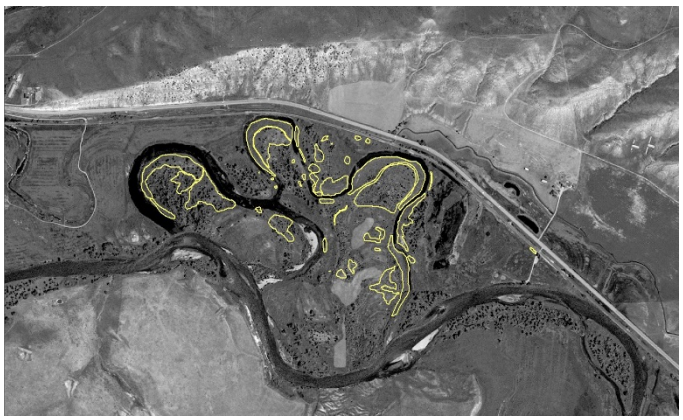
Update on Remote Sensing Imagery for Yampa River Leafy Spurge Mapping - 11/10/2020

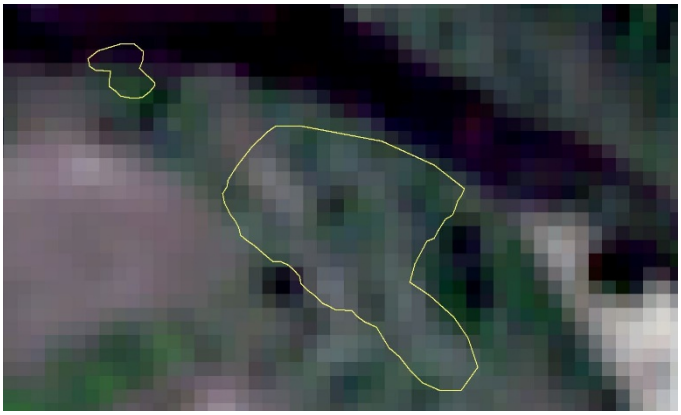
We have completed the following tasks to map leafy spurge from multispectral satellite imagery along the Yampa River corridor:

1. Pan-sharpened satellite imagery
   - We used a finer resolution panchromatic band (1.5m x 1.5m pixels) to separate and resample multispectral imagery (red, green, blue, and near infrared (NIR), 6m x 6m pixels) to create smaller pixels.
   - The pan-sharpening method used was ESRI,
   - Final, pan-sharpened imagery resulted in approximately 1.5m x 1.5m pixels in a stack of bands 1-4, red, green, blue, and NIR.



Panchromatic imagery, 1.5mx1.5m pixels

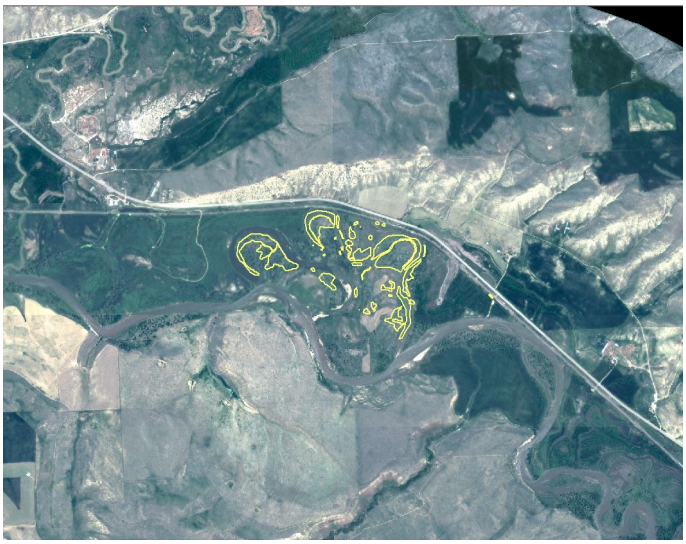
Multispectral color composite imagery, 6m x 6m pixels

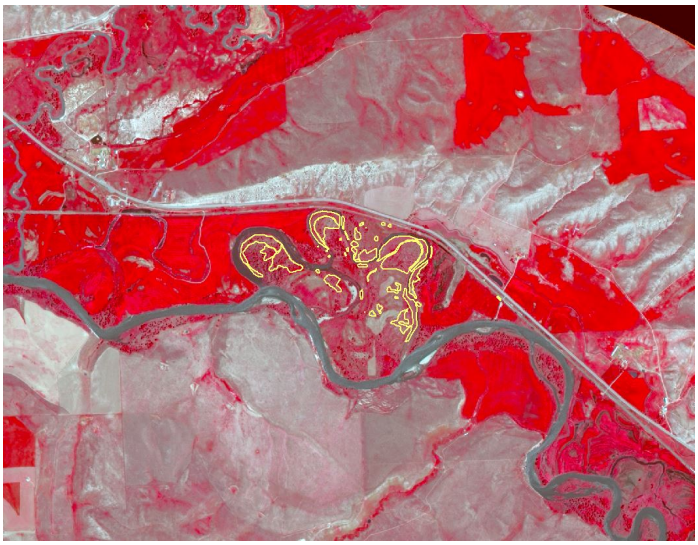


Original color composite, 6m x 6m pixels

Pan-sharpened color composite, 1.5m x 1.5 m pixels

2. Interpreted imagery, using multiple band combinations
   - By recombining band display options, different imagery attributes can be highlighted
   - Band combinations used include the following, shown below:
     - Red, green, and blue = 1, 2, and 3 – Regular color composite, true color
     - NIR, red, green = 4, 1, 2 – False color infrared





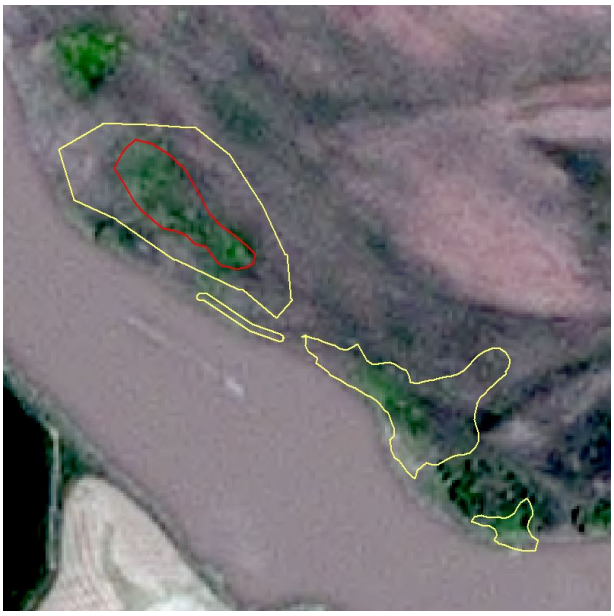
3. Altered imagery contrast, brightness, and gamma
    - These are all image display properties that can be altered to further differentiate between subtle spectral changes

Default imagery color

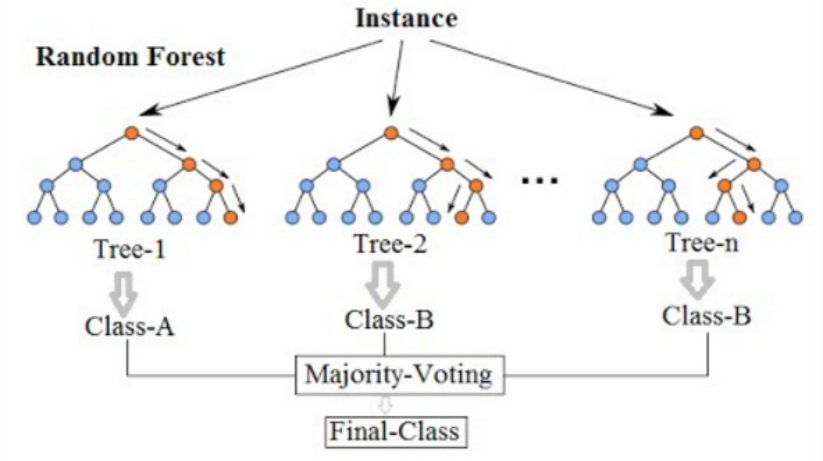
Default color composite with gamma stretch

90% clip color composite with gamma stretch, this was used for imagery interpretation due to the sharp contrast of mapped leafy spurge populations (in yellow)

4. Built training/validation set
   - The classification method used requires presence and absence points, for training and validation
   - Presence polygons for leafy spurge were digitized, based on extensive mapping on the Yampa River, knowledge of the area, and imagery interpretation (image show, right)
   - Absence polygons were digitized, trying to capture the range of various landcover features, including…
     - Water
     - Irrigated field
     - Buildings
     - Roads
     - Bare ground
     - Rocks (of various, visually different types)
     - Sand
     - Hay fields
     - Trees
     - Other vegetation …Anything in the image that is not spurge



5. Classified imagery
   - The classification method used is called Random Forest, and grows a "forest" of decision trees, with branches splitting and sorting pixels into a set of classes (figure below)



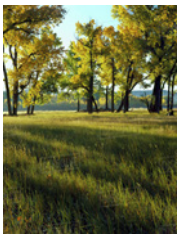
In this figure, the "instance" is a pixel

The various decision trees classify the pixel, using all of the imagery bands

The results of the trees are pooled, and the pixel is classified according to the majority class voted for across all decision trees

   - For this classification, we are classifying pixels as being likely to be spurge or being likely to be not spurge, so a binary classification of "spurge" and "not spurge", though the "not spurge" class will include various landcover classes

- In this classification, 351 trees were grown, to ensure all pixels were classified multiple times
- Resulting internal validation shows 8.24% overall classification error, with lower classification error for “spurge” than for the “not spurge” class
- Overall, this is an acceptable, and encouraging preliminary classification result

			Class Error
	86	4	0.044
	10	70	0.125

6. Assessed classification accuracy with mapped leafy spurge and imagery interpretation

- Specific accuracies and inaccuracies are informative for assessing and improving classification results
- Mapped leafy spurge populations that were missed in the final classification were:
    - Small, or very thin populations
    - Populations that were right against the river’s edge
    - Populations at locations that may move with the river (e.g. sandbars)
- Other landcover classes that were mistakenly classified as leafy spurge were:
    - Irrigated agricultural lands
    - Drainages/streams/irrigation ditches
    - Riparian vegetation, along the river and other waterways
    - Herbaceous upland vegetation
    - Lawns in developed areas
    - Locations from the river channel that MAY be leafy spurge populations
- Landcover classes that were accurately classified as “not spurge” consistently were human development (roads, structures, and disturbances), bodies of water, and forested areas