Colorado Natural Heritage Program: UAS Surveys for *Penstemon debilis*

Colorado Rare Plant Symposium

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Survey Challenges

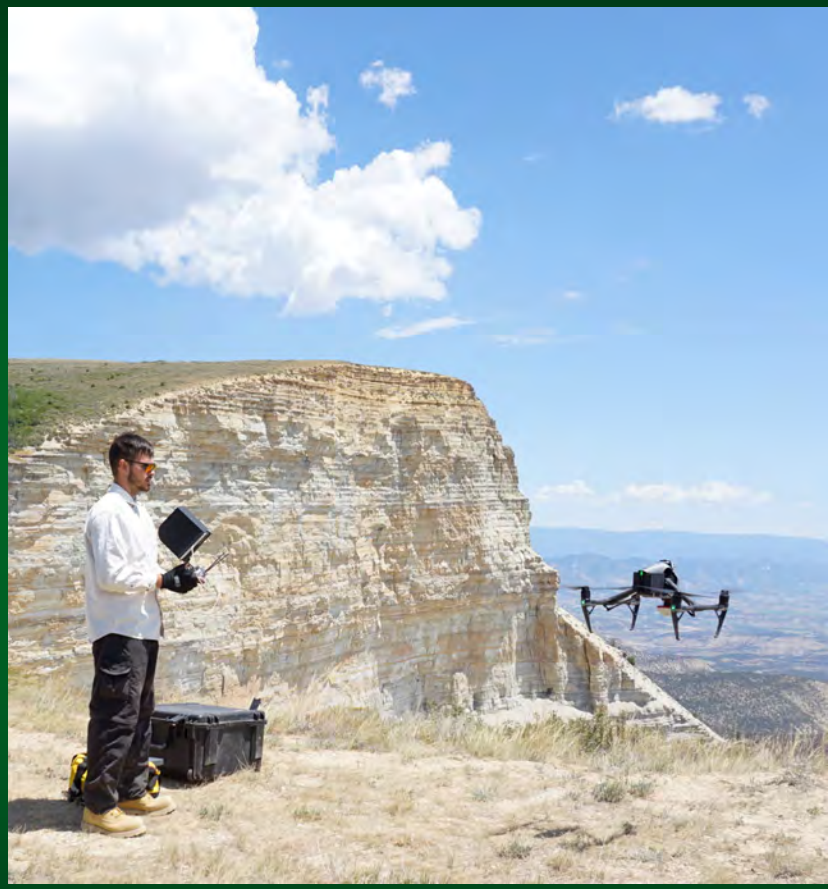
- Habitat is dangerous for surveying
- Some areas are inaccessible altogether





Unmanned Aerial Systems - Drones

- Drones can go where people can't
- Capture fine resolution images (<1cm)
- Geotagged photos give precise location
- Typically fly 400 ft (120 m) above ground



Could we use them to map rare plants?

Drone Survey Objectives

Test Multiple Cameras and Flying Altitudes:

Does the resolution of the image effect how we can detect plants?

- Flying higher covers more ground, with a coarser resolution
- Flying lower covers less ground, with finer resolution

RGB vs Multispectral:

- Red Green Blue (RGB): Super fine resolution, easier to detect plants
- Multispectral: coarse resolution, harder to detect plants
- Use the RGB data to train the multispectral data for automated detection

Find new plant populations

Methods

Identify Study Areas

Capture Images With The Drones



Process the images with Agisoft Metashape

Metashape

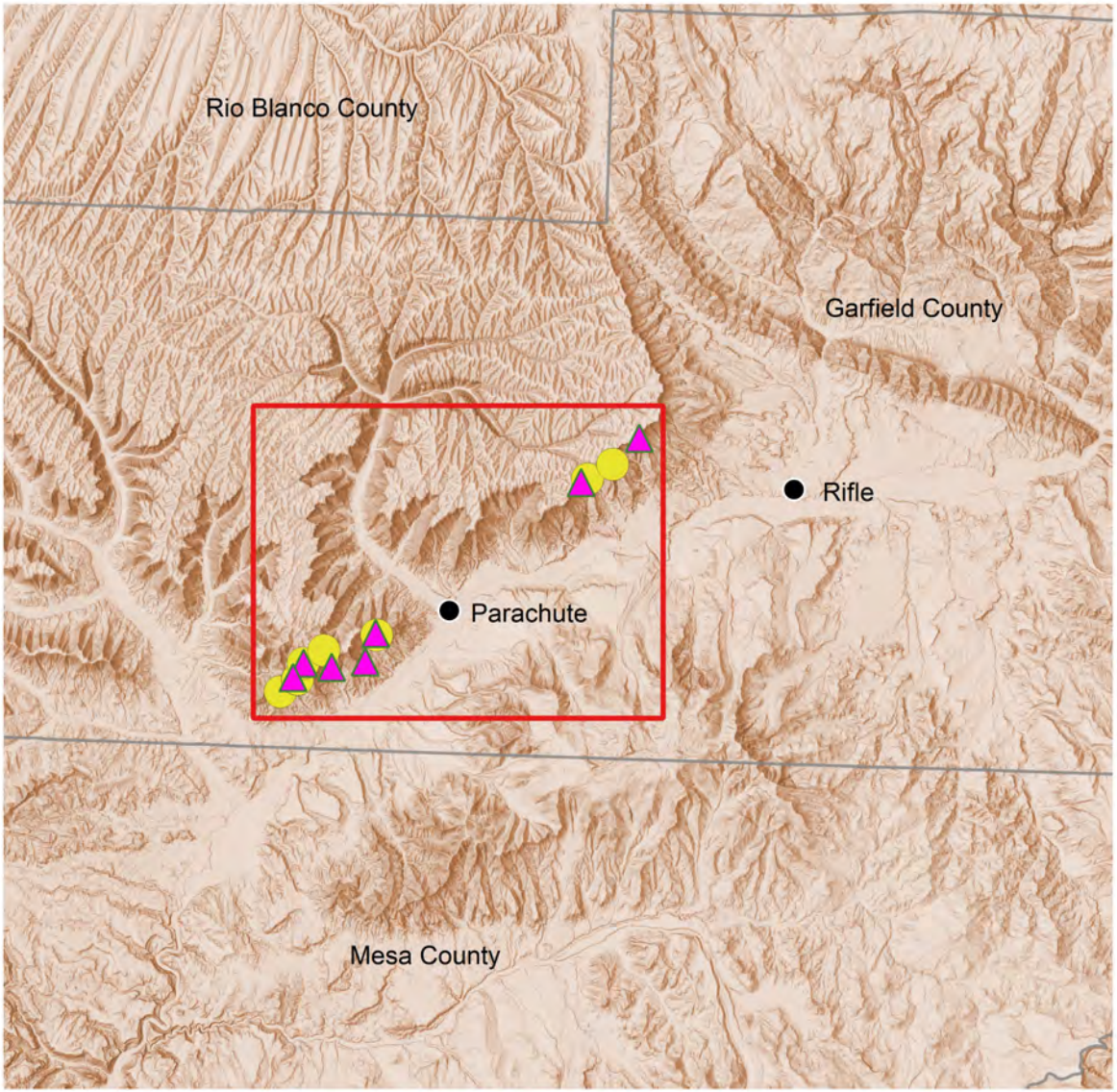
Manually identify plants in the orthomosaics

QGIS

Generated 7.5 TB of orthomsaics

Summarize population extents

Study Area





Study area for
Penstemon Debilis
UAS Mapping

COLORADO NATURAL HERITAGE PROGRAM

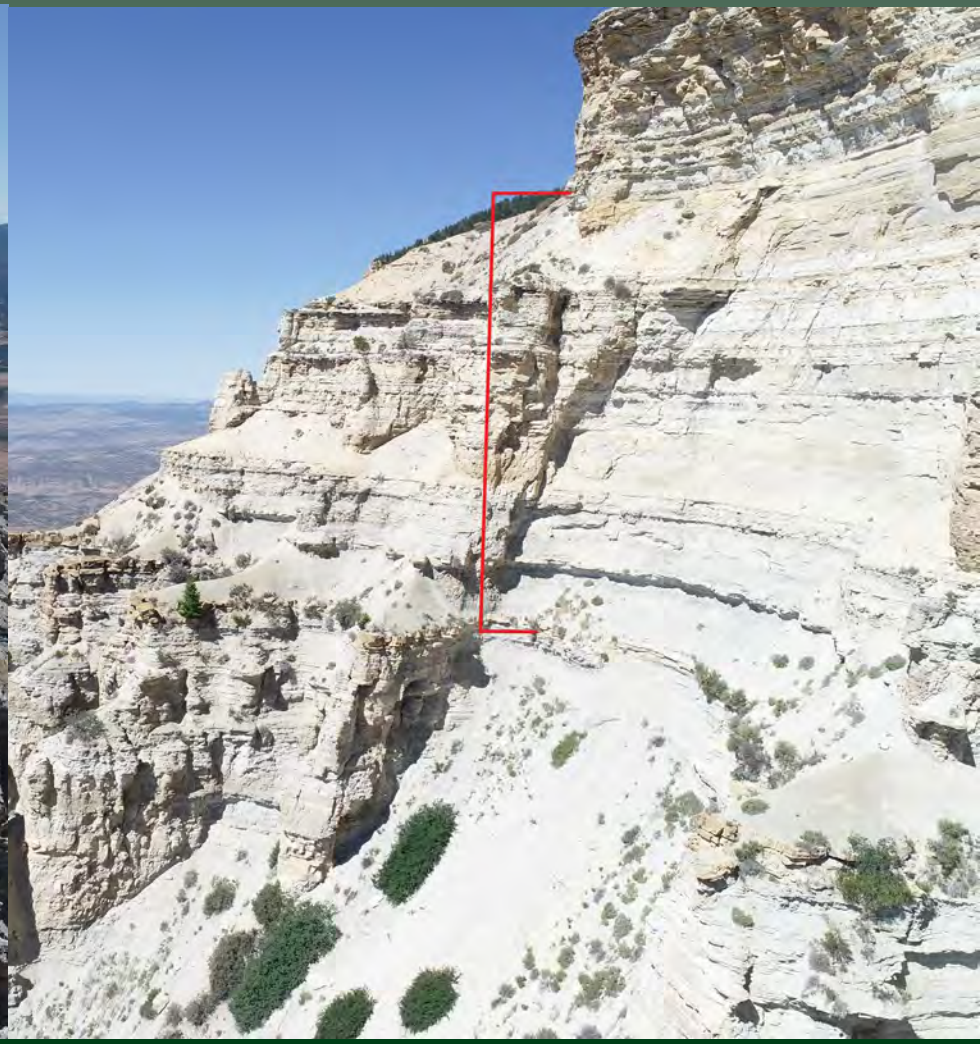
UAS Flight Locations
P. debilis Occurences
Primary Study Area

N

0 10 20 km

Drone Surveys of Suitable Habitat





What We Are Looking For:



Flying Altitude Matters!

1mm per pixel = 4m alt. RGB



3.4mm per pixel = 13m alt. RGB



5.8mm per pixel = 8m alt. MX



Multispectral Analysis

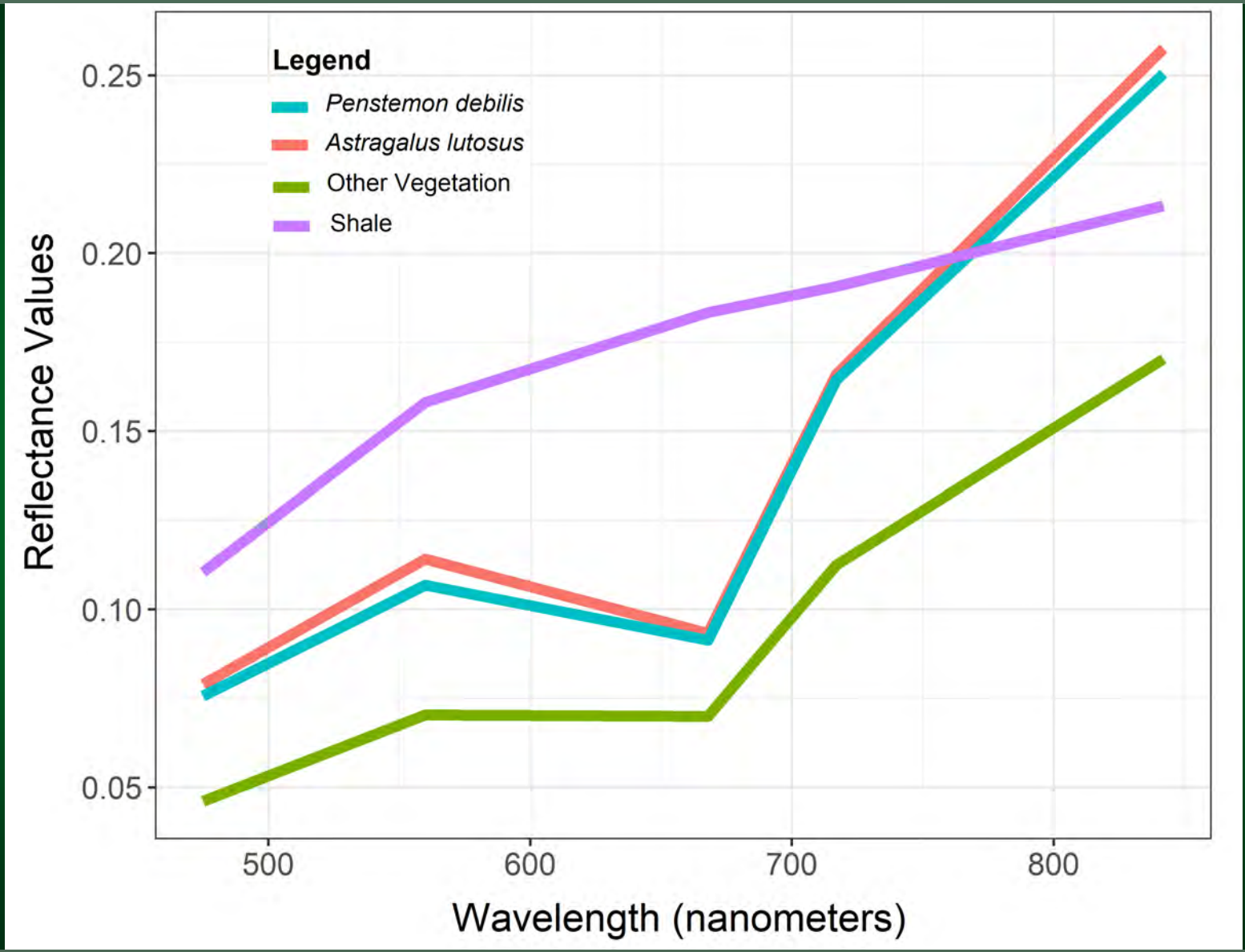
Astragalus lutosus



Penstemon debilis



Multispectral Analysis



Orthomosaic Over Known Location

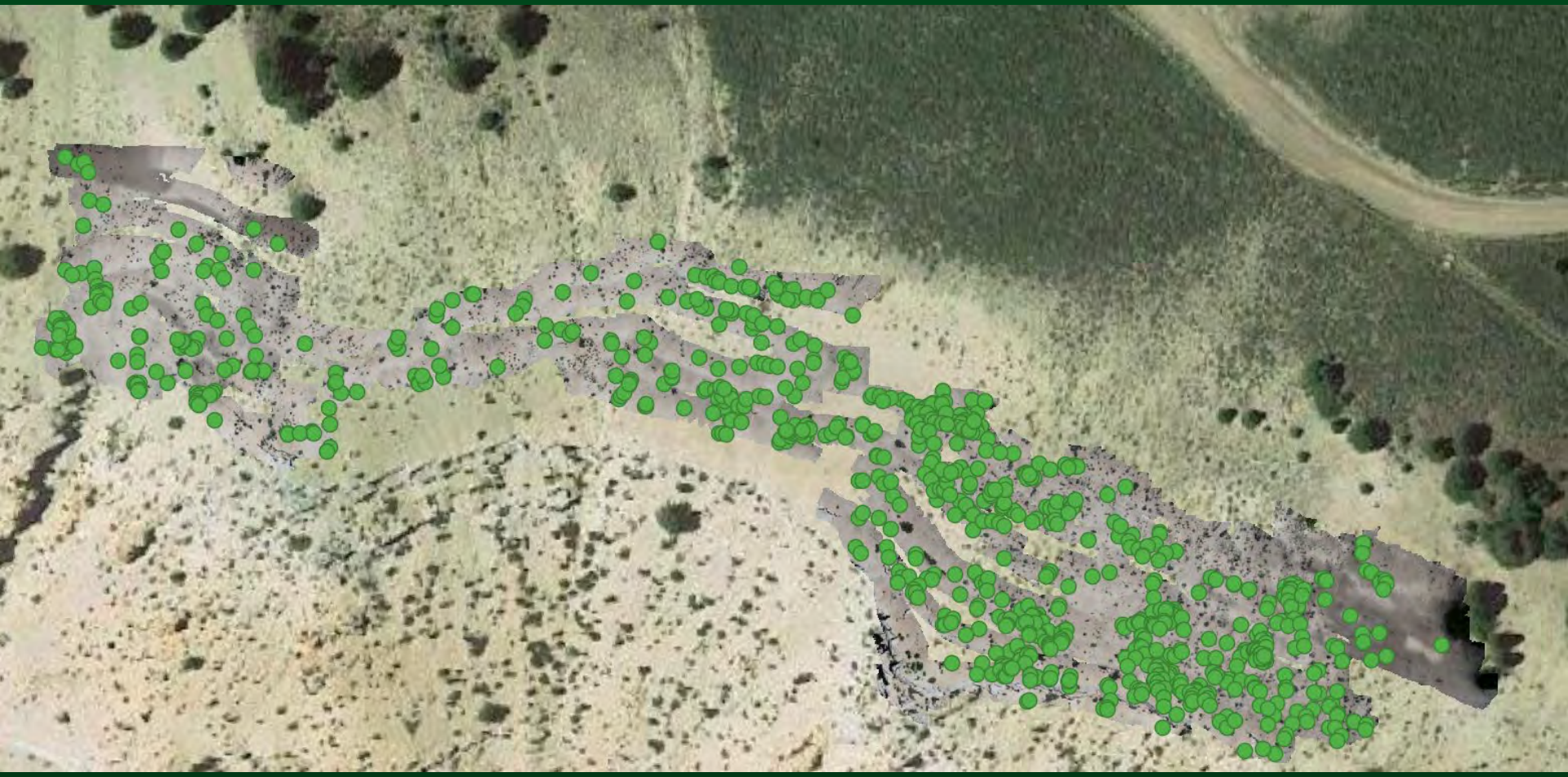


Plants in the Orthomosaic



Penstemon debilis **plant identified in 2mm orthomosaic.**

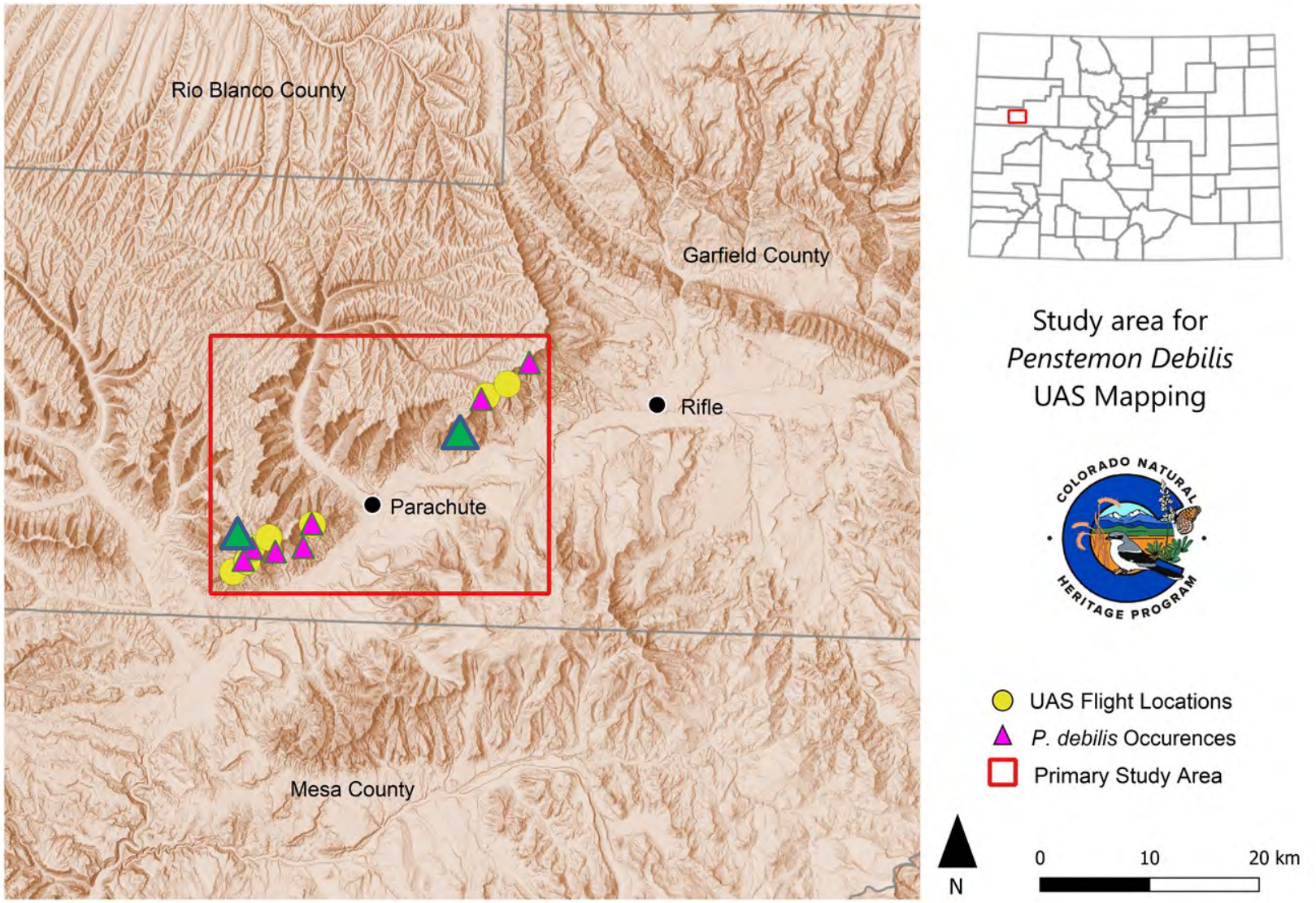
887 Flowering *Penstemon debilis* identified



Results

- Aerial surveys over 600 acres
- 100 flights
- 40,000+ images
- Inspected 14.29 acres of orthomosaics
- Detected 1604 ‘new’ *Penstemon debilis* plants
- 7 new mapped locations
- 2 new element occurrences

Results


Rio Blanco County
Garfield County
Rifle
Parachute
Mesa County
Study area for
Penstemon Debilis
UAS Mapping
COLORADO NATURAL HERITAGE PROGRAM
UAS Flight Locations
P. debilis Occurences
Primary Study Area
N
0
10
20 km

Drone Survey Pros

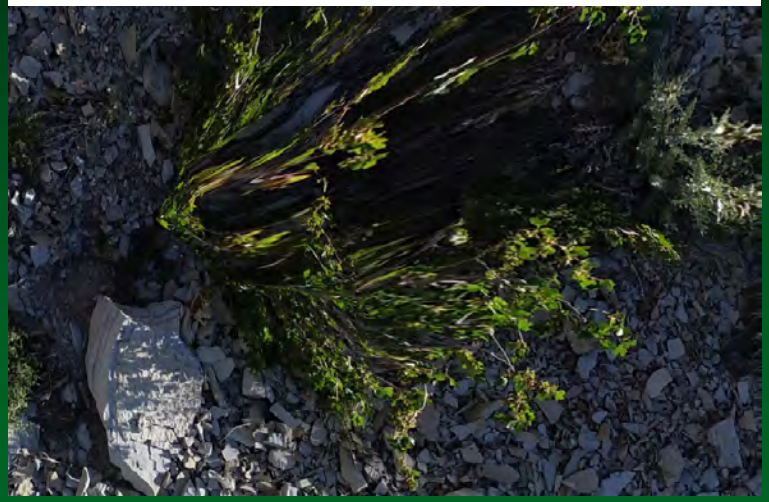
- Explore inaccessible habitat
- No disturbance to the shale slopes or plants
- Keep botanists safe from cliffs
- Georeferenced plant locations ~ tracking through time
- **Find new plants!**

Drone Survey Cons

- Orthomosaic blurring
- Shadows and lighting issues
- Orthomosaic processing time
- Difficult to automate plant counts
- Line of sight requirements

Drone Monitoring Cons

Orthomosaic Blurring



Limits to resolution



Lighting Changes



Upcoming Work:

- Continue multispectral classification exploration
- Survey new areas of suitable habitat
- Investigate potential for monitoring





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- EcoloGIS

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