Aerial Survey & Classification of Invasive Bush Honeysuckle

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Project Sponsors: Kansas Forest Service, Kansas State Research and Extension, USDA Forest Service

ABSTRACT

Invasive bush honeysuckle is present throughout many Kansas urban and rural landscapes. Because quantitative geospatial data is lacking, persons responsible for managing these infestations must rely on informal and anecdotal data to inform their deployment of limited resources to manage these infestations. To address this lack of quantitative data, the Kansas Forest Service partnered with Kansas State University's (KSU) Applied Aviation Research Center (AARC) to acquire aerial vegetation imagery and identify areas of bush honeysuckle using image classification algorithms. AARC conducted flights over the Kansas cities of Manhattan, Lawrence, Topeka, Hutchinson, and Wichita during fall 2016. Following these flight, still imagery was processed and stitched together into an orthomosaic for each city. The orthomosaics were then analyzed using common image classification algorithms to highlight concentrations of honeysuckle within and around each city. Identification of these areas was informed by using confirmed locations of bush honeysuckle to train image classification software. The final product of this research is a map of each city highlighting areas of bush honeysuckle.

BACKGROUND

Originally sold as conservation vegetation, bush honeysuckle is now considered an invasive plant and is hindering Kansas ecosystems. The detrimental effects of non-native bush honeysuckle include:

- Suppression of native forest regeneration because it leafs-out early and holds leaf cover late
- Allelopathic nature reduces seed germination and growth of other plants – shades forest floors and dominates ground cover
- High-sugar, low-fat berries offer little dietary benefit to migratory birds
- Open branching pattern offers poor protection for birds from predators
- Bare ground underneath bushes causes soil erosion problems

Typical infestation of bush honeysuckle at the edge of a forested area in Manhattan, KS

OBJECTIVES

- Capture aerial imagery over major population centers in Kansas, targeting suburban environments that are less managed
- Address image artifacts and train software to perform automated image classification to identify bush honeysuckle concentrations
- Provide an orthomosaic of each city highlighting areas of bush honeysuckle

METHODS – DATA COLLECTION

Near-infrared images were collected using a Cessna 172 S Model aircraft with a Sony a5100 camera (24.3 MP APS-C CMOS 23.5x15.6mm sensor) modified with a modified near-infrared filter.

Autopilot and mission planning software was utilized to trigger the camera triggering at preprogrammed distance intervals.

Flights were flown in a lawn-mower pattern with image overlap (necessary for the SfM software to ortho-rectify the images).

Flights were conducted in November of 2016, with the goal of collecting images during overstory canopy leaf-off conditions. During this time, bush honeysuckle retains leaves while tree leaves have dropped. However, this year, many tree leaves were still present.

Sensor pod mount on the Cessna 172S wing strut

Camera settings:
- Aperture: f/4.0
- Shutter speed: 1/2000 s
- ISO: as needed

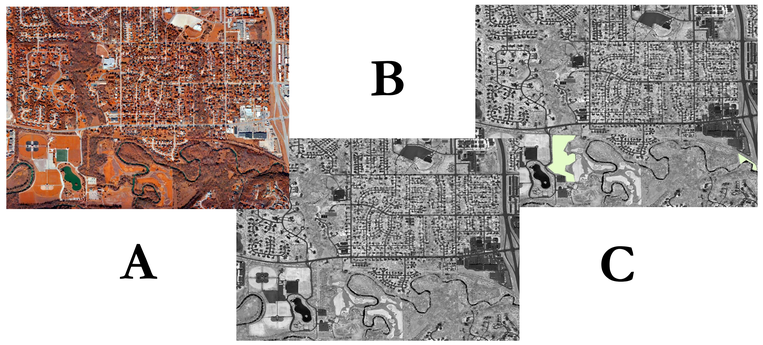
METHODS – DATA ANALYSIS

Data was first processed in the SfM software, Agisoft Photoscan Professional, to ortho-rectify and geo-register the data. This produced the orthomosaic shown in image "A."

Source imagery with a ground sample distance (GSD) of 12 cm per pixel was too much data to process, thus orthomosaics were exported at 60 cm per pixel GSD

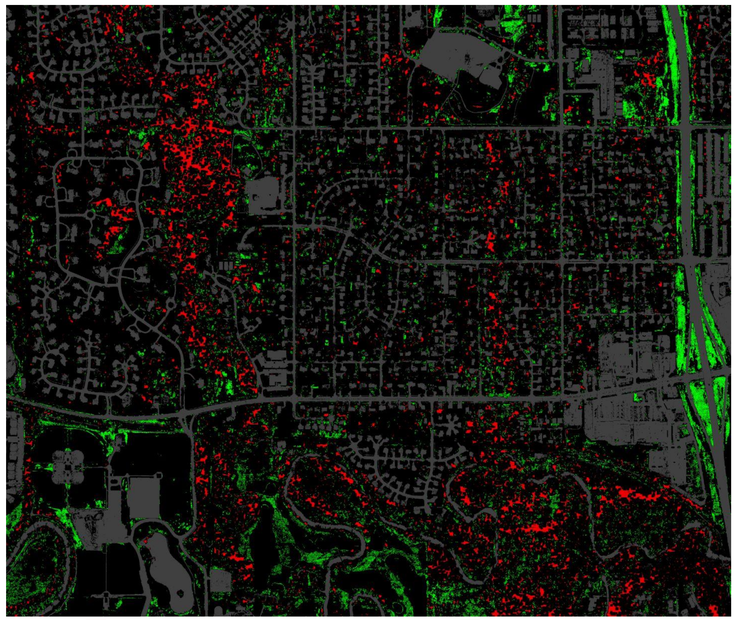
The orthomosaics were processed using Harris Geospatial's ENVI to produce classified maps, as follows:

1. Generate a vegetation index to differentiate vegetation from non-vegetation. This is shown in image "B."
2. Create a mask to cover all non-vegetation.
3. Label known locations of bush honeysuckle to train the software to identify bush honeysuckle elsewhere, as shown in image "C."
4. Confirm predicted areas of bush honeysuckle.



RESULTS

High-resolution aerial imagery and classification maps were provided for each city, similar to the image shown:



= Bush Honeysuckle **= Unclassified**
= Grass **= Masked**

CONCLUSIONS

This project demonstrated automated classification methods for the identification of bush honeysuckle from high-resolution aerial, city-wide maps. Key methodology included data acquisition of near-infrared imagery at the right time of year after trees have lost leaves and before bush honeysuckle looses leaves. The following changes are recommended in future research to improve the confidence level of classified imagery:

- Validation of classified orthomosaics using ground personnel (additional ground truth data)
- Improve source imagery by photographing later in the year with more overstory canopy leaf-off (honeysuckle will be more visible)
- Additional ground-truth areas of confirmed honeysuckle to improve classification software training and validation
- Improve sensor calibration to compensate for changing ambient lighting conditions
- Collection of lower spatial resolution images to reduce flight time and variability of lighting conditions (improve orthomosaic lighting uniformity)