Identifying visitor impacts to vegetation in open natural landscapes

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GIS 540

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Introduction

- Importance of protected areas
  - Biodiversity conservation = ecosystem function
  - Ecosystem services
  - Socio-economic benefits
- Legal mandates often require management organizations to provide for both conservation and visitor use (Organic Act 1916 (NPS, 2006))
- Protected areas stressed by internal and external ecological and anthropogenic pressures
  - Climate change
  - Encroaching development
  - Intense visitor use → humans and activities altering landscape faster than natural processes

Problem

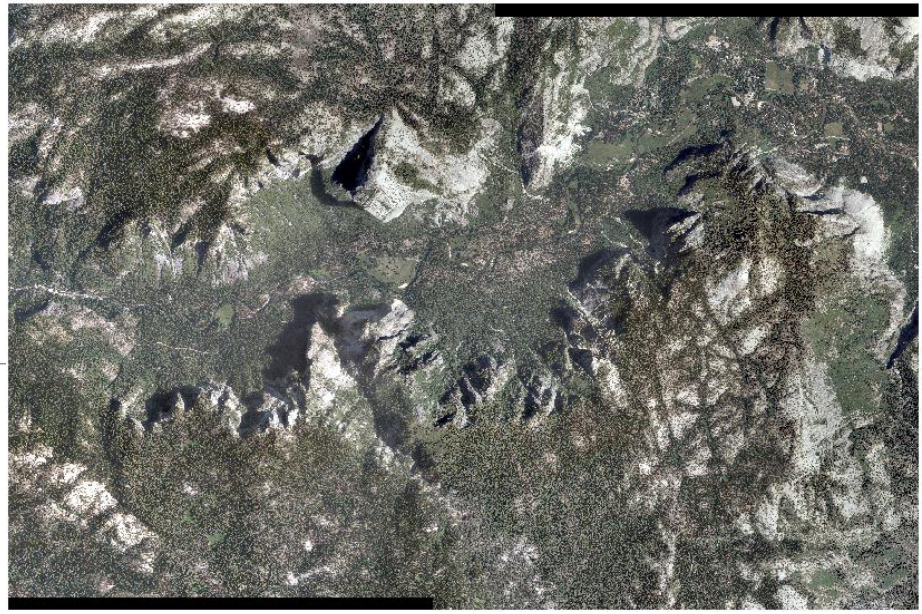
- Vegetation trampling and prevalence of bare ground is a common and perennial management concern
- Either linear corridors or concentrated areas of disturbance (e.g., patches of bare ground)
- Impacts influence the vegetation community structure, alter hydrology, and visually scar the landscape
- Field monitoring (e.g., mapping with GPS) can be time intensive
- Opportunity to test data derived from remotely sensed imagery to expedite the process

Photo credit: Yu-Fai Leung

Photo credit: Roger Putnam

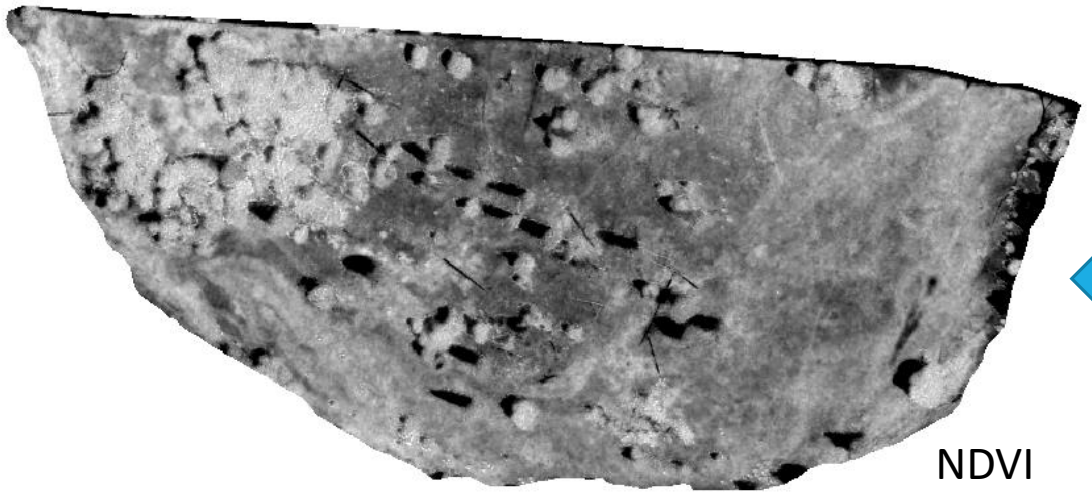
Code

- Code uses one or several orthophotos to:
  - Merge orthophoto(s) into raster mosaic and clip to area(s) of interest
  - Create Normalized Difference Vegetation Index (NDVI) for each area of interest
    - Compares red and near infrared spectral bands to create an index between -1 and 1
    - Values between -0.1 and 0.1 usually identified as bare ground



Raster mosaic of aerial imagery

CIR



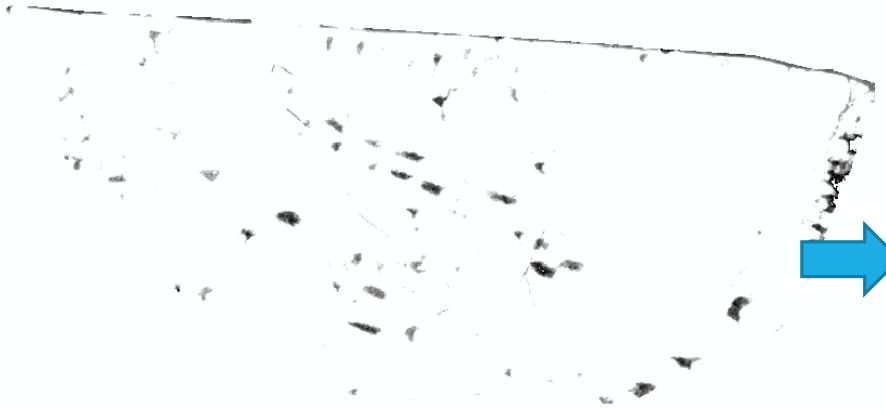
NDVI

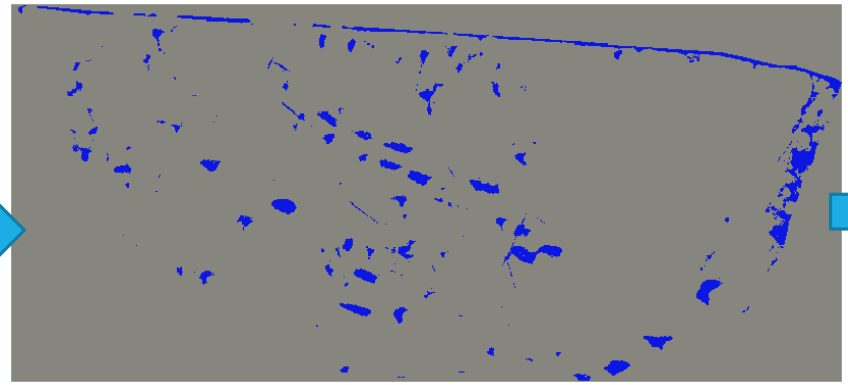
Code

- Use NDVI to extract bare ground values (-0.1 to 0.1) and reclassify those cells to 1 (remaining cells = 0)
  - Cell size defaults to 1 sq. meter → number of extracted cells are equivalent to total area in sq. meters
- Compare extracted values to actual mapped values:
  - Linear disturbance = visitor-created informal trails (buffered by half of the trail width for trail extent)
  - Areal disturbance = polygons of bare ground
  - Merges disturbance files and runs statistics

Contents | Preview | Description

OID	FREQUENCY	SUM_Area_m
0	13	2616.16200829





Cells with values between -0.1 and 0.1

Reclassified to 0 and 1

Actual mapped disturbance

Required Components

Python geoprocessing

- arcpy.ListRasters
- arcpy.Clip_management
- arcpy.sa.Divide
- arcpy.sa.ExtractByAttributes

```
#Establish numerator and denomenator for map algebra and save result
numerator = arcpy.sa.Float(arcpy.Raster(NIR_out) - arcpy.Raster(red_out))
denom = arcpy.sa.Float(arcpy.Raster(NIR_out) + arcpy.Raster(red_out))

NDVI = arcpy.sa.Divide(numerator, denom)
NDVI.save(outNDVI)
print "\t{0} created successfully.".format(outNDVI)
```

Python batch processing ('for' or 'while' loops)

- Several for loops to loop through several input and derived rasters

```
print featureExtract2.calcNDVI.__doc__
arcpy.AddMessage(featureExtract2.calcNDVI.__doc__
newClipRasts = arcpy.ListRasters("*OrthoClip*")
for n in newClipRasts:
    red = n + str(sys.argv[3])
    NIR = n + str(sys.argv[4])
    featureExtract2.calcNDVI (n, red, NIR)
NDVIrasters = arcpy.ListRasters("*NDVI*")
```

Required Components

Code reuse: Define and call at least 3 user-defined reusable functions.

- featureExtract module → meadowClip, calcNDVI and extractValues methods
- deleteRasters module → deleteNAIP, deleteReclass methods

```
def extractValues(inNDVIRast):
    '''Extracting values identified as bare ground (e.g., values between -0.1
    and 0.1) from NDVI raster(s).'''
    inNDVIRastBase = inNDVIRast[:4]
    inSQL = "VALUE <= 0.1 and VALUE >= -0.1"
    bareOut = inNDVIRastBase + "_BareGround.tif"
    extractNDVI = arcpy.sa.ExtractByAttributes(inNDVIRast, inSQL)
    extractNDVI.save(bareOut)
    print "\t{0} created successfully.".format(bareOut)
```

Code reuse: Define a class and instantiate and use an object of this type

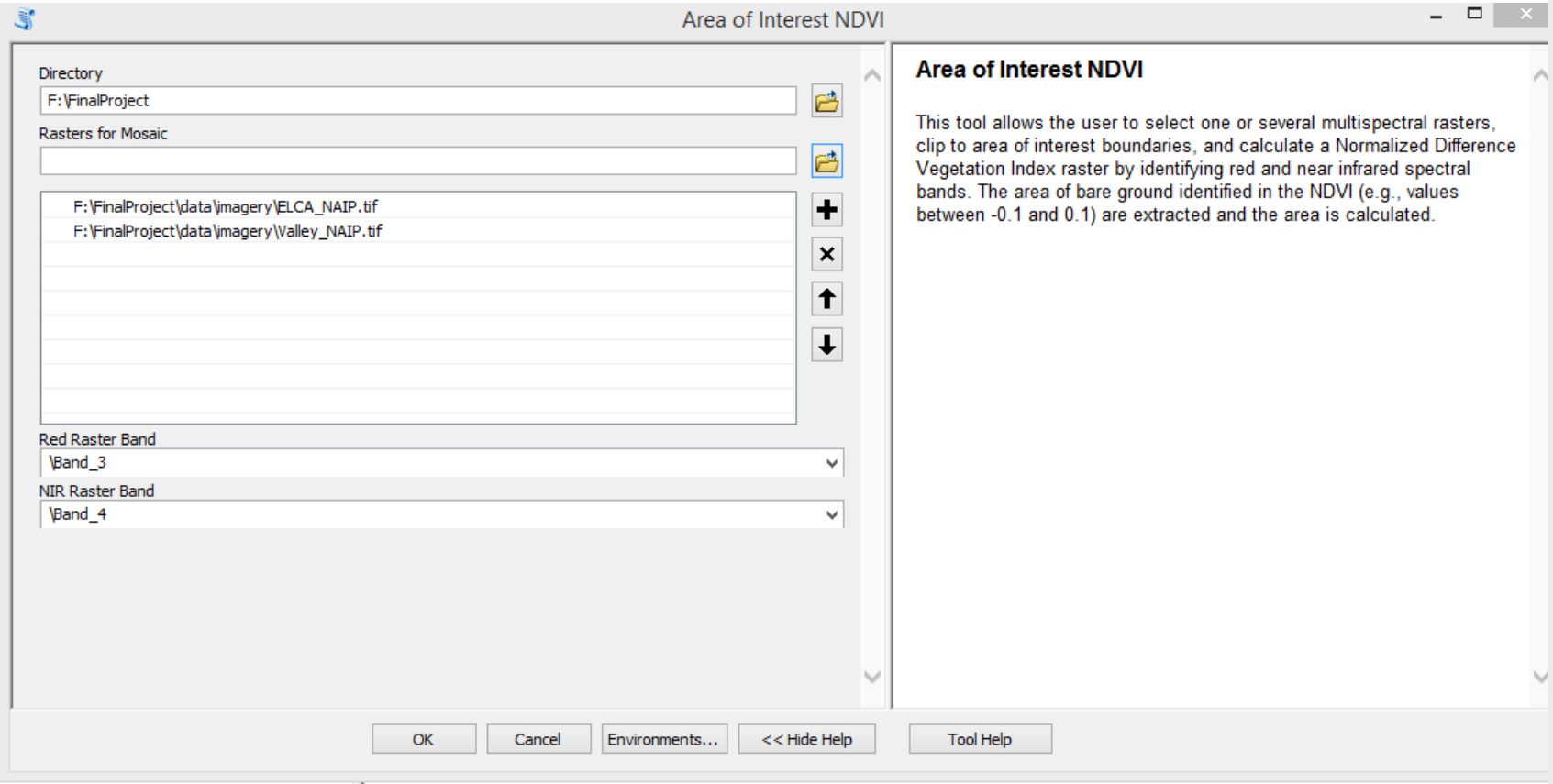
- disturbedFeatures class → identifies id, classification and segment count for mapped informal trails
- Reports number of segments classified as ‘stunted vegetation’, ‘some bare ground’ and ‘barren’ within a given shapefile

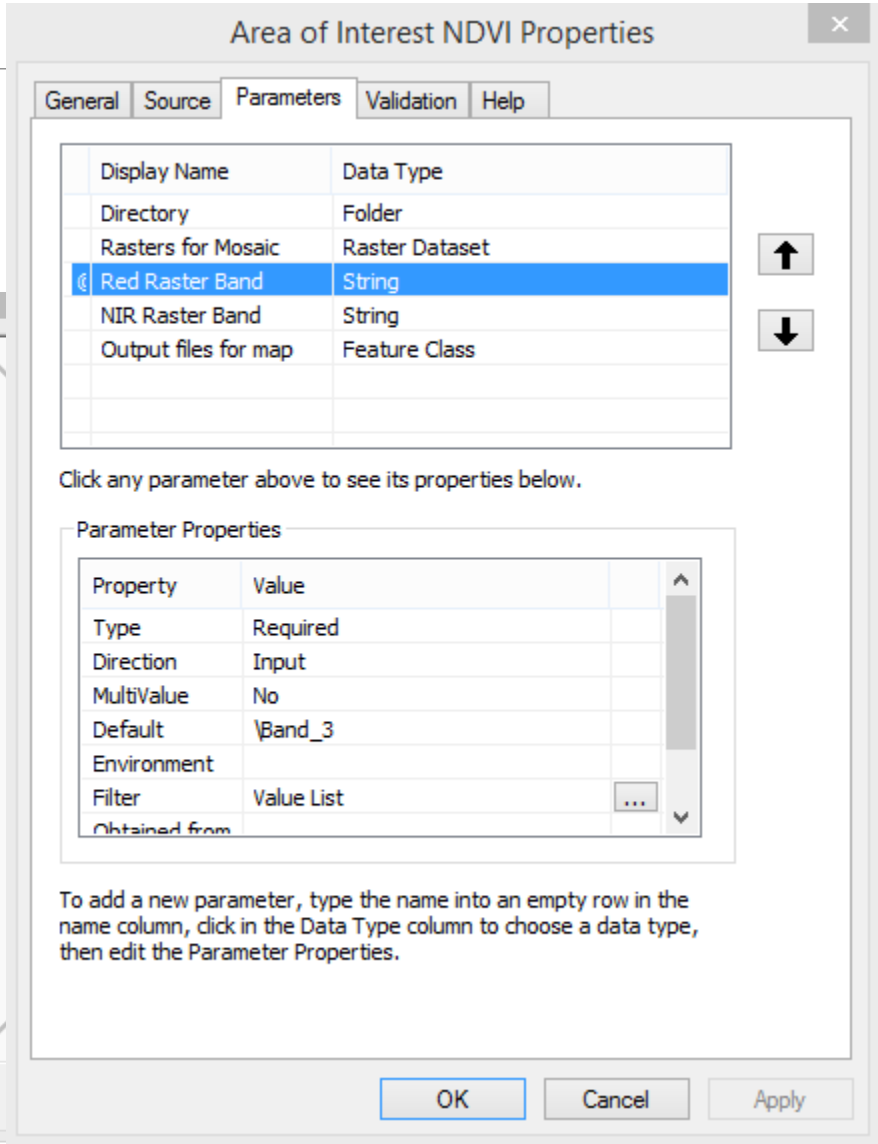
```
class disturbedFeatures:
    def __init__(self, classification, value = 0, numClass = 0):
        '''Initialize informal trail properties.'''
        self.classification = classification
        self.value = value
        self.numClass = numClass

    def addNumClass(self):
        '''Identify a numeric value based on condition class.'''
        if self.classification == "Barren":
            self.numClass = 3
            return self.numClass
        elif self.classification == "Some Bare Ground":
            self.numClass = 2
            return self.numClass
        else:
            self.numClass = 1
            return self.numClass

    def reportCount(self):
        '''Report number of segments by classification type.'''
        message = '\t\t{0} {1} segments identified.'.format(self.value, self.classification)
        print message
        arcpy.AddMessage(message)
```

Required Components

Script tools and properties:

- Area of Interest NDVI script tool



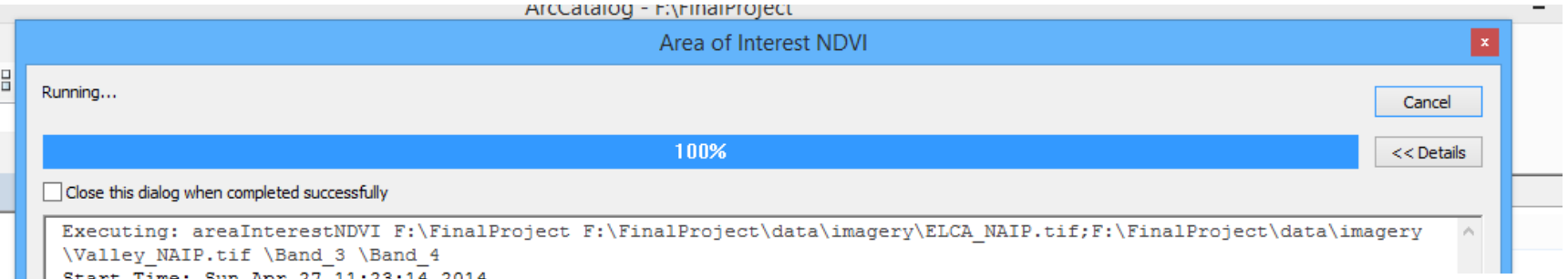


Required Components

Toolbar button for script tool:

Progressor and messages:

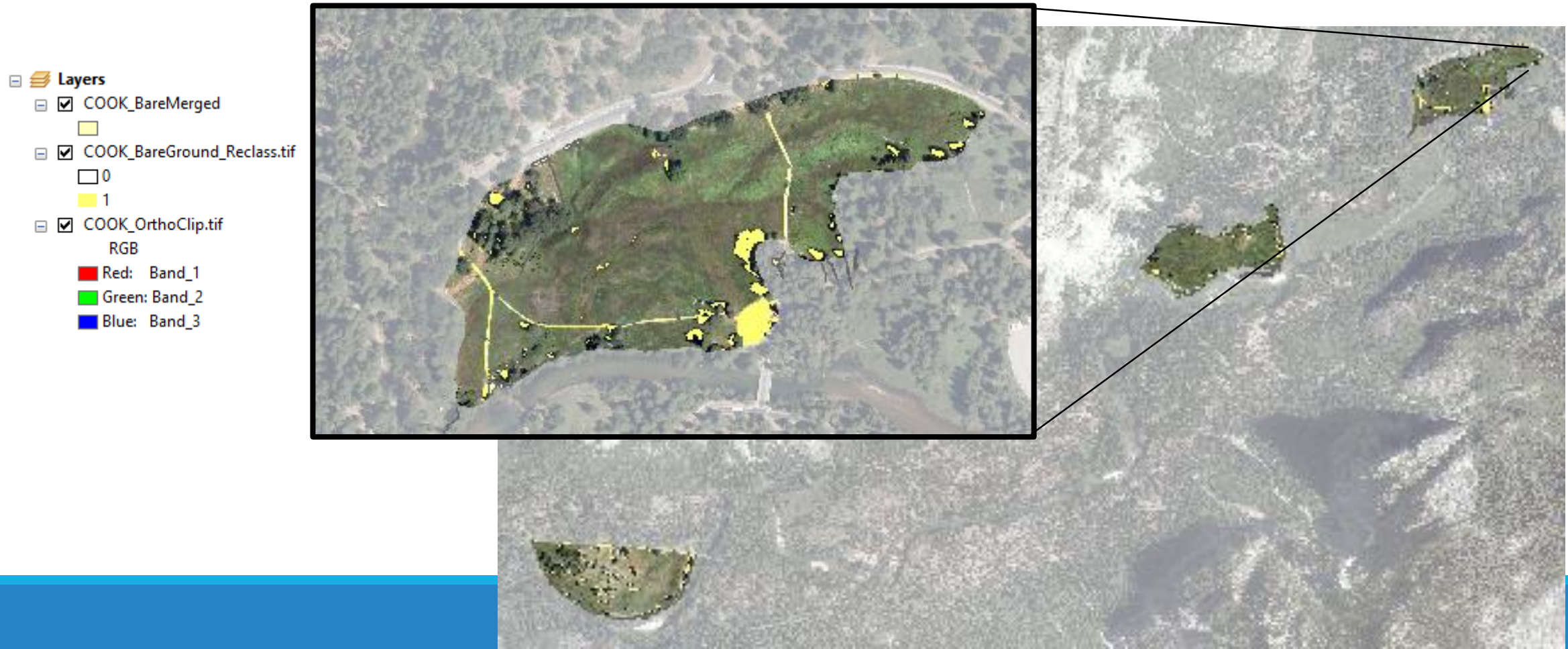
- Doc strings and print message statements move user through progress




```
Breakdown of classified segments in 2011_COOK_S1.shp:
          7 Barren segments identified.
          29 Some Bare Ground segments identified.
          72 Stunted Vegetation segments identified.

Calculating bare ground identified in mapped informal trails.
     Bare ground mapped from informal trails in LEID is 691.48 sq. meters.
     Bare ground mapped from informal trails in ELCA is 1324.40 sq. meters.
     Bare ground mapped from informal trails in COOK is 354.07 sq. meters.
```

Required Components

Automatically display geoprocessing output in the map.



Demo

http://screencast.com/t/ZBZLmL7vYv