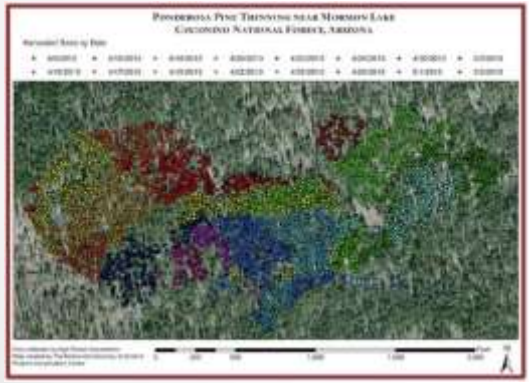
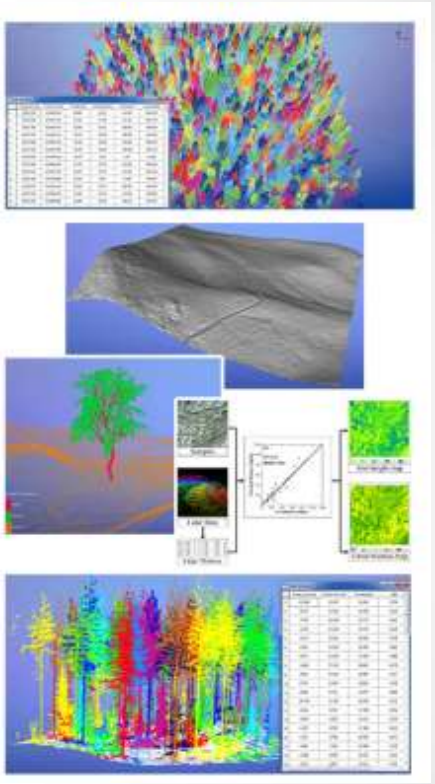
4FRI Digital Timber Project





Mike Shettles (Reporting), USFS

Timber Measurements Society

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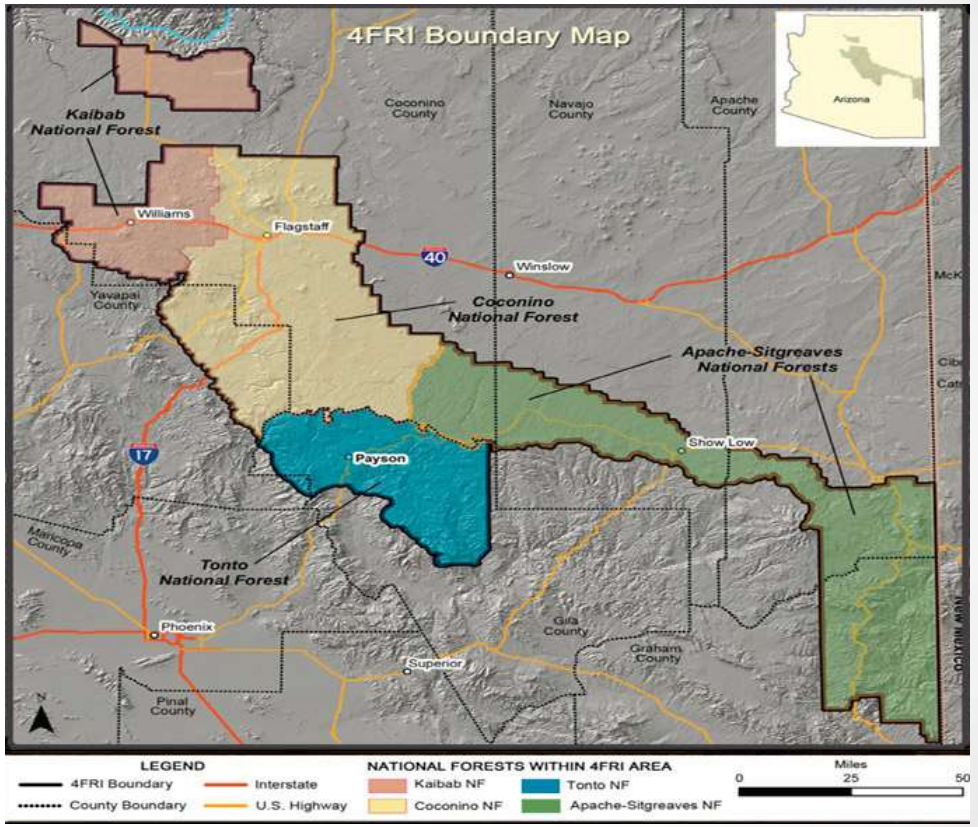
Couer d'Alene, Idaho

4FRI Overview

- Four Forest Restoration Initiative
- 2.4 million acres across the Apache-Sitgreaves, Coconino, Kaibab and Tonto National Forests
- Multiple stakeholders
- The Nature Conservancy (TNC) mediators between USFS and stakeholders
- Primary goal includes mechanically treating up to 50,000 acres per year during a 20-year period
- Primarily low-value small-diameter trees and biomass
  - Tough for purchasers to sustain themselves economically
  - **Created a push to increase the efficiency in planning and implementation**



Designation by Prescription (DxP)

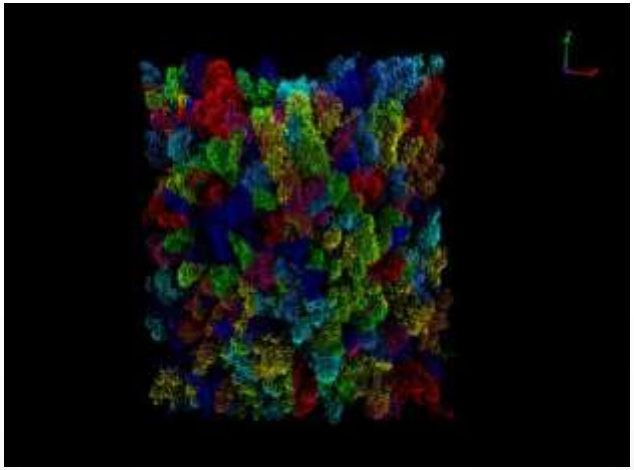
- Major theme: let's speed up the process and stop marking timber.
- DxP is a prescription process based upon an "end condition", where the trees aren't marked with paint; purchasers get to decide which trees to cut, so long as the end condition is met (e.g. leave 40 BA of pine and 20 BA left of oak, or a residual canopy cover of 60%).
  - **75% of 4FRI units will not be marked.**
- But, DxP is wrought with uncertainties—it was originally meant for simple prescriptions, but the prescriptions on the 4FRI aren't even close to simple, making it very hard to **verify** prescriptions are being met.
- Hence, this digital restoration project—making DxP more easily administrated while still helping make the project economically viable for the purchasers doing the actual harvesting.

Problem → Solution

1. Need to speed things up by not marking trees with paint
   → **Tablet Marking**

2. Ensuring spatially-explicit "patchy" prescriptions are executed
   → **In-cab, GPS-enabled Tablet Technology**

3. Sale administration/monitoring
   →**Aerial LiDAR**

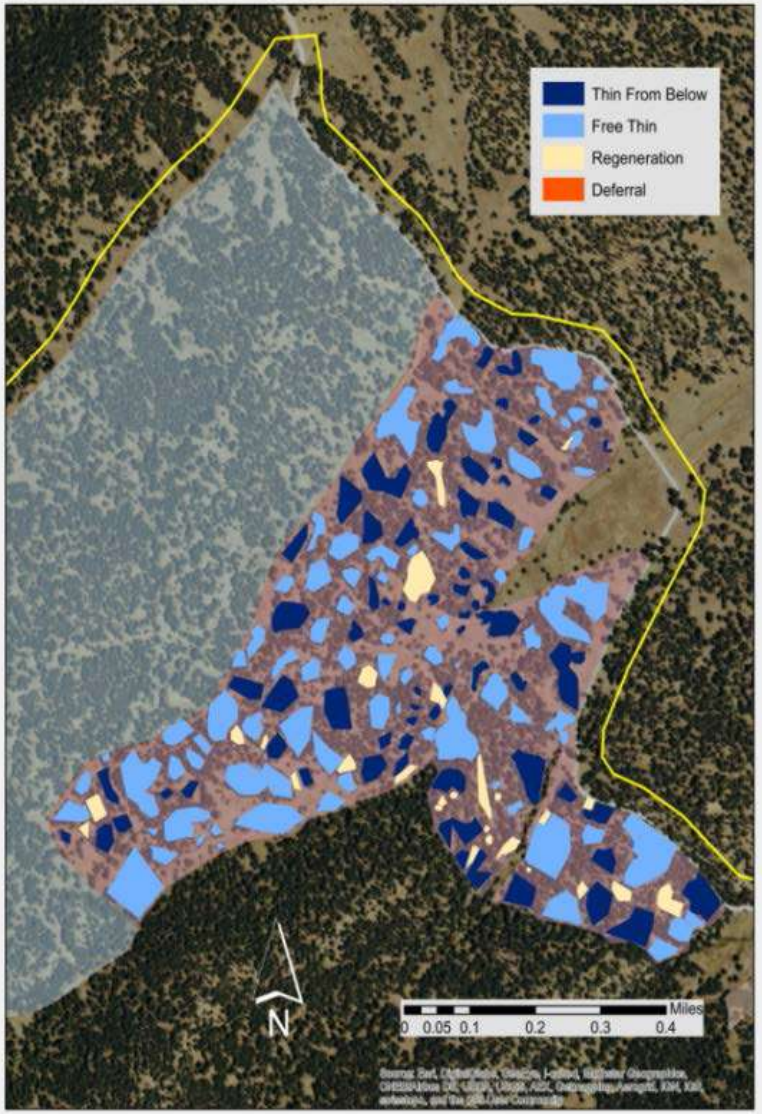


Tablet Marking

- Aim is to increase the efficiency of marking crews
- **Hardware:** IPads
  - GPS receivers are the off-the-shelf
- **Software:** ESRI ArcGIS online and Collector App
  - Download maps and collect feature information in the field

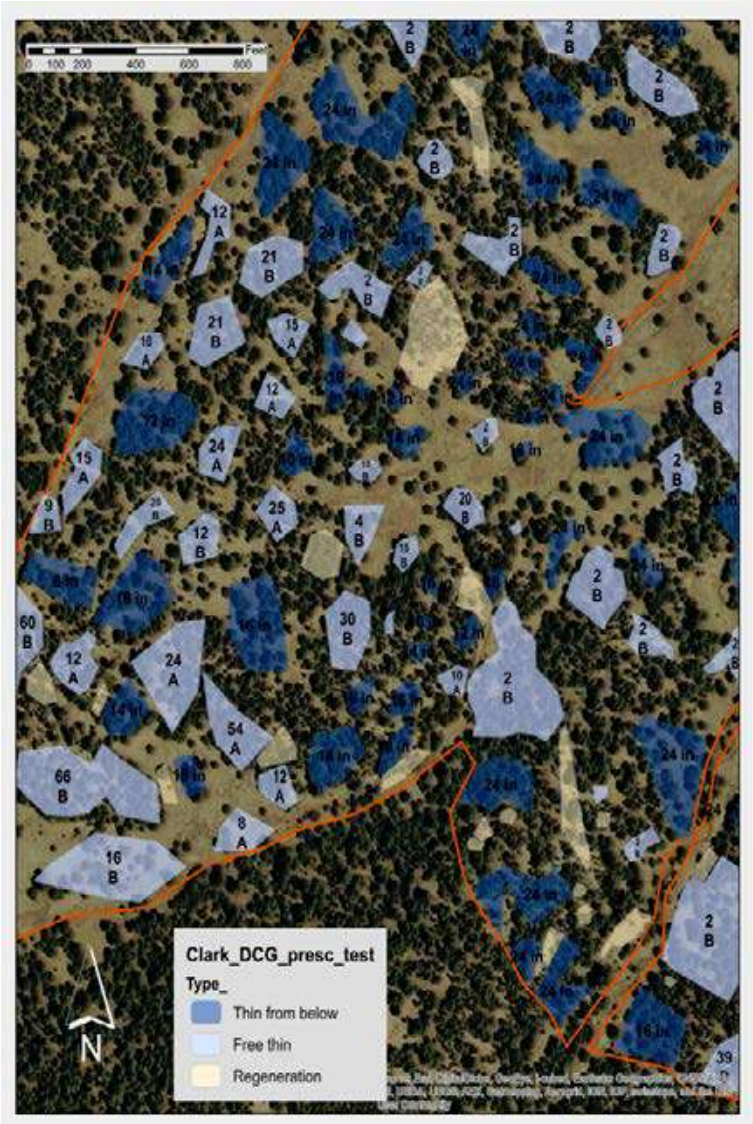
Tablet Marking Cont'd

- Field crews designate spatially where tree clumps and groups should be placed and generally how the structure in those areas should look.
- Tablet marking is the only of the 3 aforementioned solutions that has been tested operationally.



Tablet Marking Cont'd

- To provide an even greater level of information for operators, the digitally marked polygons from handheld tablets can be further labeled before being uploaded to GPS-enabled in-cab tablets
- The operator uses this digitally-marked map to navigate within a stand and to assist with decisions regarding placement and structure of clumps/groups and interspace

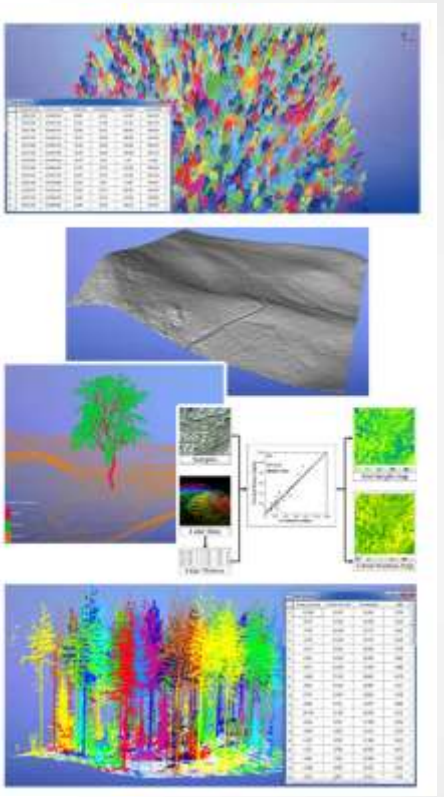


In-cab, GPS-enabled Tablet Technology

- Aim is to ensure spatially-explicit patchy prescriptions are met on the ground
- **Hardware:** XPLORE ruggedized tablets
  - High-grade antennae mounted to the top of the cab
- **Software:** TimberGuide from Genesis Industries
  - Unit map, aerial images, roads, unit boundaries, tablet-marked polygons, etc.
  - Records productivity (trees cut/hour) and UTM coordinates of each cut-tree

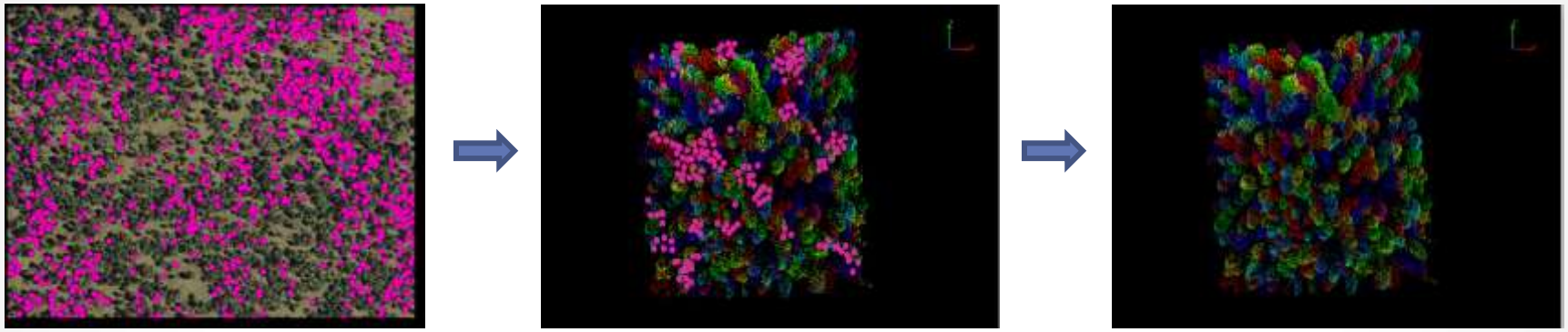
Aerial LiDAR

- Aim is to make DxP sale administration/monitoring easier
- Phase 1 LiDAR collected for the 4FRI EIS area
  - Flown in 2014
- **Software:** LiFOREST
  - Allows user to use published algorithms for calculating several key forest metrics such as percent canopy cover.
  - Users can also calculate other forest parameters, such as basal area, by including ground sample data, and then creating localized regression equations for their project areas.



Aerial LiDAR Cont'd

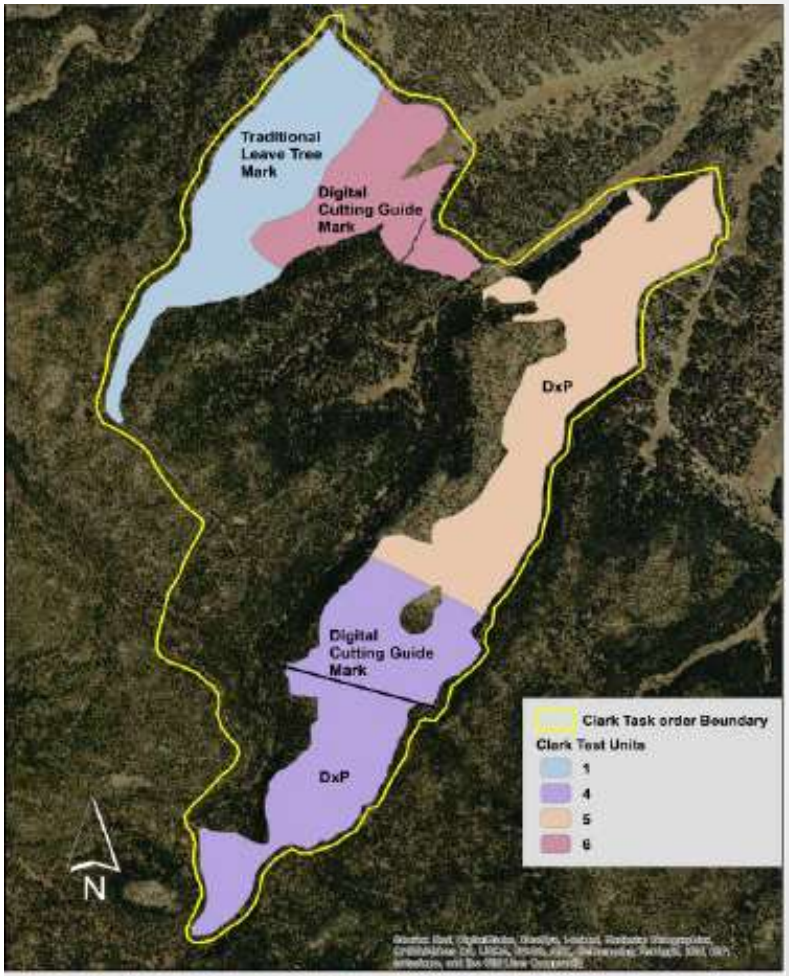
- Using the UTM coordinates, individual trees can be segmented out of the LiDAR point cloud, allowing for more rapid monitoring of during and post-treatment results



- TNC and Northern Arizona University working together on this
- TNC is also working with T&D in San Dimas to develop diameter measurement capabilities using a camera system on the head of a feller-buncher that would capture and process an image prior to cutting
    - Strengthen relationships between the trees' coordinates and the estimate of canopy cover removed from the LiDAR dataset

Pilot Project

- Clark Task Order (1,684 acres)
- Three marking methods compared:
  - Traditional Leave-Tree Mark
    - 680 acres
  - DxP
    - 677 acres
  - Digital Marking
    - 327 acres
- **Operational results to-date are for the tablet-marking only.**
  - In-cab technology with a harvester was operationally tested fon an Arizona State Forestry project in November and December 2015.
  - Productivity results will help guide 4FRI operations in the near future



Productivity Outcomes-No Surprises

	Current Marking	Current DxP	Digital Restoration Guide
Personnel Production	8 ac/day/person	17 acres/day/person	40-60 acres/day/person
Paint	Trees/boundary	Boundary Only	Boundary only
Extra Admin. steps	None	Yes	None
Desired Condition	Exact as marked	Unknown^	As marked by DRG^
Cost			
Layout	$40/acre	$13/acre	$16/acre
Administrative	+	+	+
Implementation Production	*	*	*

^Potential to test once harvesting operations occur
* Currently awaiting harvesting operations for testing
+ Currently being assessed by USFS

Areas of Concern

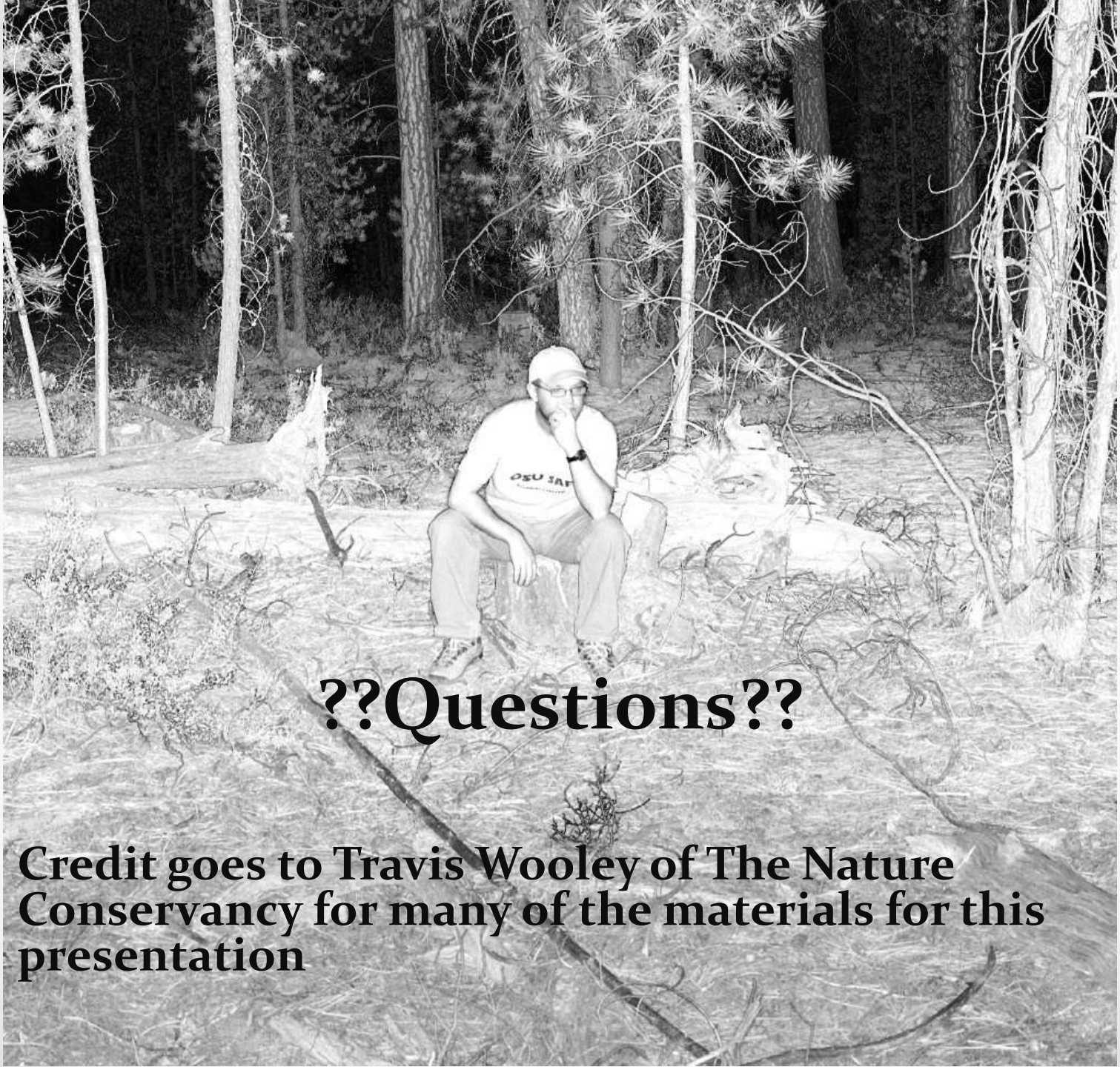
- Inaccuracies
  - GPS on the tablets—locations of the polygons
  - UTM coordinates of each tree
  - LiDAR data itself
  - Estimate of updated stand structure from post-treatment LiDAR data
  - Will any of these uncertainties derail the project? Or, do these even matter as far as the final outcome?
- Increased sale administration time
  - Additional field visits to ensure compliance
- Final map produced post-treatment
  - Could this be a source of strife with the stakeholders if inaccuracies in the map result in differences with what's actually been done on the ground?

Bottom Line

- Hand-held tablets have potential to save time and reduce costs for Timber Sale Administration activities.
- Hand held tablets also fosters the ability to compare prescriptions/marking to what occurred on the ground, in a much more rapid fashion.
    - In-cab results and LiDAR algorithms/relationships still pending

FOUR FOREST RESTORATION INITIATIVE

The Nature Conservancy



??Questions??

Credit goes to Travis Wooley of The Nature Conservancy for many of the materials for this presentation