapping Results

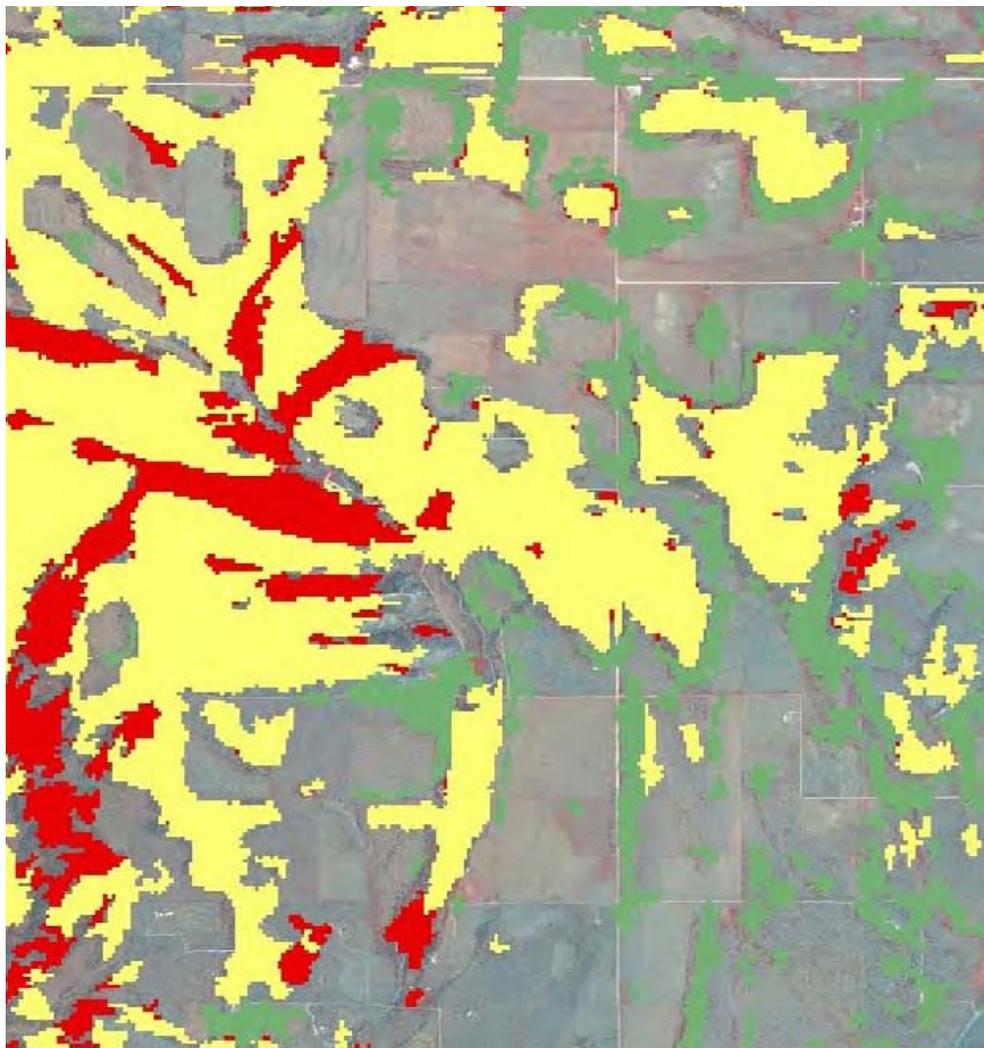
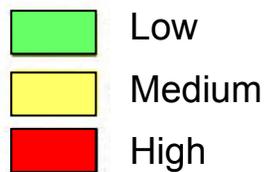


Forest Density Overview



Legend

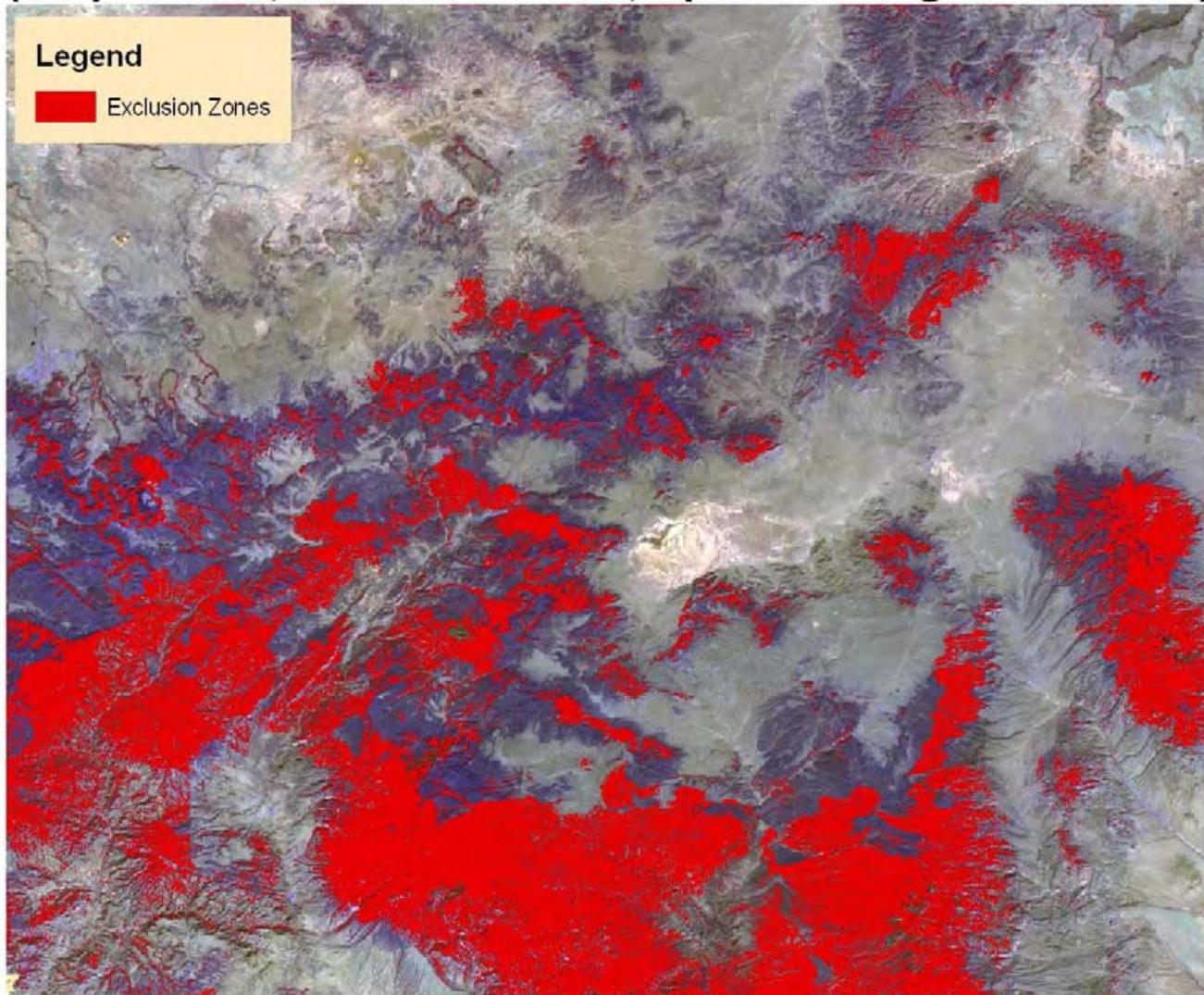
Forest Density



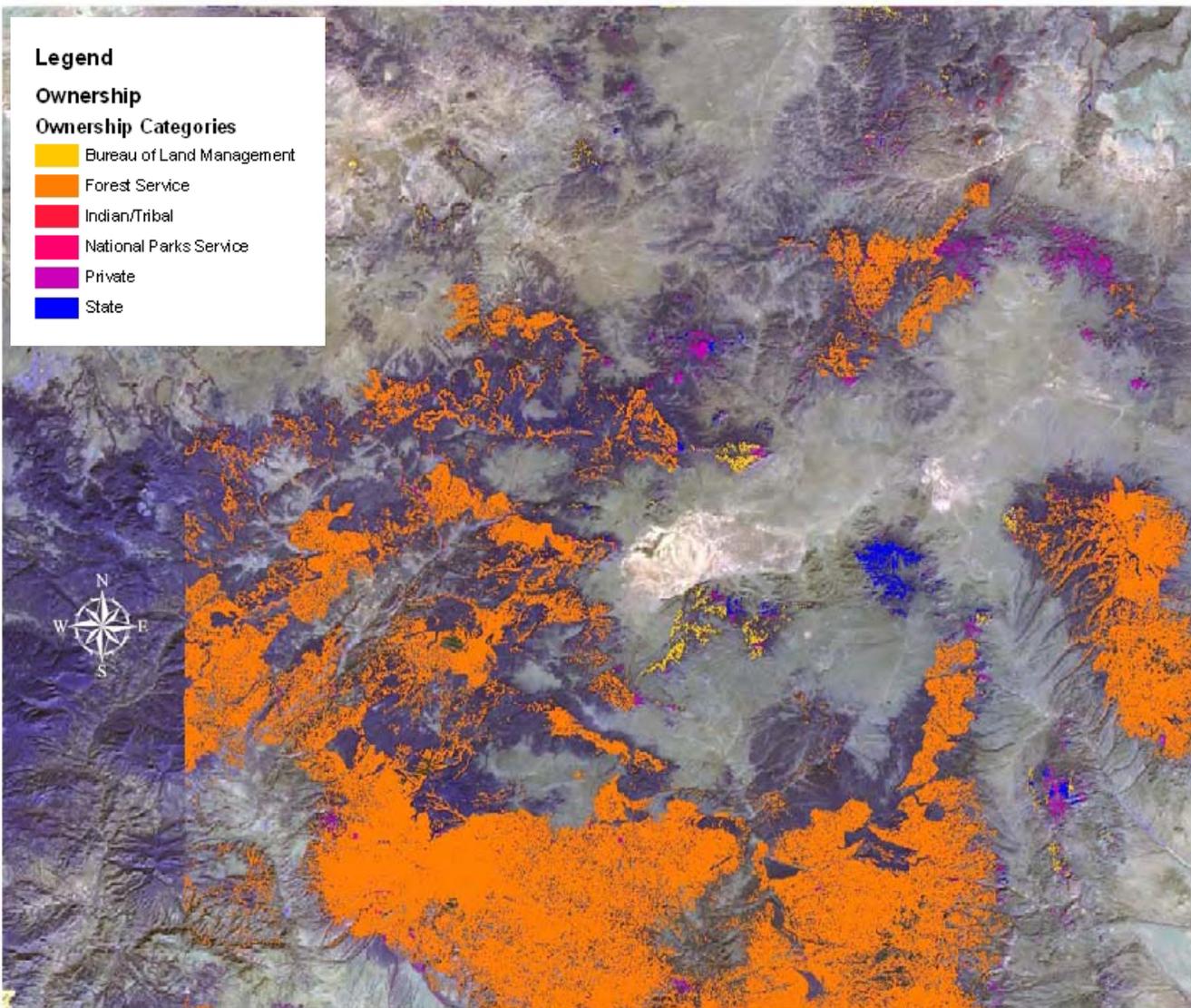
Exclusion Areas



(Slope >30%, Roadless Areas, Special Designated Areas)



Ownership





Automated Detection & Mapping of “Red Attack” Beetle Killed Trees

A Growing Problem



Native Communities Development Corporation
Satellite Imaging & Mapping Division



Example #1



Example #1



Example #2



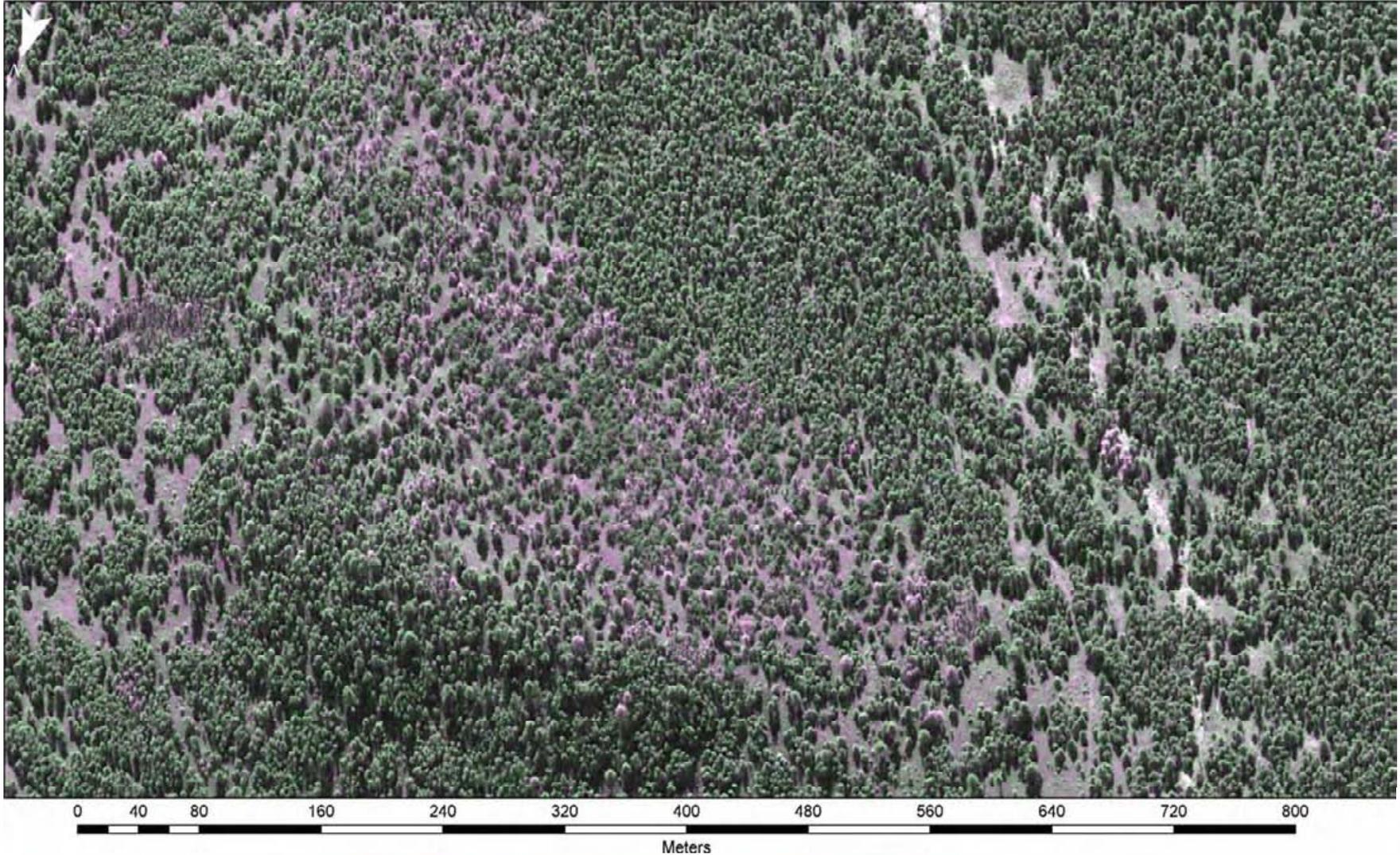
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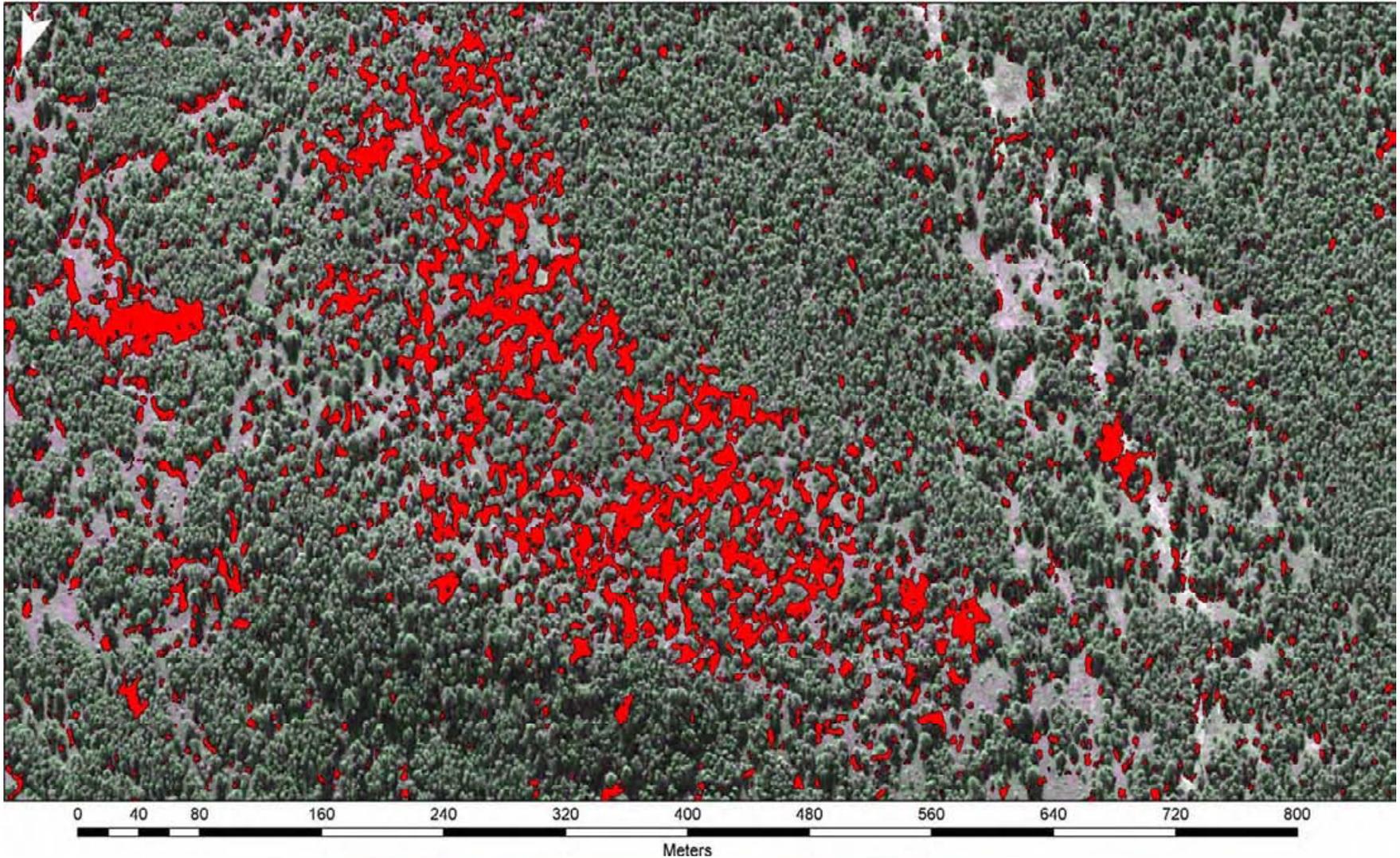
Example #2



Example #3



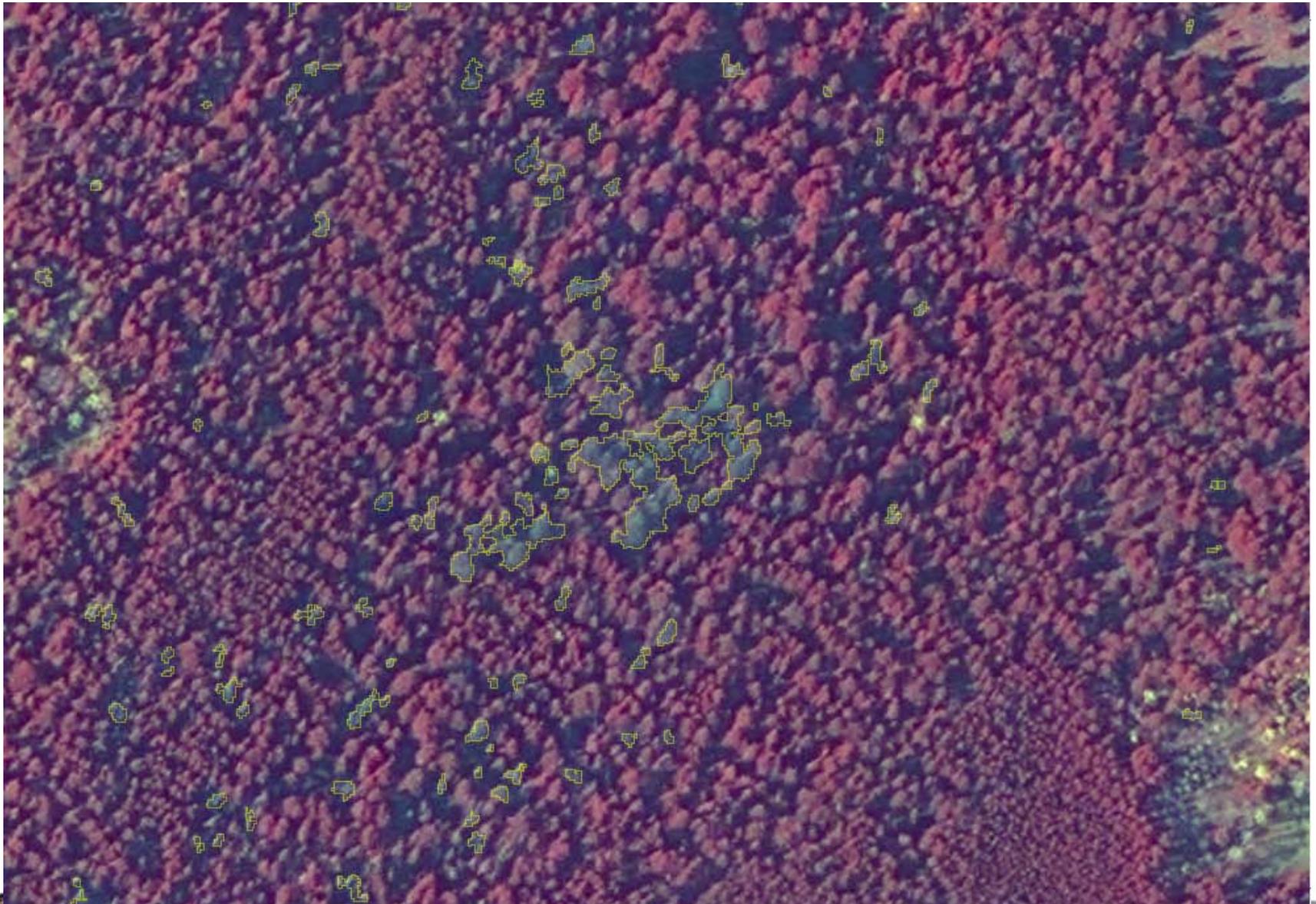
Example #3



Example #4



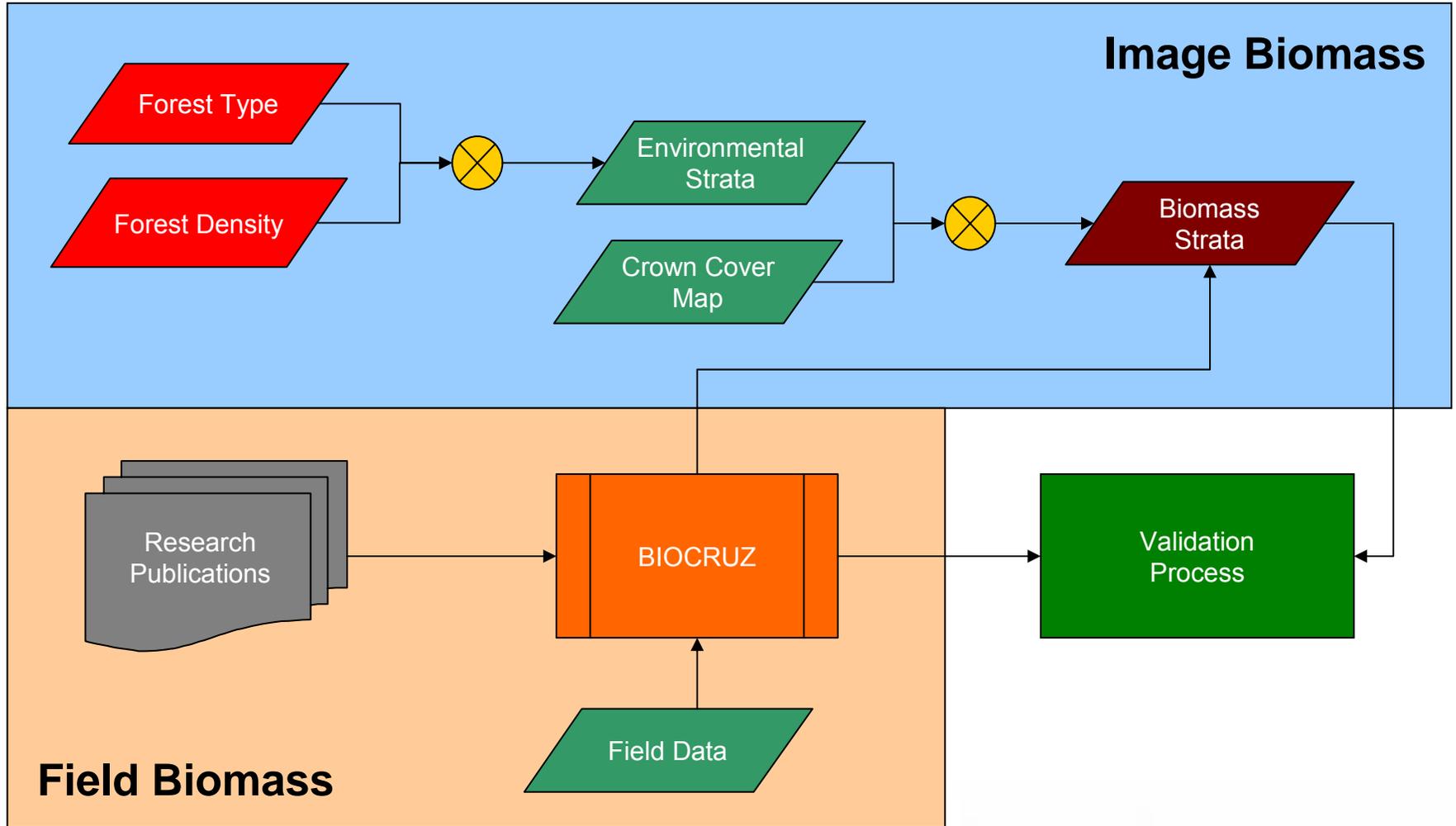
Example #4





Forest Biomass Supply Estimation Methodology

Methodology Overview





Field Data Collection

- **Plots:** 48
- **Size:** 1/20th acre
- **Samples:** 1,010
- **Traditional Cruising Methods**
 - Biltmore Stick
 - Clinometer
 - Logger's Tape
- **Data Collected (English Units)**
 - Mixed Conifer Forest
 - Species
 - Diameter at Breast Height (DBH) - inches
 - Height – feet



Dahl Environmental Services, LLC



Biomass Calculations

Field Biomass

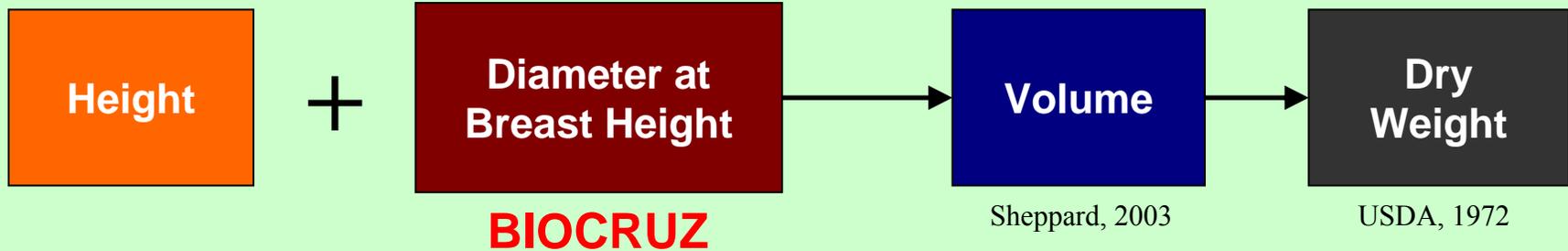
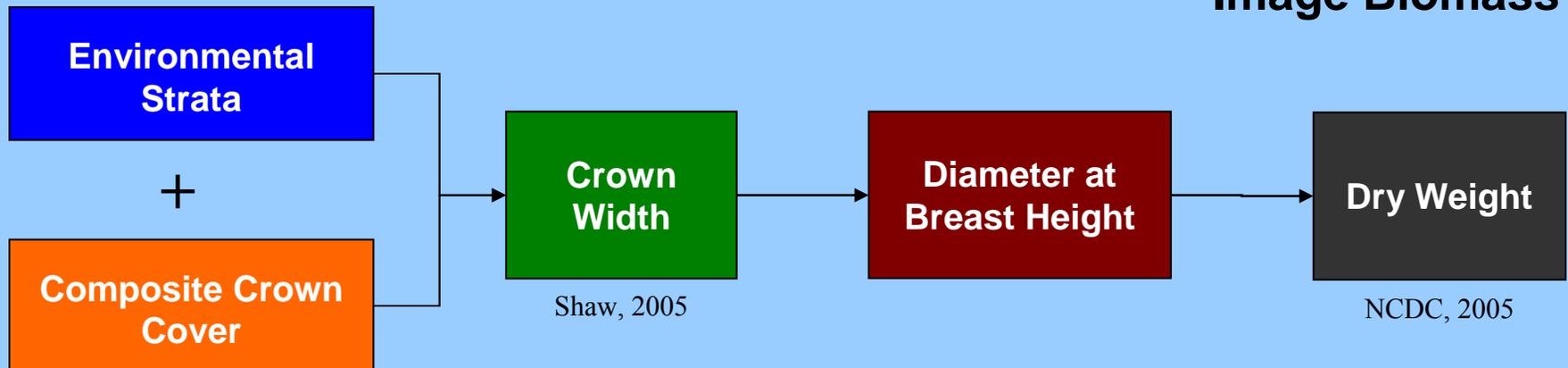


Image Biomass



Field Data Regression

- Equation optimized for image-based biomass estimates

DBH (in) vs. Bone Dry Biomass (kg)

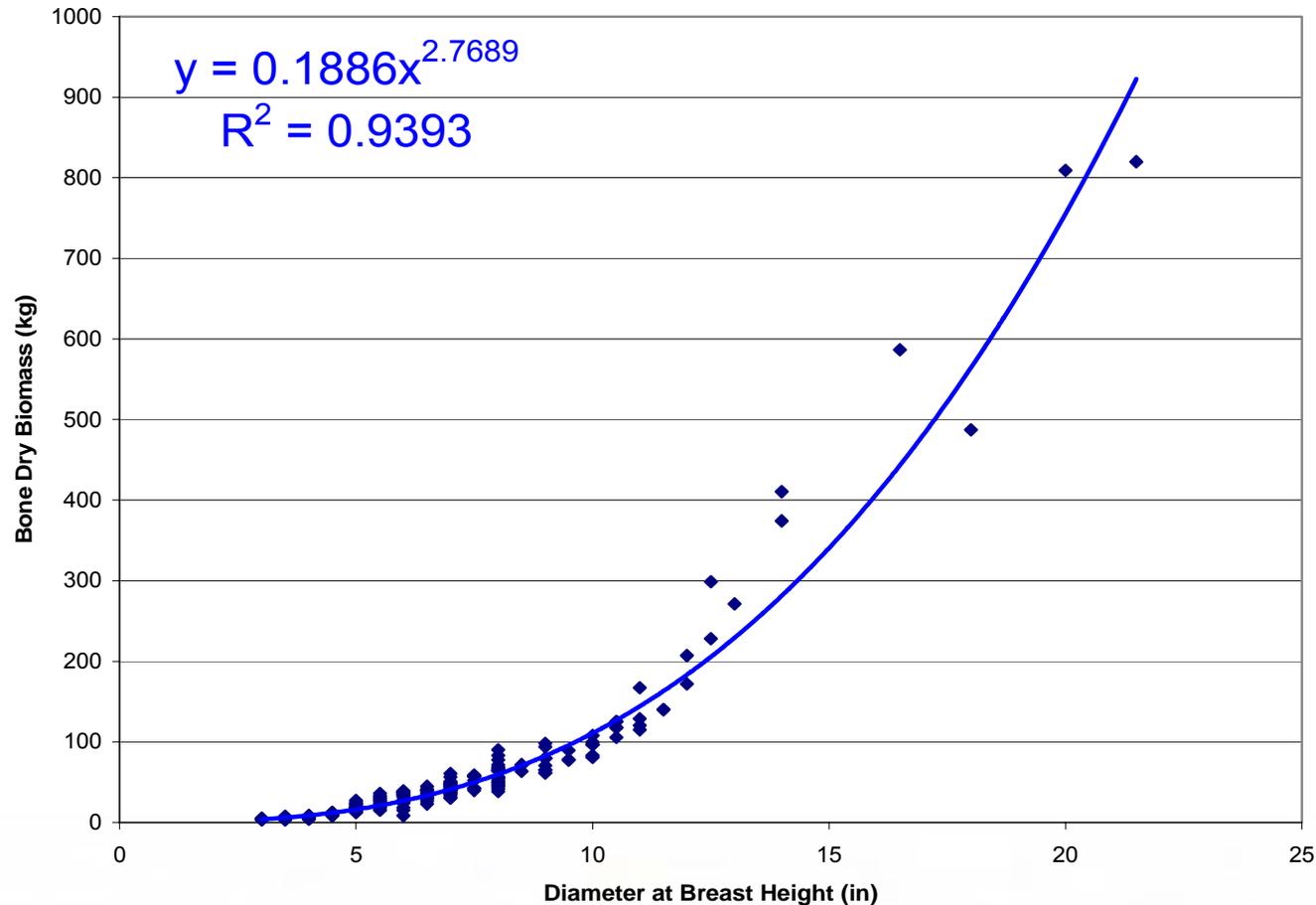


Image Data Validation

Dry Weight (tons per plot)

Plot ID	Field Biomass	Image Biomass	Conservative Bias
9	1.51	1.35	(0.16)
14	1.56	1.45	(0.11)
17	2.08	1.95	(0.13)



Available Bone Dry Biomass by Land Owner

	BLM	STATE	FOREST SERVICE	PRIVATE
Available Tons	1,983,019	1,992,197	27,688,871	7,317,680





**SATELLITE IMAGING &
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