

Ultra-High Resolution Remote Sensing for Species Identification and Restoration Monitoring

Monitoring Mule Deer Habitat Restoration



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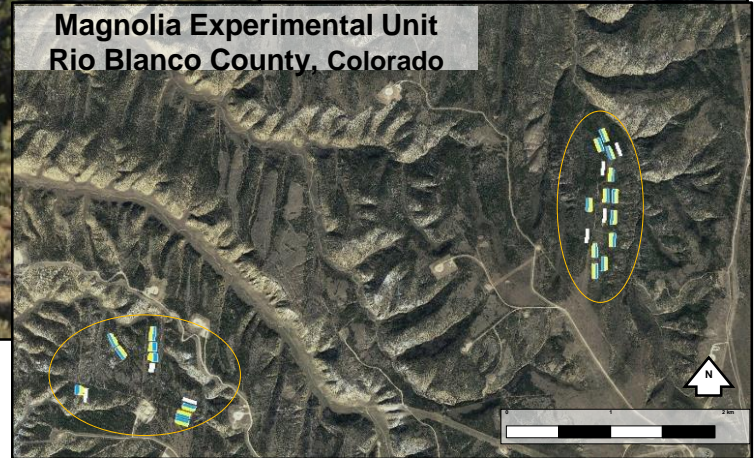
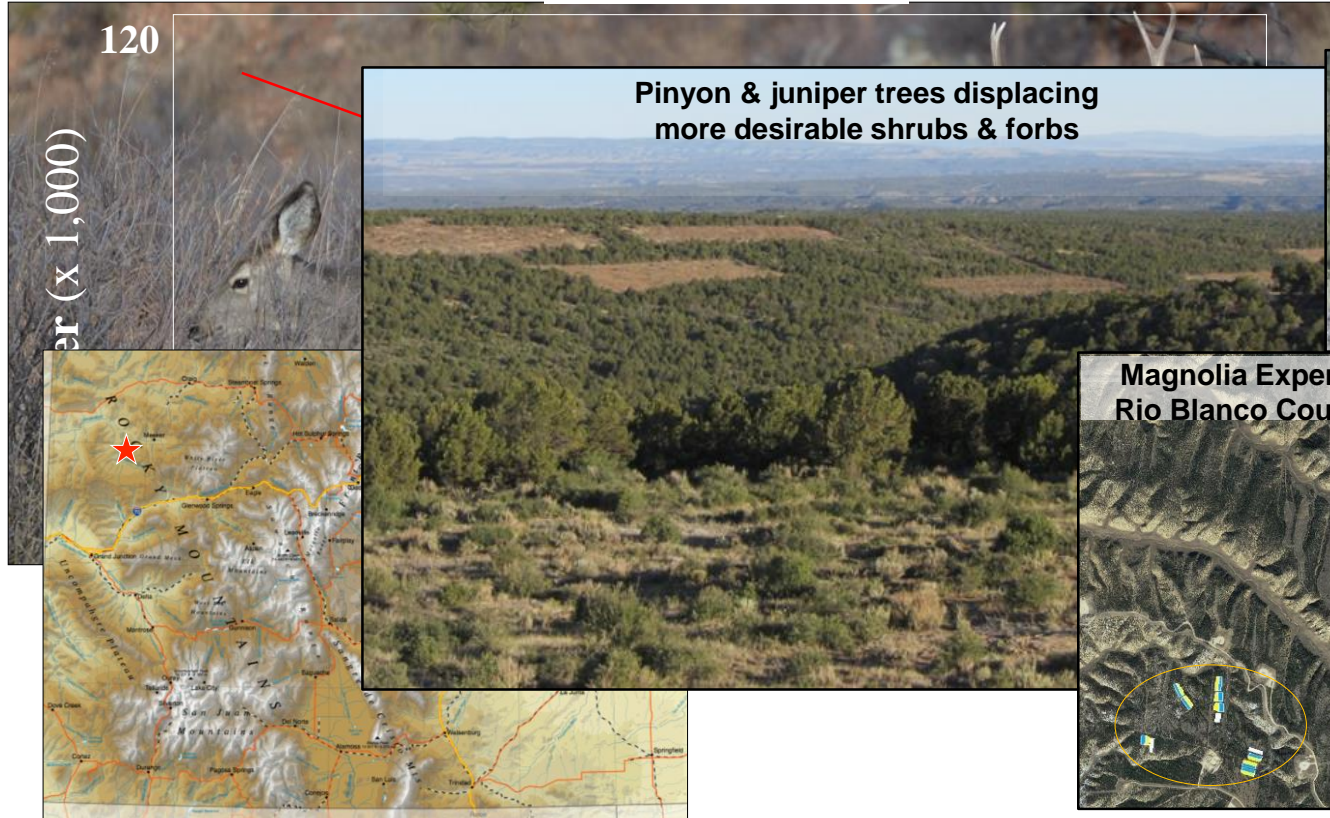


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Colorado Mule Deer Declines & Habitat Restoration

Northwestern CO



Obstacles to Monitoring



- Long-term monitoring is critical!
- Some challenges limiting monitoring implementation
 - Technical (poor design, site access, property rights)
 - Institutional (financial)
- Remote sensing can be...
 - Time and cost efficient
 - Collect data on rugged terrain and on land w/o access

Can we use remote sensing to monitor restoration?

Obstacles to Monitoring



Are remote sensing methods equal to ground surveys?

Obstacles to Monitoring



Are remote sensing methods equal to ground surveys?

Compare **cover** estimates for:

1. Functional groups
- | | | |
|--------|-------|------------|
| Tree | Shrub | Herbaceous |
| Litter | Bare | |

Obstacles to Monitoring



Are remote sensing methods equal to ground surveys?

Compare **cover** estimates for:

1. Functional groups

Tree Shrub Herbaceous
Litter Bare

2. Key Shrub Species

Serviceberry

Snowberry

Sagebrush

Antelope bitterbrush

Rubber rabbitbrush

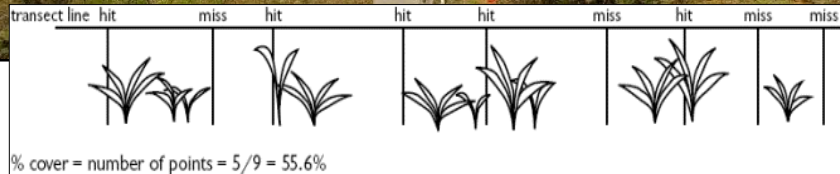
Yellow rabbitbrush

Mountain Mahogany

1. Monitoring On-the-Ground



Line-point-intercept to estimate canopy cover



28 plots ($\sim .07\text{ha}$)

13 transects/plot

300 LPI hits/plot

- Time & labor intensive
- Small sample of plot

2. Monitoring In-the-Air



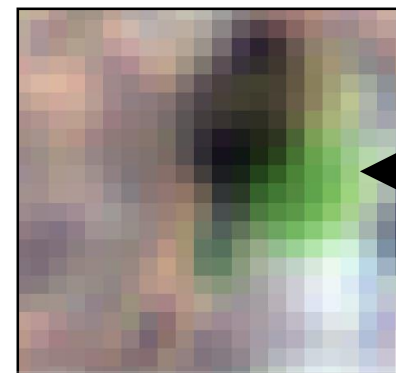
August 2017



Multi-spectral camera

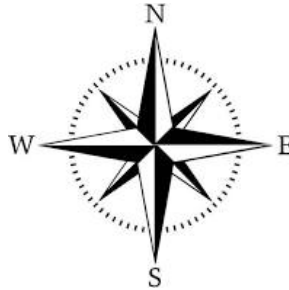
- 5 bands (B, G, R, RE, NIR)

Altitude of 80 m =
“Ultra-high” resolution
~5.5 cm / pixel
4 million pixels per hectare



0.5 m
wide
shrub

- Time efficient
- Sample all of plot



~~Compass led
transects~~

June 2018

ERNA

AMAL

AMAL

SYRO

PIED

SYRO

CH

AMAL

SYRO

AMAL

SYRO

AMAL

Bunchgrass

SYRO

SYRO

AMAL

SYRO

AMAL

SYRO

SYRO

SYRO

SYRO

AMAL

SYRO

AMAL

1

4. Monitoring On-the-Computer



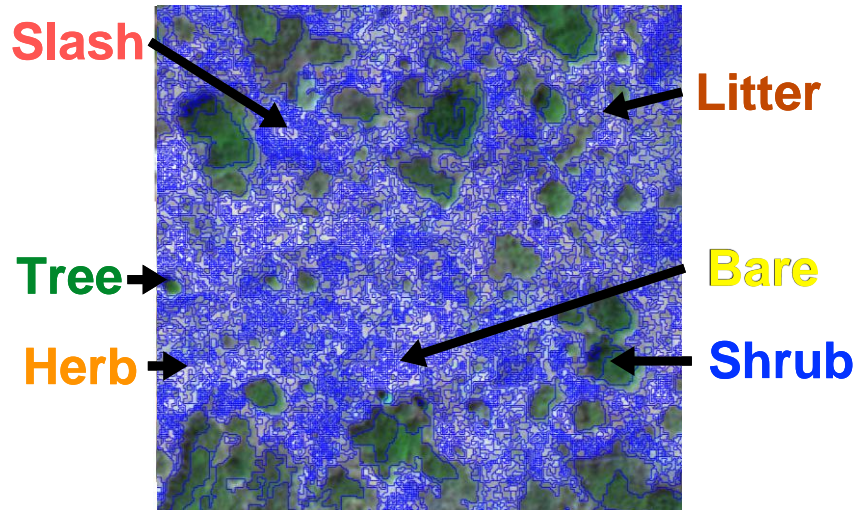
OBIA can use
Spectral statistics
Shape
Size
Texture
Relations to...
...neighbor objects
...super-objects
...sub-objects
etc...



Ruleset

Object-Based Image Analysis

(Image segmentation)



(Classify Objects)

*Automated classification for all your sites

Monitoring Methods: Ruleset Creation

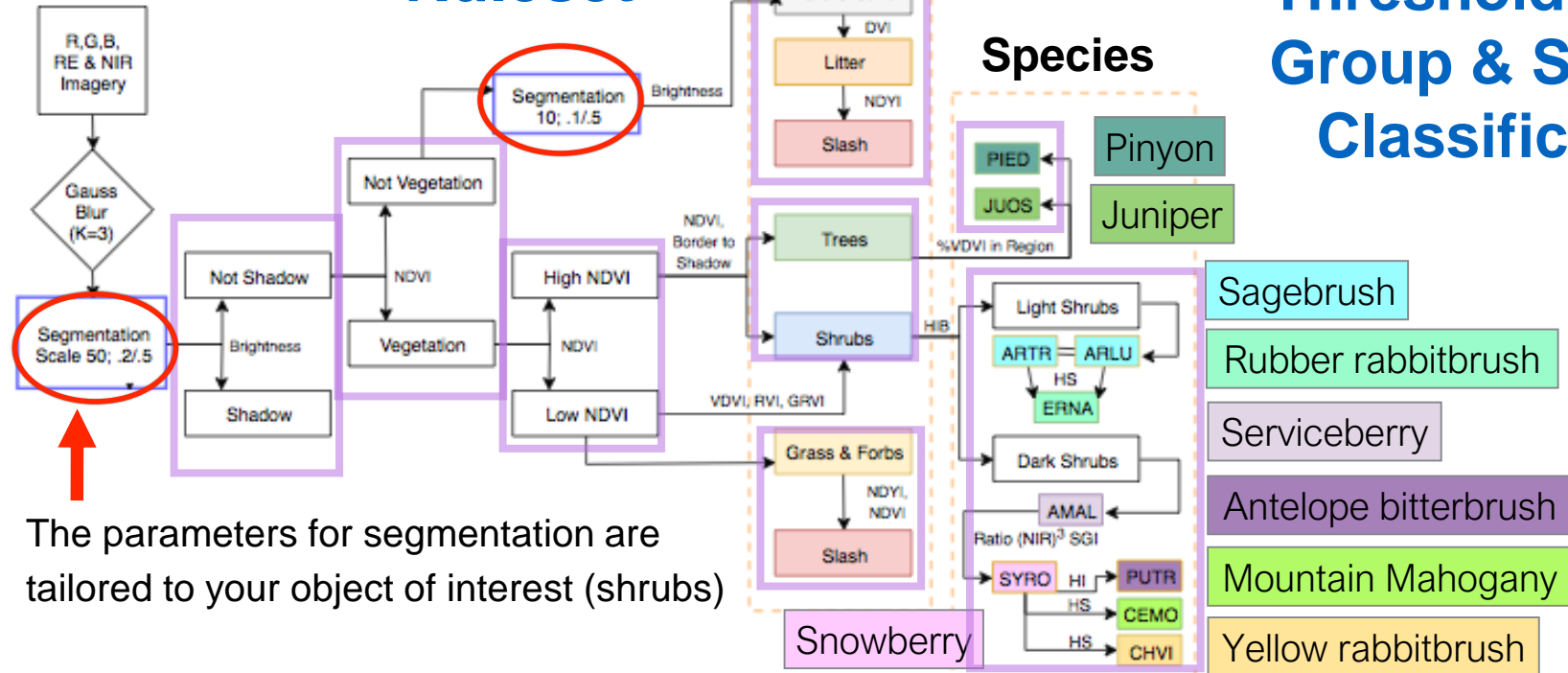


Ruleset

Functional groups

Species

Hierarchical, Threshold-based Group & Species Classification

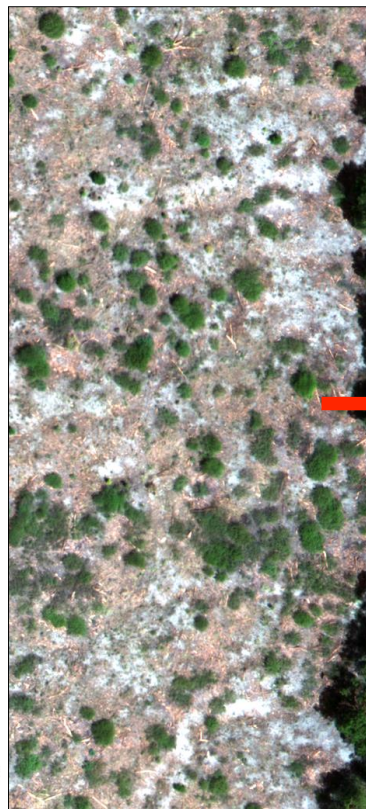
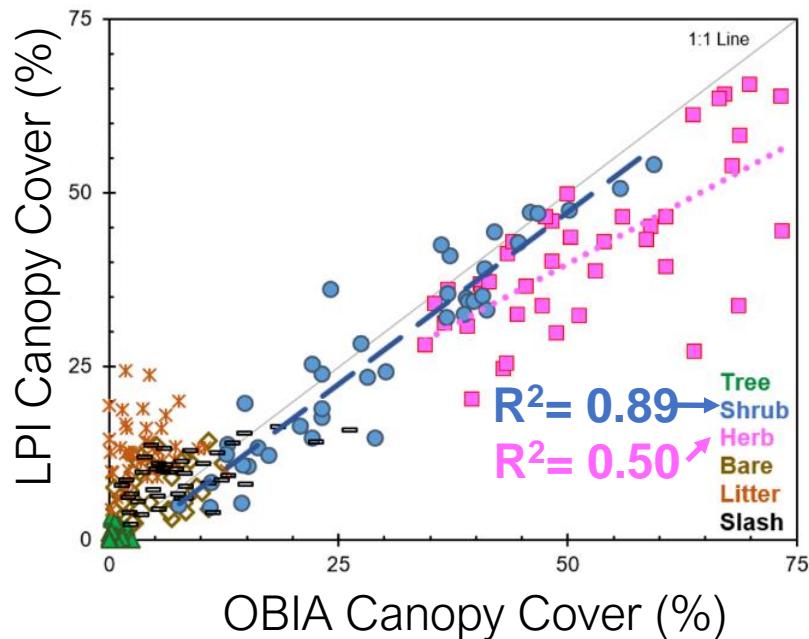


The parameters for segmentation are tailored to your object of interest (shrubs)

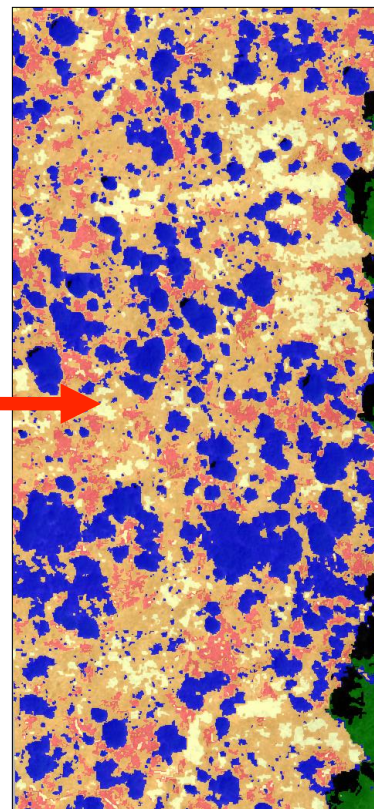
Object Classification: Functional Groups



Excellent estimation of
shrub cover



← 30 m →

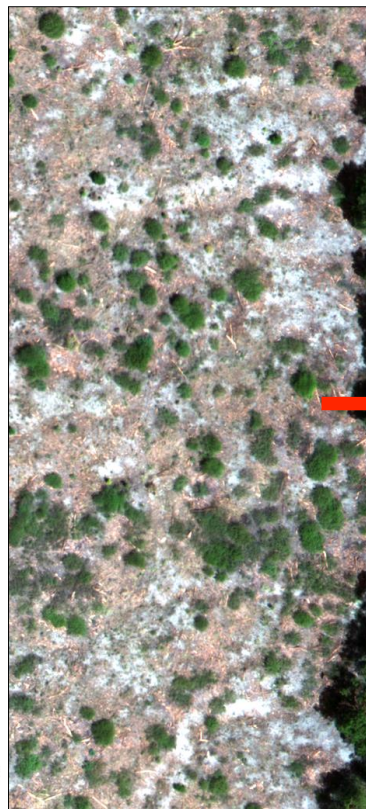
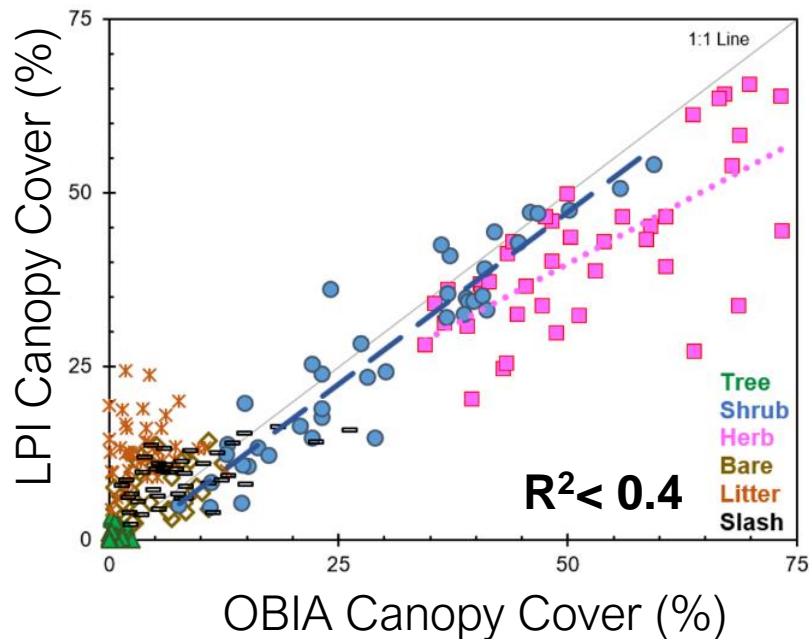


- Tree
- Shrub
- Herb
- Bare
- Litter
- Slash
- Shadow

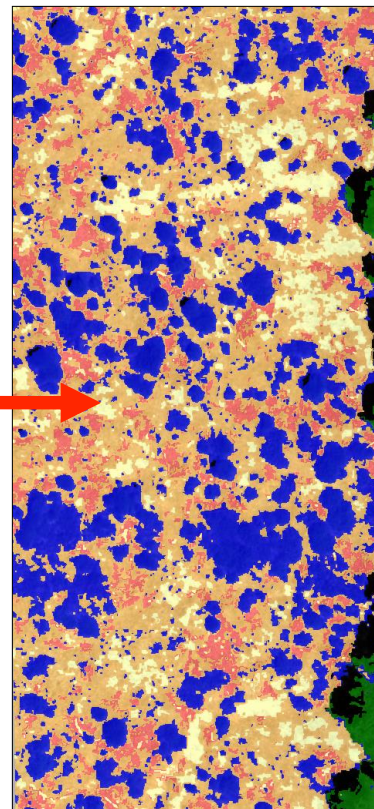
Object Classification: Functional Groups



Not so great estimation
of other cover



← 30 m →

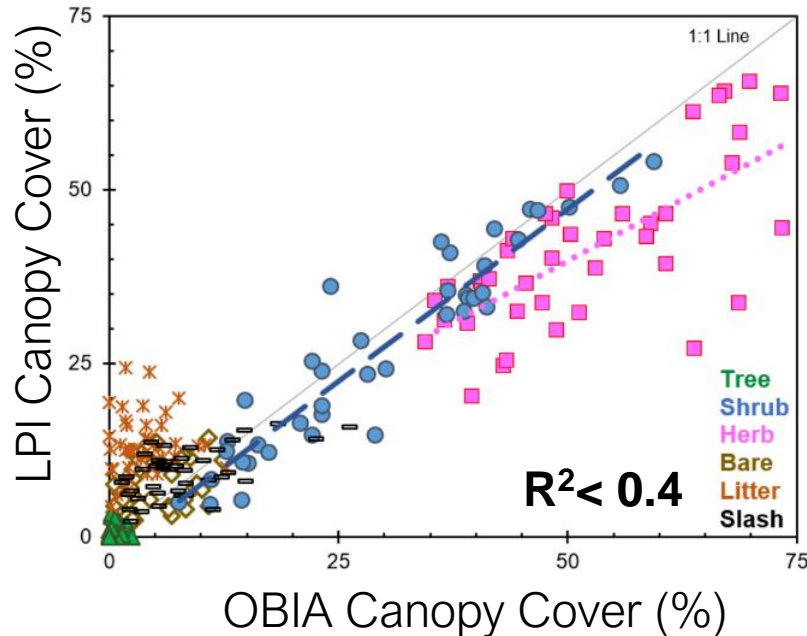


- Tree
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Object Classification: Functional Groups



Not so great estimation
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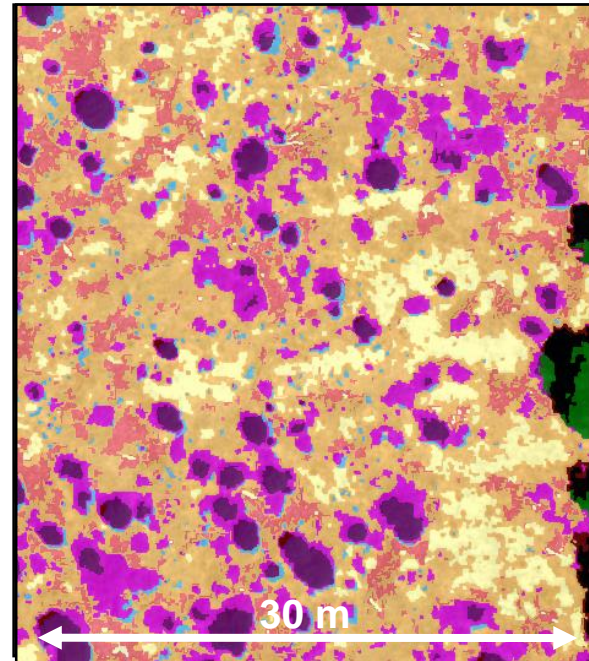
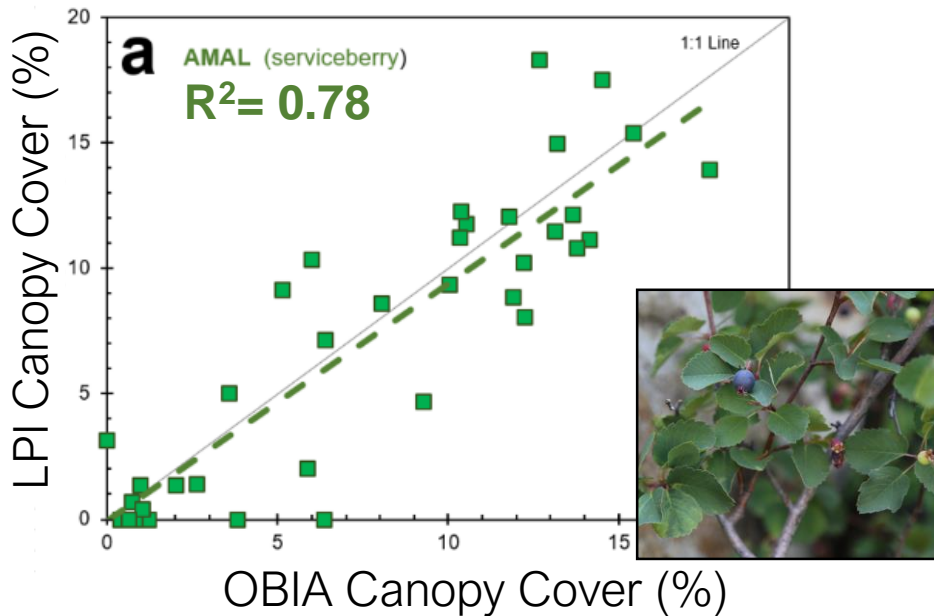
- Small shrubs => herbs.
- August: Senescent herbs.
- Bare and litter spatial res << 5.5cm resolution.

Object Classification: Species



Accurate Estimation of Key Shrub Species

Serviceberry (preferred)



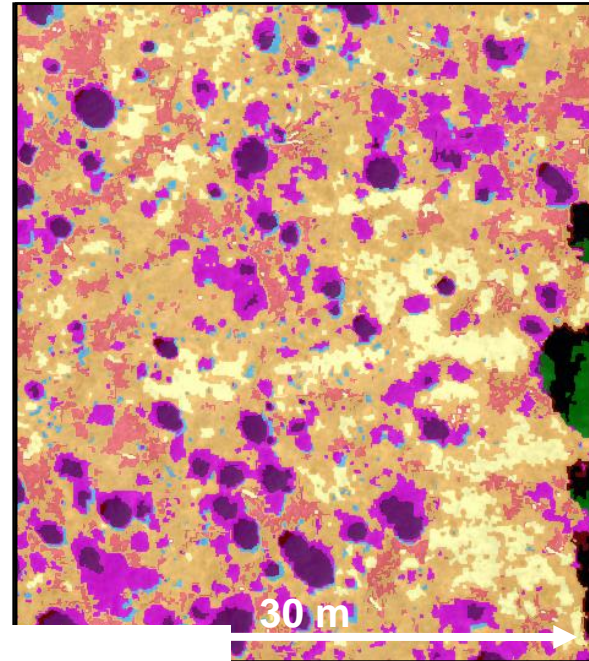
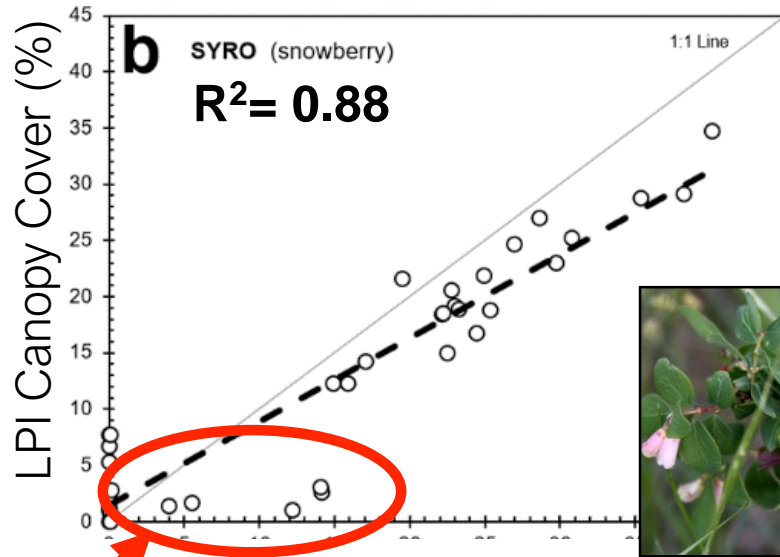
- Serviceberry
- Snowberry
- Artemisia sp.
- Herbaceous
- Litter/Bare
- Slash

Object Classification: Species



Accurate Estimation of Key Shrub Species

Snowberry (not-desirable)



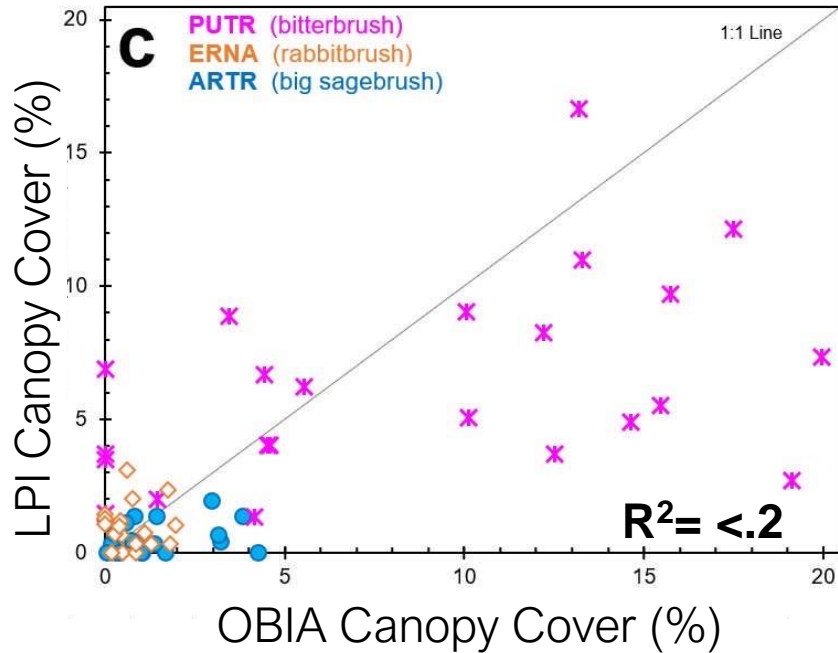
- Serviceberry
- Snowberry
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- Herbaceous
- Litter/Bare
- Slash

Misclassification in mixed sites with mountain mahogany

Object Classification: Species



Other shrubs not well-classified



- Need more ground-truthing
 - GPS species in plots
- Ruleset modifications



Monitoring Methods: Remote Sensing



In summary,

- Ultra high-resolution drone-collected data facilitates cost-effective long-term monitoring

Monitoring Methods: Remote Sensing



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1. Time Efficient

3d in Field
+ Analysis



VS.

28d in Field
+ Stats



Monitoring Methods: Remote Sensing



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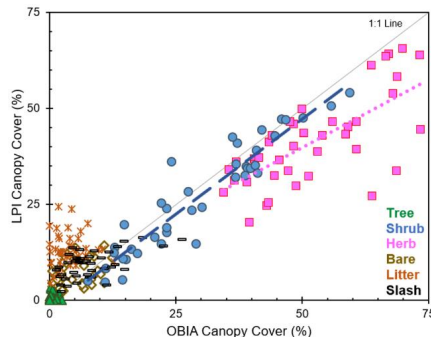
VS.

28d in Field
+ Stats

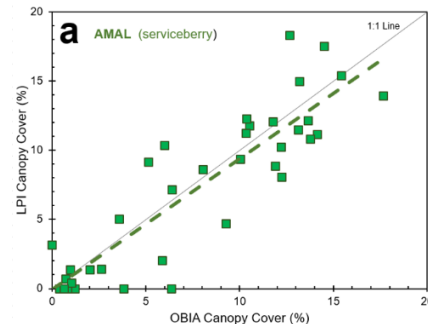


2. Comparable Cover Estimates

Shrubs



Key Species



Monitoring Methods: Remote Sensing

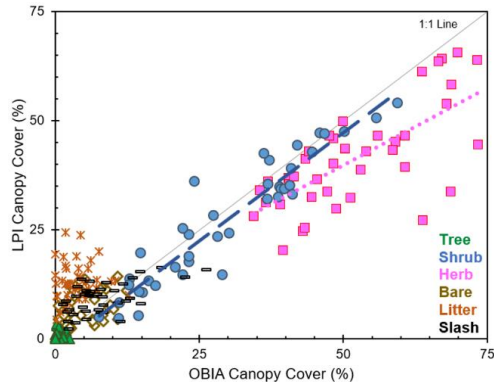


In summary,

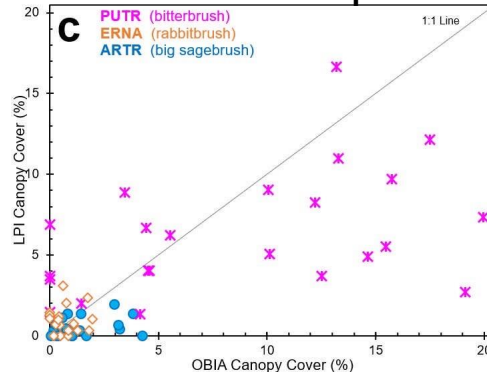
- Ultra high-resolution drone-collected data facilitates cost-effective long-term monitoring

3. Need Better Ground-Truthing!

Herb Bare Litter Slash



Other Shrub Species



And more!

Ultra-High Resolution Remote Sensing for Species Identification and Restoration Monitoring

Can we use remote sensing to monitor restoration?

Yes!

- Efficient and can collect more data
- Provides tools to ask (and answer) new questions about:
 - Plant spatial and temporal distribution and change detection
 - Horizontal and vertical structure (photogrammetry or lidar)
 - Physiological status of key species
- Permanent record of vegetation cover
 - Better analytical technologies every year...

Ultra-High Resolution Remote Sensing for Species Identification and Restoration Monitoring

Can we use remote sensing to monitor restoration?

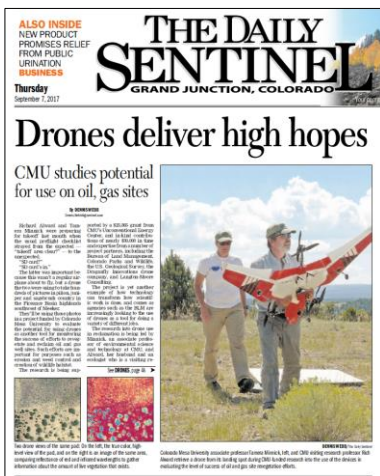
But must include...

Yes!

Periodic ground-surveys!

- Increases accuracy of remote sensing
- Record data not quantifiable by your remote sensing protocols
 - Eg. New weed invasions





Thank you!

Questions?



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