

# Keeping Invasives at Bay

## Youngs Bay Aquatic Invasive Plants Project

Graham Klag – North Coast Watershed Association  
Narayan Elasmar – Columbia River Estuary Study Taskforce  
Carla Cole – Lewis and Clark National Historical Park

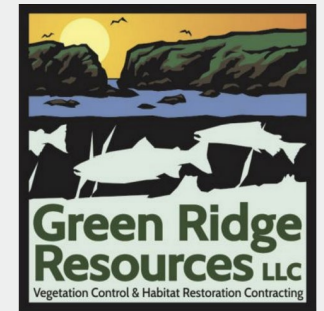




# KIAB Mission



- The mission of Keeping Invasives at Bay is to control the spread of Purple loosestrife (*Lythrum salicaria*) and Yellow flag iris (*Iris pseudacorus*) in Youngs Bay.
- To support this effort, drone-based aerial photography is used to map the Area of Potential Effect. After the imagery is processed, Geographic Information Science (GIS) geoprocessing tools are applied to identify the invasive plant species across the landscape.
- Identified patches are prioritized for treatment, and a contractor uses navigation software to locate and treat in the field.



# Strategic Partnership

## Lewis & Clark National Historical Park (LEWI)

- FUNDER
- Logistics consultant
- Provided dedicated battery charging space

## North Coast Watershed Association (NCWA)

- Geoprocessing
- GIS analysis
- Cartography

## Columbia River Estuary Study Taskforce (CREST)

- Drone operator
- Ground survey crew
- Post-process imagery

## Green Ridge Resources LLC

- Licensed applicator
- On the ground crew to conduct treatments
- Treatment tracking in ArcGIS Field Maps



Team up to **Track**, **Target**, **Treat** invasive species in Youngs Bay

# Project History



- Cooperative Agreement Between LEWI and the NCWA from 2022 to 2027
- Building off of previous treatments conducted with Clatsop Soil and Water Conservation District in 2016
- Evolving workflow and case study for NCWA, LEWI, CREST and Green Ridge Resources
- First full work flow utilized in later this month!

Table 1: Skipanon- Point Description

FID	Species	Description	Date-Time	Longitude	Latitude
1573	JKW	JKW10X60	2016-08-29T17:35:11Z	-123.914884	46.16654
950	JKW	JKW20X20	2016-05-31T17:27:00Z	-123.923248	46.18721
953	JKW	JKW30X70	2016-05-31T18:07:35Z	-123.923585	46.18548
949	JKW	JKW30X80	2016-05-31T17:06:07Z	-123.923655	46.18616
951	JKW	JKW40X60	2016-05-31T17:39:03Z	-123.923542	46.186
788	PLS	PLS100X120	2016-04-20T17:33:40Z	-123.90412	46.1756
1513	PLS	PLS100X120	2016-08-17T20:58:18Z	-123.907131	46.18085
1531	PLS	PLS100X120	2016-08-22T19:25:43Z	-123.904944	46.17048
757	PLS	PLS100X400	2016-04-18T19:34:06Z	-123.903856	46.17283



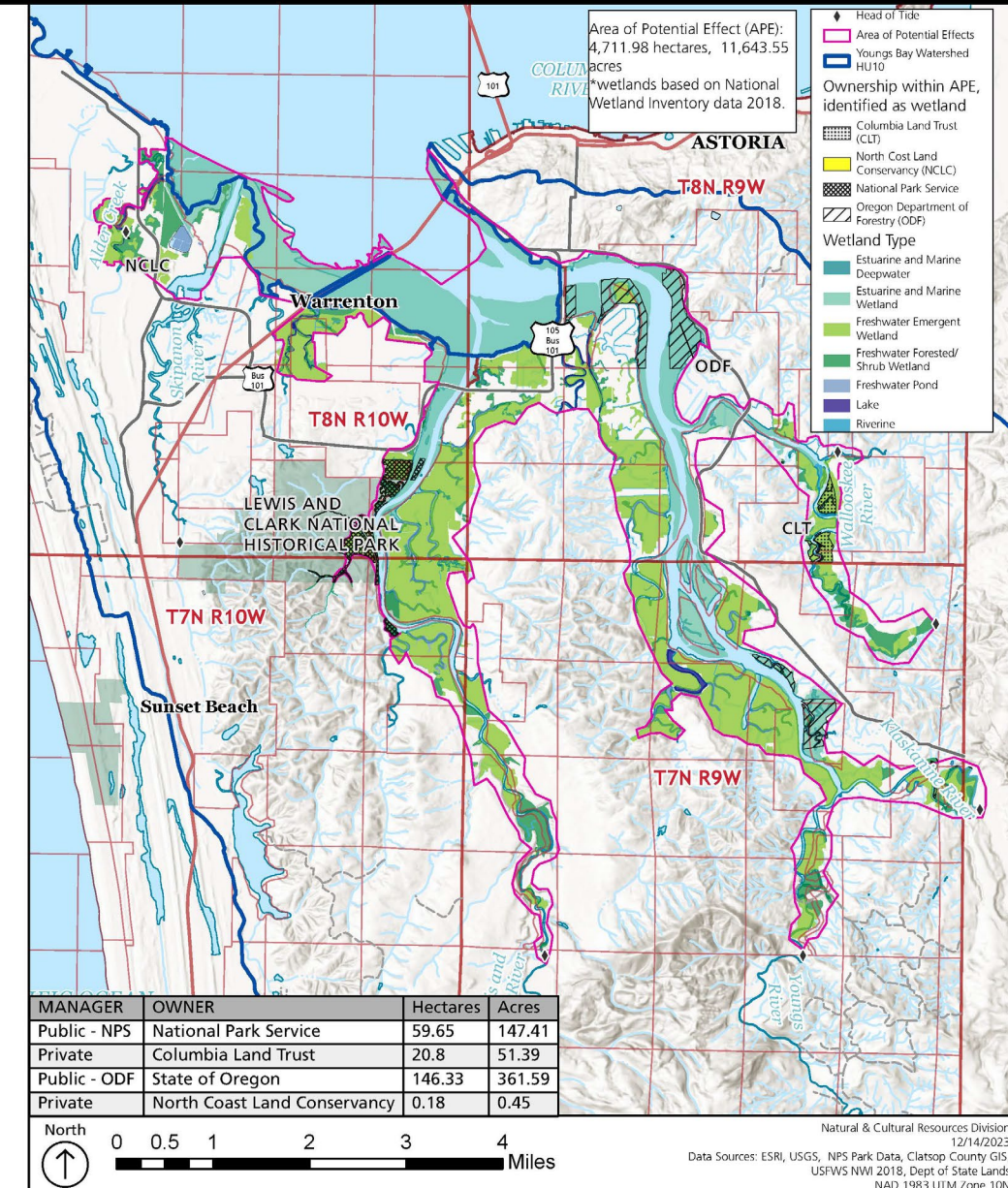


## Area of Potential Effect

Area of Potential Effect (APE) within Youngs Bay  
11,643.55 acres, where Purple loosestrife and  
Yellow flag iris can proliferate

The Stakeholder properties account for 561  
acres and include LEWI, Oregon Department  
of Forestry (ODF), North Coast Land  
Conservancy (NCLC), and Columbia Land Trust  
(CLT).

Priority is given to Stakeholder properties





# TARGETS



Dana Visalli, UW Burke Museum Herbarium

Purple loosestrife  
*Lythrum salicaria*



Dana Visalli, UW Burke Museum Herbarium



Craig Althen, UW Burke Museum Herbarium

Yellow Flag Iris  
*Iris pseudacorus*



Clayton J. Antieau, UW Burke Museum Herbarium



# TREAT - KIAB Year 1 Treatment



- Green Ridge Resources – Licensed applicator
- Tablet with ArcGIS Quick Capture for treatment tracking
- Tank mix consisted of 1.5% volume to volume mix of aquatic labeled imazapyr (Polaris™), 0.75%
- Volume to volume mix of Agridex surfactant, and hi-light blue



\* Content by Aaron Duzik, Green Ridge Resources



## 2022 Skipanon-101 Iris/loosestrife foliar treatment data

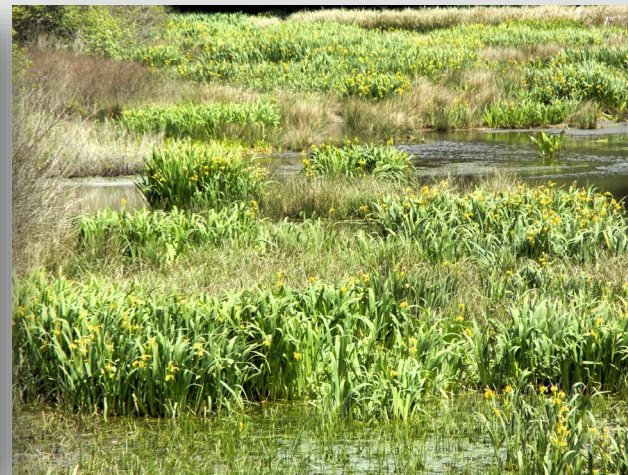
Date	Start	Temperature	Wind	Tank Mix*	End
09/20/22	08:10	54°F Clear	N 1mph	35 gallons	16:30

Date	Start	Temperature	Wind	Tank Mix*	End
09/21/22	08:15	54°F Foggy	E 3mph	70 gallons	16:15

Date	Start	Temperature	Wind	Tank Mix*	End
09/22/22	08:15	56°F Overcast	S 8mph	35 gallons	16:20

Date	Start	Temperature	Wind	Tank Mix*	End
09/23/22	08:45	59°F Overcast	calm	30 gallons	16:45

Date	Start	Temperature	Wind	Tank Mix*	End
09/29/22	08:10	61°F Overcast	N 2mph	60 gallons	16:30

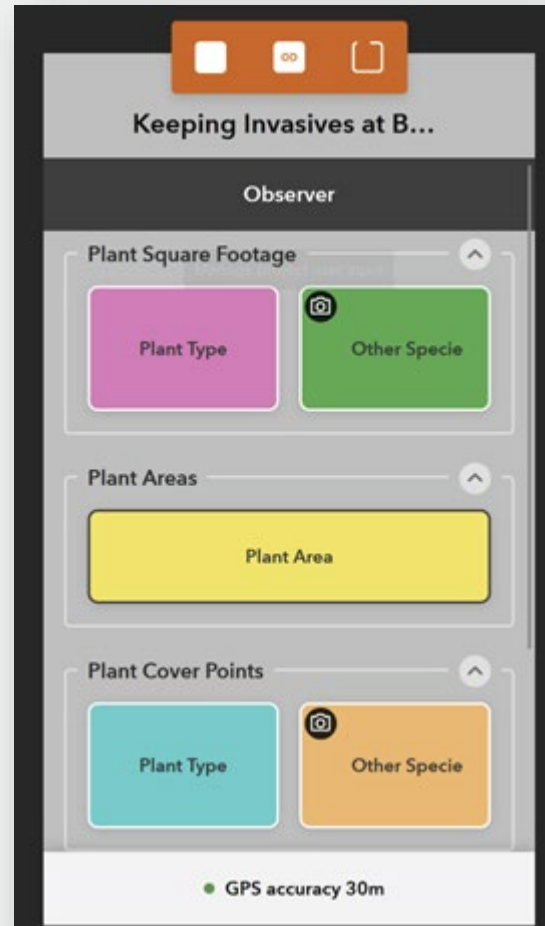




# TREAT



- Green Ridge Resources – Initial treatment in 2022
- Pre-Drone flights
- ArcGIS Quick Capture application developed for contractor
- Point and line data on treatments and plant species
- To be used in ground truthing further work





# TRACK - KIAB Year 1 Remote Sensing



Year 1 was a scaled back learning year

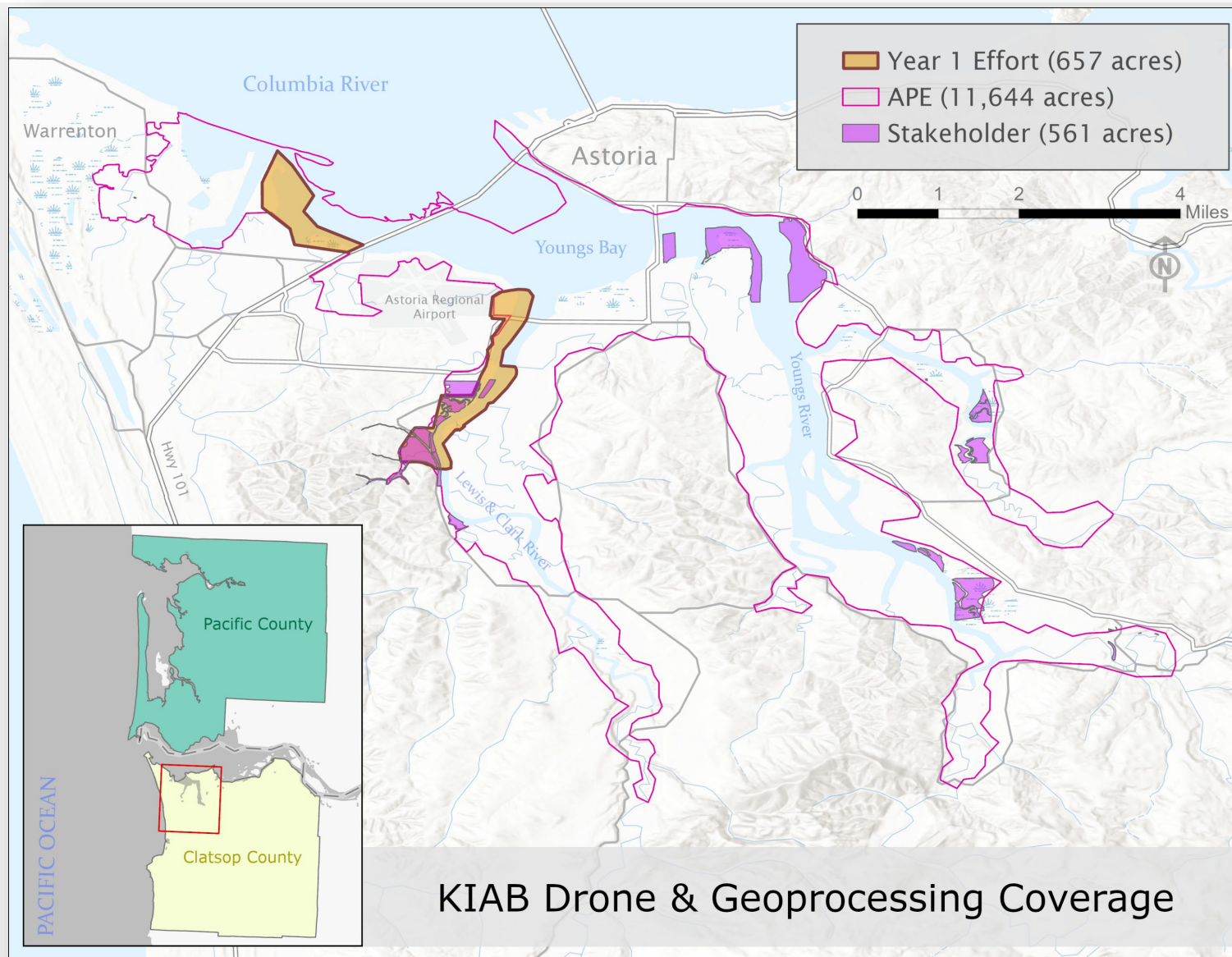
Focused our effort on Public Lands

- Youngs Bay confluence (DSL)
- Lewis & Clark River from confluence to LEWI (DSL, ODF, & LEWI properties)

Only used RGB sensor

Targeted Purple loosestrife ONLY

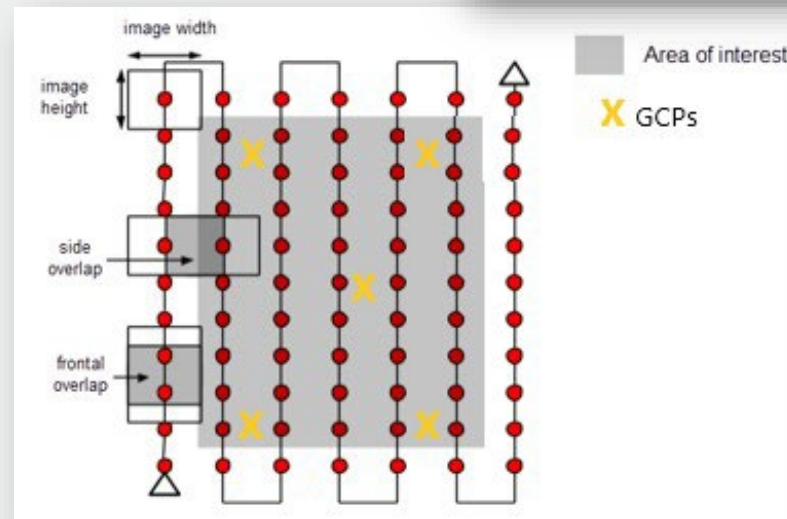
Refined the geoprocessing to detect Purple loosestrife flowers with RGB orthomosaics



# TRACK



- Department of Defense (DoD) National Defense Authorization Act (NDAA) compliant drone and sensors
  - Inspired Flight 800 Tomcat
  - Sentera 65R RGB
  - Sentera 6x Multispectral
- Fly grid pattern over site
  - Photo capture interval = 2 seconds
  - Altitude = 250 ft AGL (GSD = 0.4 inches/pixel)
  - Front & side overlap = 80%





# TRACK



- Ground Control Points (GCPs) deployed to improve geospatial accuracy of orthomosaics
- Q Ground Control
  - Mission Planning
  - Autonomous flight control
- Post-processing with Pix4D
  - Stitch photos collected from grid pattern
  - Georeference orthomosaic with GCP's







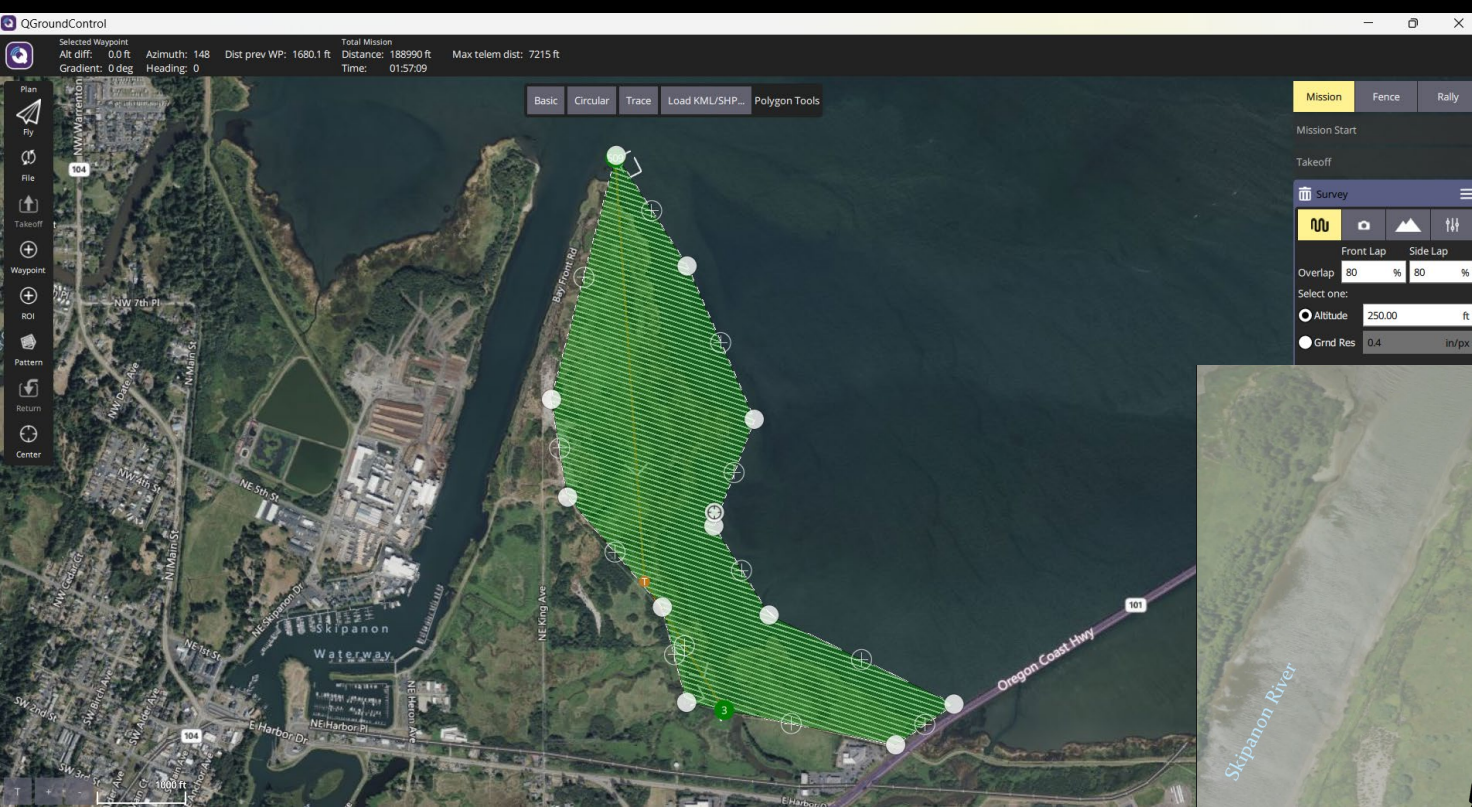








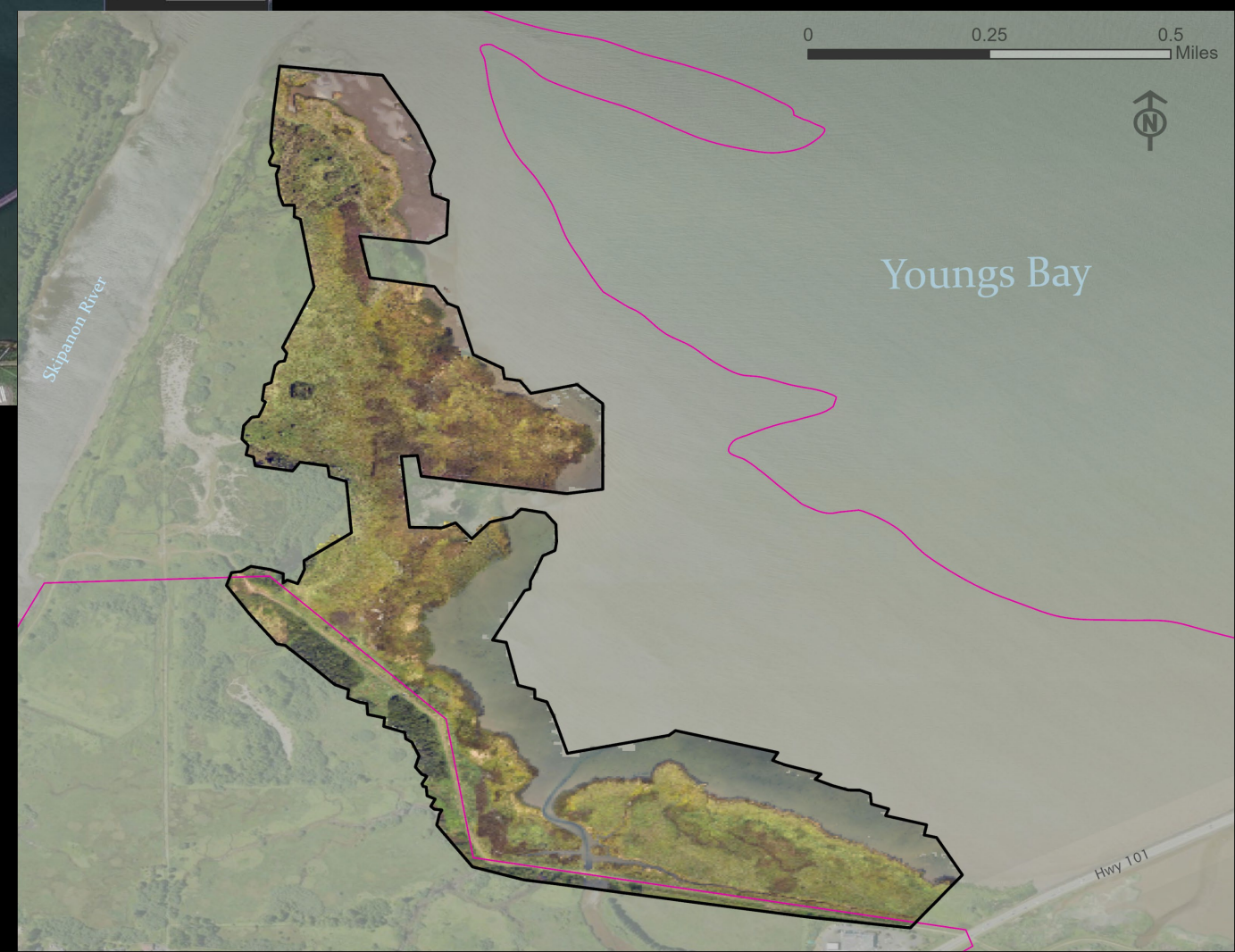




# Skipanon River to Hwy 101

## Orthomosaic

- 252 acres
- 2,291 photos





# Orthomosaics

- Covered 658 acres over 5 days
- Collected 6,758 photos
- Orthomosaics & DEMs ~ 550gb



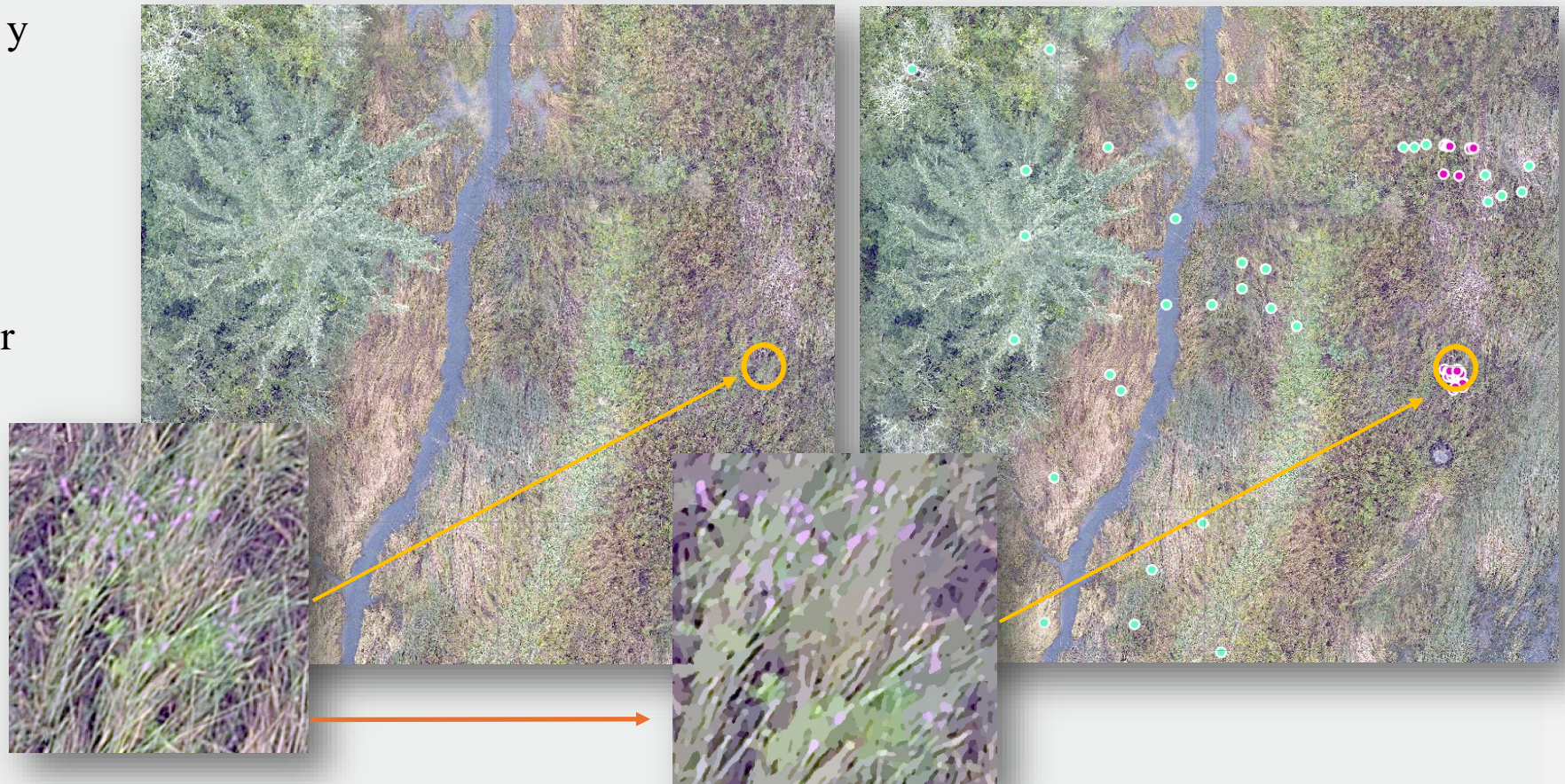


# TARGET



## Raster Data Interpretation with 2024 Orthophotos in ArcGIS Pro

- Image classification by segmentation to identify Purple loosestrife as RGB pixels
- Classification used for model trainings and location validation





# TARGET



## Critically Imperiled Plant Profile (Not Listed or Proposed under the Endangered Species Act)

*Lomatium ochocense*, Ochoco lomatium

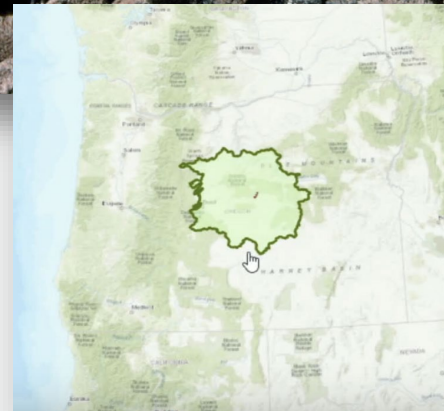
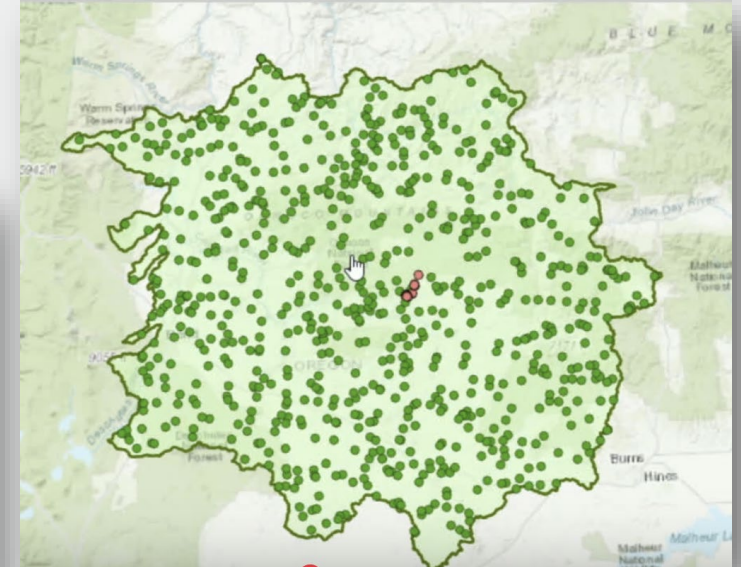
### Threats

- Not yet assessed by NatureServe

### Conservation Status

- [NatureServe Global Conservation Status: G1](#)

Workflow utilized by Nature Serve, Oregon Biodiversity Center and PSU to create a species distribution map to help predict the presence of rare native plants based on field verification



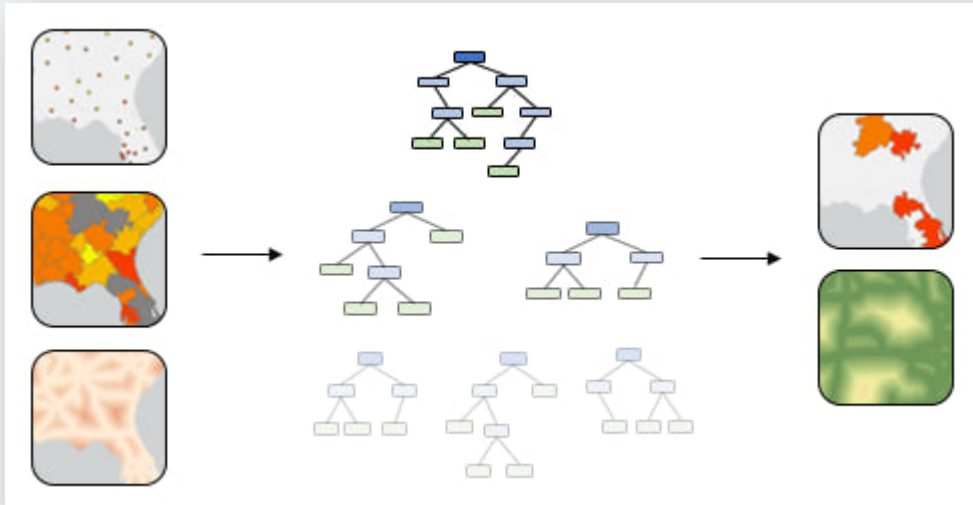


# TARGET



## Forest-based and Boosted Classification and Regression

- Spatial statistics on raster datasets
- Categorical training data on presence and absence data from image classification and pixel segmentation
- Training model to prediction



Geoprocessing

Forest-based and Boosted Classification and Regression

Parameters Environments

Prediction Type  
Train only

Model Type  
Forest-based

Input Training Features  
PI\_Merge\_2024

Variable to Predict  
Presence

☒ Treat Variable as Categorical

☐ Include All Prediction Probabilities

Explanatory Training Variables  
Variable  Categorical ☐

Explanatory Training Distance Features

Explanatory Training Rasters

Raster	Categorical
KIAB_L&CR_AMCo to Otter Point_trans	<input type="checkbox"/>
KIAB_L&CR_Mouth to AMCo_transparer	<input type="checkbox"/>
KIAB_L&CR_OtterPoint to Colewort_trar	<input type="checkbox"/>
Highest_Hits_LYB.tif	<input type="checkbox"/>
Highest_Hits_NC.tif	<input type="checkbox"/>
Bare_Earth_NC.tif	<input type="checkbox"/>
Bare_Earth_LYB.tif	<input type="checkbox"/>

Output Trained Model File

Run

Geoprocessing

Forest-based and Boosted Classification and Regression

Parameters Environments

Prediction Type  
Predict to raster

Model Type  
Forest-based

Input Training Features  
PI\_Merge\_2024

Variable to Predict  
Presence

☒ Treat Variable as Categorical

☐ Include All Prediction Probabilities

Explanatory Training Rasters

Raster	Categorical
KIAB_L&CR_AMCo to Otter Point_trans	<input type="checkbox"/>
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Highest_Hits_NC.tif	<input type="checkbox"/>
Bare_Earth_NC.tif	<input type="checkbox"/>
Bare_Earth_LYB.tif	<input type="checkbox"/>

\* Output Prediction Surface

Match Explanatory Rasters

Prediction	Training
KIAB_L&CR_AMCo to Ott	KIAB_L&CR_AMCo to Otter Point_tran
KIAB_L&CR_Mouth to AM	KIAB_L&CR_Mouth to AMCo_transpare

Run

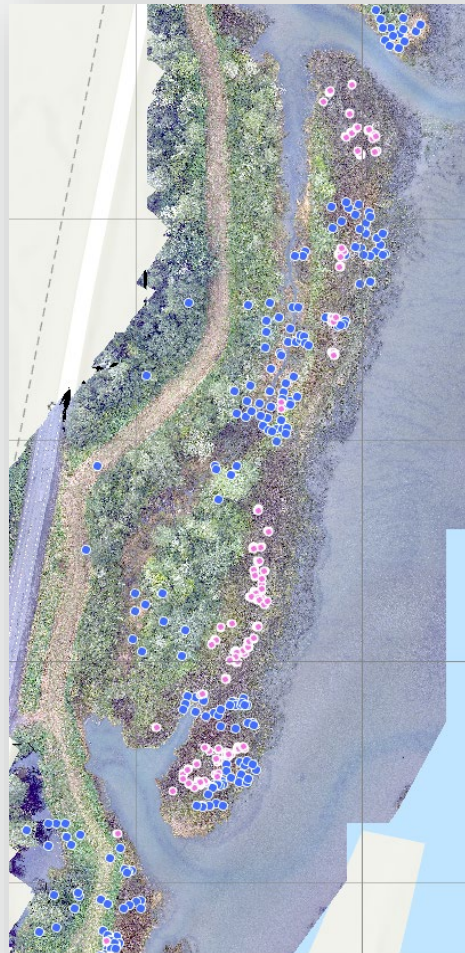


# TARGET



## Forest-based and Boosted Classification and Regression

- Presence and absences of species as points identified in ArcGIS Pro as categorical points.
- Other explanatory variables include Orthomosaics, and DOGAMI Lidar data used to train model
- Training model outputs used to run predictive raster outputs.
- Predictive raster outputs help to locate other areas of interest, protection and possible treatment



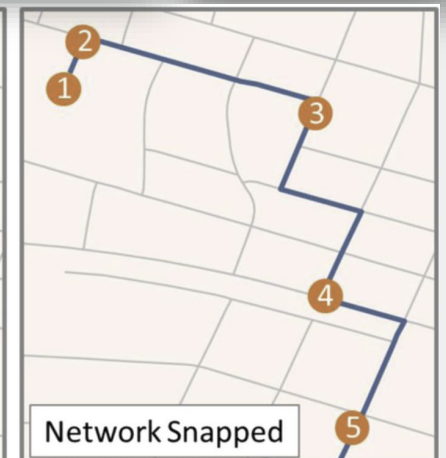
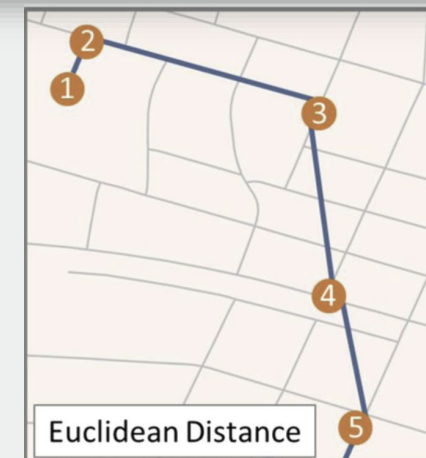
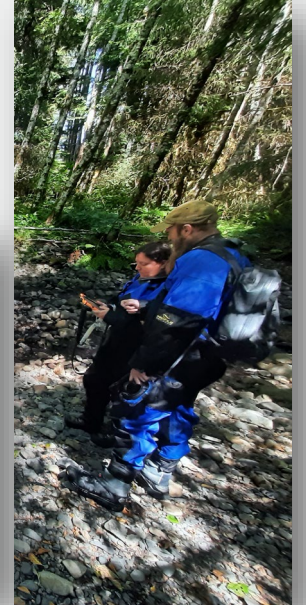


# TARGET



## ArcGIS Field Maps and Field Work

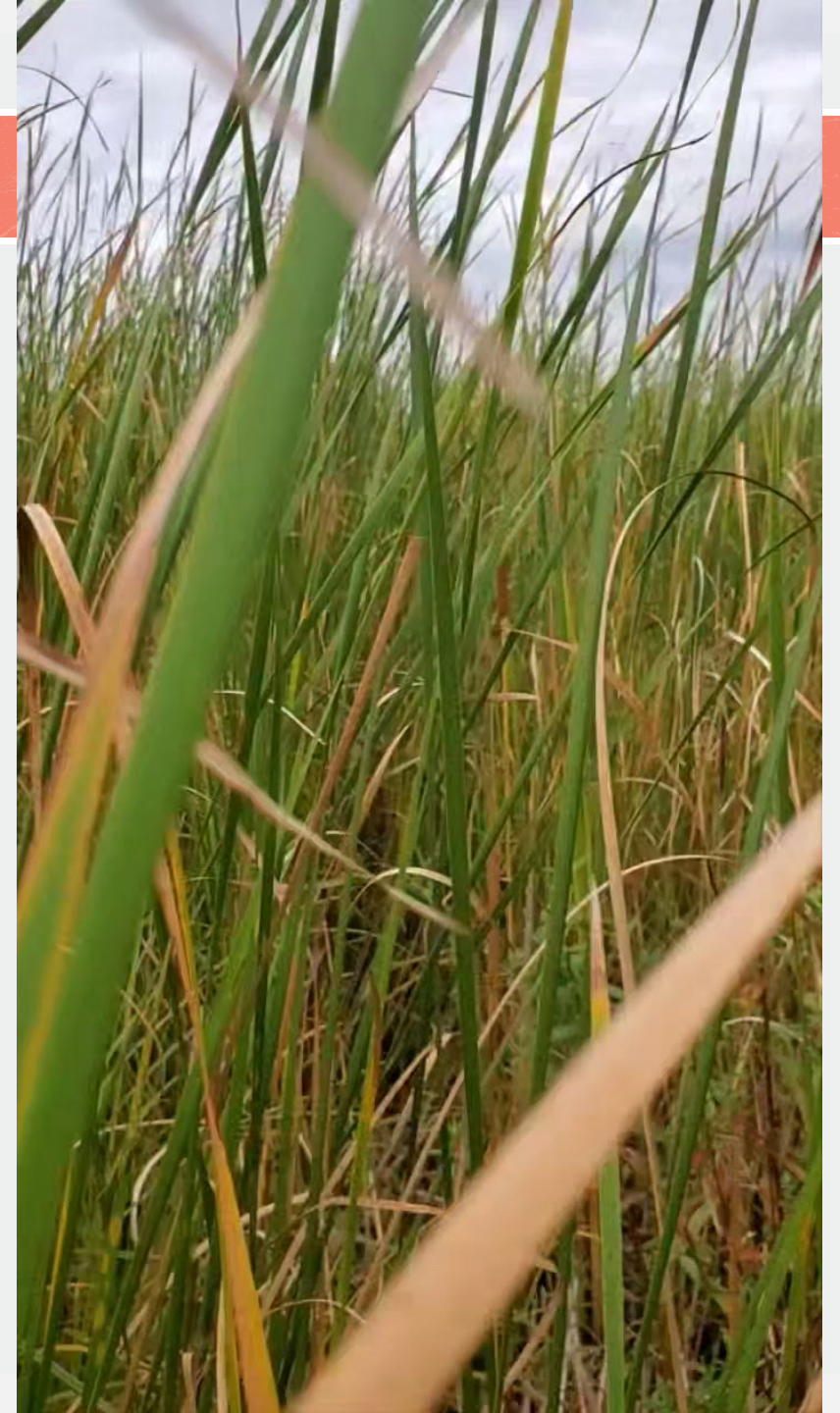
- Raster predictions, segmented pixels and validated presence used together to generate final treatment polygons for 2025 treatment areas
- Field Maps display of polygons treatment areas with a Euclidean distance calculation of the least cost path between patch locations based on bare ground elevation and patch distance
- Application of herbicide and ground truthed paths tracked to help calculate future project cost and the relationship of treatments to the model.





# Lessons Learned

- Detection of flowers are adequate with RGB but not for leaf detection
- More robust ground-truthing effort
- Increase the acreage covered by starting earlier in the season
- Flying in Astoria Regional Airport controlled airspace has permitting challenges
- Post-processing imagery takes forever!
- Spatial Statistics on Raster Data





# Next Steps



- Collect multispectral imagery to potentially detect the leaves of invasives
- Include and target Yellow flag iris in Year 2 May - June
- Keeping Invasives at Bay is a multi-year pilot project with enormous potential to use the framework in other watersheds.
- The first year of KIAB was a learning year that was successful at a smaller scale





# Acknowledgements and Thank Yous



- Lewis & Clark National Historical Park – Carla Cole & Kayla Fermín
- Green Ridge Resources – Aaron Duzik
- Oregon Department of State Lands
- Esri support, Nature Serve, Oregon Biodiversity Center and PSU

# Q U E S T I O N ?