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Abstract

Amur honeysuckle bush (*Lonicera maackii*) and Morrow's honeysuckle (*Lonicera morrowii*) are two of the most aggressively invasive species to become established throughout areas along the Blue River in metropolitan Kansas City, Missouri. These two large, spreading shrubs (locally referred to as bush honeysuckle in the Kansas City metropolitan area) colonize the understory, crowd out native plants, and may be allelopathic, producing a chemical that restricts growth of native species. Removal efforts have been underway for more than a decade by local conservation groups such as Bridging The Gap and Heartland Conservation Alliance, who are concerned with the loss of native species diversity associated with the spread of bush honeysuckle. Bush honeysuckle produces leaves early in the spring before almost all other vegetation and retains leaves late in the fall after almost all other species have lost their leaves. Appropriately timed imagery can be used during early spring and late fall to map the extent of bush honeysuckle. Using multispectral imagery collected in February 2016 and true color aerial imagery collected in March 2016, a coverage map of bush honeysuckle was made to investigate the extent of bush honeysuckle in a study area along the middle reach of the Blue River in the Kansas City metropolitan area in Jackson County, Missouri. The coverage map was further classified into unlikely, low-, and high-density bush honeysuckle density at a 30-foot cell size. The unlikely density class correctly predicted the absence and approximate density of bush honeysuckle for 86 percent of the field-verification points, the low-density class predicted the presence and approximate density with 73-percent confidence, and the high-density class was predicted with 67-percent confidence.

Introduction

Amur honeysuckle bush (Lonicera maackii) and Morrow's honeysuckle (*Lonicera morrowii)* are two of the most aggressively invasive species to become established throughout areas along the Blue River in metropolitan Kansas City, Missouri. These two species are locally referred to as bush honeysuckle in the Kansas City metropolitan area. Bush honeysuckle plants are large, upright, spreading shrubs reaching 6–20 feet (ft) in height (depending on species), with spring flowers that change from white to yellow and produce red berries containing seeds in September and October (Missouri Department of Conservation, 2018). Originally from Asia, bush honeysuckle was first brought to North America in the mid- to late 1800s for landscape ornamentals, wildlife cover, and erosion control (Shouse and others, 2013) and is one of the most aggressive exotic plants that has escaped and colonized natural areas (Missouri Department of Conservation, 2010; 2018). Because of its use as an ornamental shrub, large densities are common in urban areas, but the shrubs are present throughout Missouri. Bush honeysuckle produces leaves early in the spring before most other vegetation and the leaves remain into late fall after most other vegetation have lost their leaves, giving them a competitive advantage over native plants (Missouri Department of Conservation, 2018). The seeds germinate in the shady understory, and bush honeysuckle can also sprout from intact roots. Once established, bush honeysuckle forms dense understory thickets (fig. 1) that limit sunlight to native plants and compete for soil moisture and nutrients, and research indicates they may be allelopathic, producing a chemical that restricts growth of most other plants in their vicinity (Luken and Mattimiro, 1991; Bauer and others, 2012).

Areas along the Blue River in metropolitan Kansas City in Jackson County, Missouri, are infested with bush honeysuckle. At select locations within the Blue River Basin, bush honeysuckle removal efforts by local conservation groups, such as Bridging The Gap and Heartland Conservation Alliance (HCA), have been ongoing for more than a decade (Missouri Department of Conservation, 2008). Removal efforts are labor intensive, and if left unchecked, the spread of invasive species can result in substantial ecosystem function loss with major economic implications (Hartman and McCarthy, 2004; Nowak and others, 2013).

Figure 1. Photographs of bush honeysuckle in a Kansas City, Missouri, park. *A*, thickets dominating the understory and *B*, close up of bush honeysuckle.

The U.S. Geological Survey (USGS), in cooperation with Mid-America Regional Council (MARC), investigated the extent of bush honeysuckle in a study area along the middle reach of the Blue River in the Kansas City metropolitan area in Jackson County, Mo. (fig. 2). High-resolution satellite and aerial imagery of the metropolitan Kansas City area are readily available. These data, when coupled with remote sensing analytical techniques, can be used to map the current (that is, the most recent dataset available) extent of bush honeysuckle within the study area, support restoration effectiveness, and provide a sound basis for understanding how bush honeysuckle has historically spread within the region. Because the growing season of bush honeysuckle begins several weeks earlier and ends several weeks later than most deciduous trees and shrubs in the Kansas City area, there is a brief time window when bush honeysuckle is visible in high-resolution satellite and aerial imagery that can be used to map its extent. This time window varies from year to year but typically is near the end of March and the end of November.

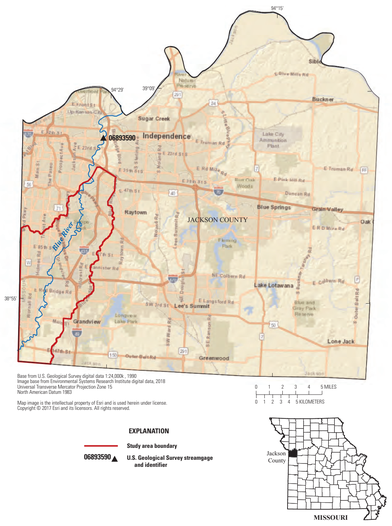


Figure 2. Location of the study area along the Blue River in the Kansas City metropolitan area in Jackson County, Missouri.

Description of Study Area

The Blue River has a drainage area of about 258 square miles (mi2) at the Blue River at 12th Street in Kansas City, Mo., streamgage (USGS site identification number 06893590; fig. 2), and flows from undeveloped areas in its headwaters in Kansas and Missouri northward through metropolitan Kansas City, Mo. Along the river corridor in Missouri are large undeveloped tracts that include parks owned by the city of Kansas City and Jackson County. The study area consists of a 24-mile-long corridor along the middle Blue River in Kansas City, Mo.; covers an area of about 68 mi2; and extends from the Jackson County, Mo., boundary to the south and west to Interstate 70 in the north. The study area includes mixed land use, dominated by developed and forested areas (Applied Ecological Services, Inc., 2004), and includes large tracts of park land in Jackson County along the Blue River.

Purpose and Scope

The purpose of this report is to present the results of an investigation on the efficacy of using publicly available remote sensing imagery to map the extent of bush honeysuckle in the Blue River Basin. For this study, publicly accessible imagery archives were searched for imagery of the study area that was acquired within the period of interest (2016–17).

Methods

This section describes the data collection methods, data processing techniques, and quality assurance of the data used in this study. Imagery from February and March of 2016 was processed and analyzed, followed by a field verification in November 2017. Datasets that supported the processing and show the results of the analysis are available as a USGS data release (Ellis, 2018). Based on field-verification data, the processed imagery was classified into three density classes (unlikely, low, and high) of honeysuckle to prepare a density map (fig. 3).

Image Selection and Classification

On November 5, 2016, USGS personnel attended a bush honeysuckle removal event hosted by Bridging The Gap, which is a local organization that provides environmental education and volunteer opportunities for bush honeysuckle removal in the study area. During the removal event, areas of active bush honeysuckle infestation were identified in the study area. The locations and approximate distribution of bush honeysuckle infestation were recorded and used to evaluate the suitability of spring and fall imagery.

Publicly available historic multispectral satellite imagery archives were reviewed, including imagery from Worldview-3 satellite (DigitalGlobe, Westminster, Colorado), Worldview-2 satellite (DigitalGlobe, Westminster, Colo.), Satellite Pour l'Observation de la Terre (SPOT 5; Astrium Services GEO-Information, Toulouse, France), and Landsat 8 thematic mapper. Imagery was reviewed during the period when bush honeysuckle would be visible in the understory (the months of March and November) and when forest canopy would be at a minimum. The review determined that no suitable multispectral satellite imagery was available that covered the study area when only the understory was visible.

True color aerial imagery was identified on Google Earth™ (Google Earth, March 27, 2016) that seemed to show the understory with a minimum of forest canopy. The locations identified in November 2016 during the bush honeysuckle removal event as areas of bush honeysuckle infestation were visible in the imagery and were selected for analysis. Additionally, MARC provided multispectral leaf-off aerial imagery that was acquired in February 2016 (http://www.marc.org/Data-Economy/Maps-and-GIS/Current-Projects/Aerial-Photography) for the entire study area. This imagery was acquired while the bush honeysuckle was still dormant and also was used in the analysis (fig. 4).

The imagery analysis was approached using methods similar to Shouse and others (2013). Both sets of imagery were degraded to a cell size of 3 ft, which was chosen as an approximation of the diameter of a small bush honeysuckle plant. The February 2016 imagery, which included a multispectral band, was analyzed using the normalized difference vegetation index (NVDI), and the resulting raster consisted of cells with values that ranged from −1 to 1. In this range of values, specific ranges were identified that seemed to be representative of impervious surfaces; evergreen vegetation; unnatural green vegetation, such as golf courses and sports fields; and open water. These classes were chosen to represent a "mask layer," which is assumed to be an area where no bush honeysuckle would be growing during the acquisition of the March 2016 imagery. All ranges that were identified to be in the mask layer were reclassified into a single raster, with values of "1" and "0," with "1" representing areas where no bush honeysuckle was likely to grow and "0" representing areas where bush honeysuckle may grow. The March 2016 imagery, however, had no multispectral band, which is necessary to use the NVDI for analysis. Instead, a supervised classification was chosen to analyze the spring imagery. The supervised classification tool requires the selection of "training polygons" be drawn around groups of pixels that depict features of interest. In this case, 30 polygons were drawn around features that depicted impervious surfaces, evergreen vegetation, unnatural green vegetation, and open water. The supervised classification resulted in unique classes that represented each training polygon. The classes that corresponded to green vegetation were reclassified into a single raster with values of "1" and "0," where "1" represented green vegetation and "0" represented no green vegetation. Finally, the results of the February 2016 imagery classification were subtracted from the results of the March 2016 imagery classification. The resulting raster had values of "−1," "0," and "1," from which "1" represented bush honeysuckle and "0" and "−1" represented areas where no green vegetation was originally detected and areas of green vegetation that had been masked out, respectively.

The resulting raster, which depicted the absence or presence of bush honeysuckle, was overlain with a 30-ft grid, and the percentage of bush honeysuckle presence values in each 30 ft by 30 ft grid cell was calculated for comparison to human-estimated field-verification points (hereafter referred to as field-verification points) and to create a bush honeysuckle coverage map (Ellis, 2018). The grid cell size was chosen to match the scale of field verification, which was estimated over a 30-ft square at the field-verification point. The bush honeysuckle coverage data were reclassified into data classes of unlikely, low-, and high-density bush honeysuckle occurrence (bush honeysuckle density map) based on the results of the quality assurance analysis. The bush honeysuckle density map (fig. 3) provides users the predicted density of bush honeysuckle and an associated confidence of the prediction.

Quality Assurance of the Classified Imagery

On November 9, 2017, members of HCA, the USGS, a University of Missouri–Kansas City biogeography class, and other citizen volunteers conducted a field-verification event, in which presence or absence of bush honeysuckle was noted at approximately 110 random locations in three field-verification areas (fig. 3) within the study area. At each location, the approximate percent of bush honeysuckle coverage was estimated from the ground for comparison to the 30-ft gridded data. USGS and HCA staff performed a brief field-training exercise before the field-verification session to attempt to standardize bush honeysuckle identification and coverage estimation procedures. Volunteers were instructed to estimate the coverage (in percent) of bush honeysuckle from the perspective of looking downward from above the land surface within 15-ft from a randomly selected point, take photographs in each of the four intercardinal directions from that point, and choose locations with varying density and maturity of bush honeysuckle (fig. 5). Each location coordinate was determined with a handheld global positioning system unit that had been corrected with the wide-area augmentation system, with an approximate horizontal accuracy of 10 ft. The field-verification areas were chosen for their accessibility (public land) or proximity to areas of interest to MARC and HCA for the management and the spread of bush honeysuckle and because they seemed to have a wide range in bush honeysuckle coverage. After the field-verification event, several points were eliminated from the dataset for incomplete site descriptions, locations, or coverage estimates. Of the 110 points collected during the field-verification event, 52 were used in the final analysis (table 1). Geotagged photographs from field points (fig. 5), when available, were used to confirm the location recorded, or in some cases adjust the location of the field-verification point (fig. 6).

Though some unknown human error is likely to exist in the estimation of bush honeysuThough some unknown human error is likely to exist in the estimation of bush honeysuckle coverage from the ground, the field-verification point was assumed to accurately represent the bush honeysuckle coverage at the time of field verification. The bush honeysuckle coverage estimates from the field-verification points were compared to the predicted bush honeysuckle coverage value (table 1) values at each 30-ft cell at the corresponding location. At the highest field-verification point (estimated to be 100-percent bush honeysuckle coverage), the predicted value of bush honeysuckle coverage was 38 percent. This highest field-verified point was chosen to scale the data, instead of using the average percent difference of the entire dataset, because scaling by the lower average percent difference causes the highest field-verified points (which are assumed to be correct) to be calculated over 100-percent coverage. The predicted bush honeysuckle coverage data were scaled by this factor for comparison purposes, with values more than 100 percent being set equal to 100-percent coverage (table 1). Finally, the scaled bush honeysuckle coverage data were reclassified into three ranges of predicted bush honeysuckle coverage (0 to 10 percent, greater than 10 to 56 percent, and greater than 56 to 100 percent), which were chosen to maximize the accuracy of the prediction, identify areas where bush honeysuckle is likely to be absent, identify areas where bush honeysuckle is likely to be present, and identify areas of high-density bush honeysuckle that are more efficient to remediate. These reclassified data were used to produce a bush honeysuckle density map (fig. 3). The accuracy of the ranges was determined by the number of field-verification points in which the field-verification points and the scaled bush honeysuckle coverage value fell into the same range (0 to 10 percent, greater than 10 to 56 percent, and greater than 56 to 100 percent bush honeysuckle coverage) (fig. 6).

Table 1. Comparison of field-estimated coverage, in percent, during the November 2017 field verification to predicted bush honeysuckle coverage value, in percent, determined from March 2016 Google Earth™ imagery.

[NW, northwest; NE, northeast; SW, southwest; SE, southeast; scaled honeysuckle coverage value was obtained by dividing the predicted honeysuckle coverage value by the highest predicted value, 38 percent; difference, in percent, was calculated by dividing the difference between the field estimate coverage average and the predicted honeysuckle coverage value by the field-estimated coverage average and multiplying by 100]

Point number	Point location		Field-estimated coverage, in percent					Predicted honeysuckle coverage value, in percent	Difference, in percent	Scaled honeysuckle coverage value, in percent
	Longitude	Latitude	NW	NE	SW	SE	Average			
1	−94.5165	38.9896	0	0	0	0	0	2	undefined	undefined
2	−94.5083	39.0433	0	0	0	0	0	0	0[a]	0
3	−94.5076	39.0429	0	0	0	0	0	0	0[a]	0
4	−94.5063	39.0423	0	0	0	0	0	0	0[a]	0
5	−94.5312	38.9944	0	0	0	0	0	6	undefined	undefined
6	−94.5312	38.9937	0	0	0	0	0	2	undefined	undefined
7	−94.5138	38.9886	0	0	0	0	0	0	0[a]	0
8	−94.5124	38.9902	0	0	0	0	0	2	undefined	undefined
9	−94.5132	38.9927	0	0	0	0	0	0	0[a]	0
10	−94.5180	38.9902	2	3	3	2	3	2	−20	5
11	−94.5119	38.9930	2	5	4	2	3	0	−100	0
12	−94.5058	39.0420	0	20	0	0	5	0	−100	0
13	−94.5050	39.0413	0	20	20	0	10	3	−70	8
14	−94.5138	38.9908	10	10	10	10	10	4	−60	11
15	−94.5141	38.9912	20	10	10	10	13	0	−100	0
16	−94.5142	38.9918	25	20	0	20	16	5	−69	13
17	−94.5140	38.9907	40	20	20	20	25	11	−56	29
18	−94.5207	38.9940	40	20	20	20	25	14	−44	37
19	−94.5123	38.9924	20	12	40	35	27	3	−89	8
20	−94.5161	38.9923	20	30	40	20	28	6	−78	16
21	−94.5155	38.9917	60	40	5	10	29	3	−90	8
22	−94.5172	38.9905	0	40	80	0	30	3	−90	8
23	−94.5152	38.9911	40	20	40	20	30	5	−83	13
24	−94.5148	38.9915	40	40	20	40	35	9	−74	24
25	−94.5139	38.9909	40	60	20	20	35	10	−71	26
26	−94.5041	39.0413	0	80	0	80	40	4	−90	11
27	−94.5149	38.9911	40	40	40	40	40	9	−78	24
28	−94.5137	38.9906	20	60	20	60	40	8	−80	21
29	−94.5173	38.9926	60	20	40	40	40	21	−48	55
30	−94.5109	38.9925	45	40	50	35	43	12	−72	32
31	−94.5157	38.9904	40	60	20	60	45	5	−89	13
32	−94.5184	38.9930	60	40	60	20	45	7	−84	18
33	−94.5343	38.9965	50	40	90	15	49	11	−77	29
34	−94.5054	39.0414	0	100	0	100	50	26	−48	68
35	−94.5130	38.9914	40	50	50	60	50	14	−72	37
36	−94.5161	38.9919	60	65	30	50	51	7	−86	18
37	−94.5044	39.0419	60	80	20	60	55	2	−96	5
38	−94.5162	38.9920	80	60	40	40	55	4	−93	11
39	−94.5121	38.9907	50	70	40	60	55	3	−95	8
40	−94.5200	38.9933	60	60	40	60	55	7	−87	18
41	−94.5168	38.9922	70	50	80	50	63	22	−65	58
42	−94.5133	38.9925	60	90	40	60	63	9	−86	24
43	−94.5329	38.9936	75	90	95	4	66	16	−76	42
44	−94.5350	38.9954	85	60	75	60	70	36	−49	95
45	−94.5334	38.9942	40	95	70	80	71	20	−72	53
46	−94.5305	38.9952	80	60	80	80	75	43	−43	100[b]
47	−94.5309	38.9941	90	80	50	80	75	26	−65	68
48	−94.5112	38.9924	65	70	100	70	76	27	−65	71
49	−94.5081	39.0436	80	80	80	80	80	0	0	0
50	−94.5313	38.9925	95	100	60	90	86	29	−66	76
51	−94.5316	38.9946	90	80	95	85	88	35	−60	92
52	−94.5087	39.0431	100	100	100	100	100	38	−62	100

[a]Point numbers 2–4, 7, and 9 have the same field-estimated average honeysuckle coverage and predicted honeysuckle coverage, so the percent difference is considered to be 0.

[b]Scaled predicted honeysuckle coverage was over 100 percent, so value was changed to 100 percent.

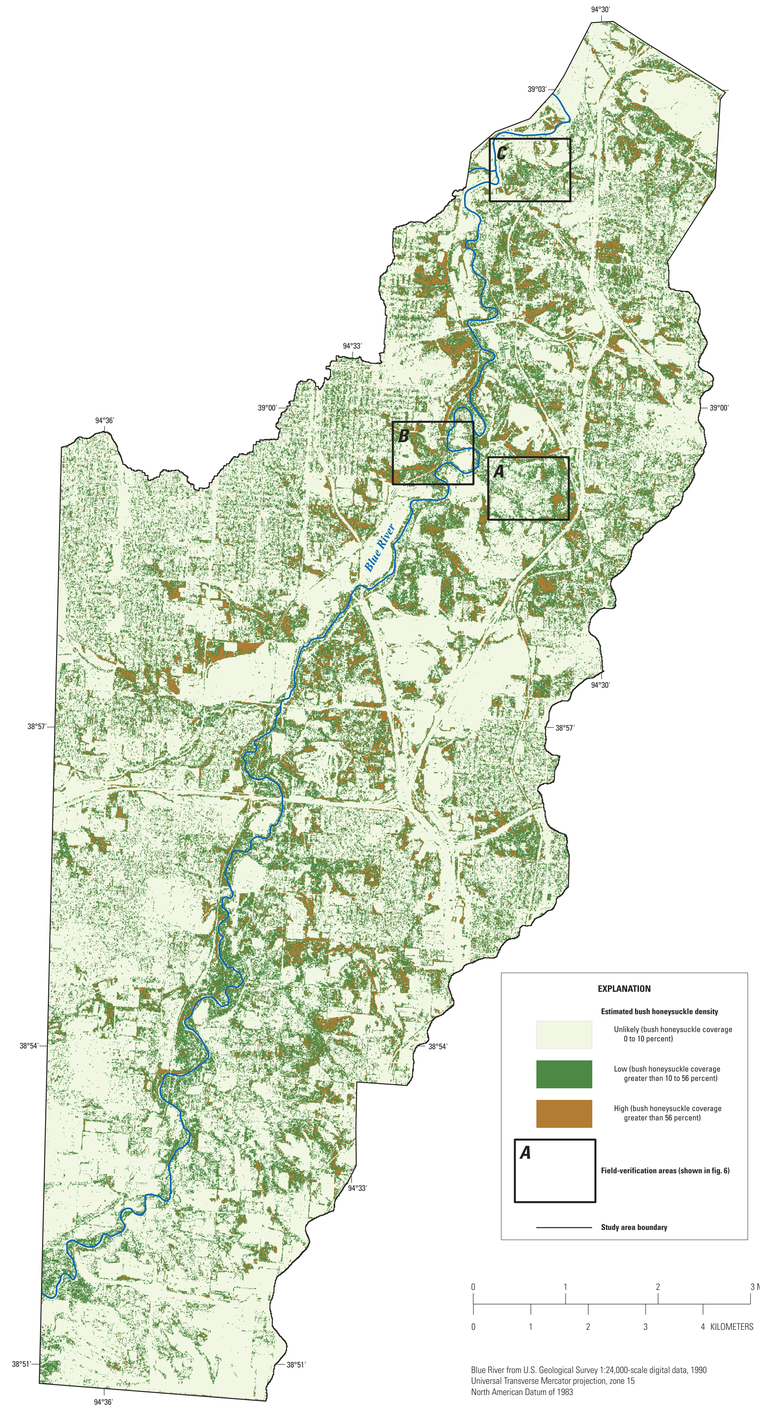


Figure 3. Estimated density of bush honeysuckle in the study area, along with lettered locations of field-verification areas.

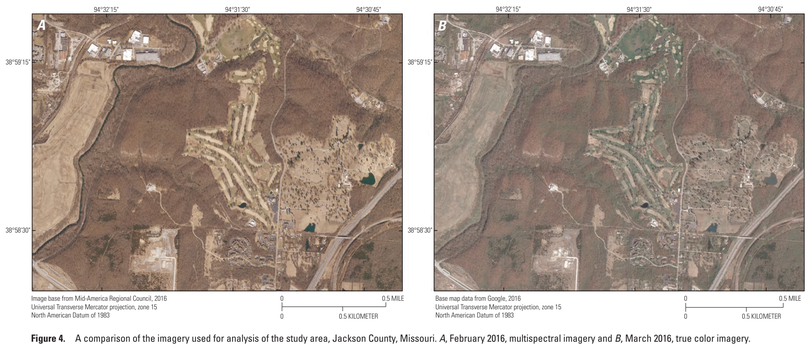
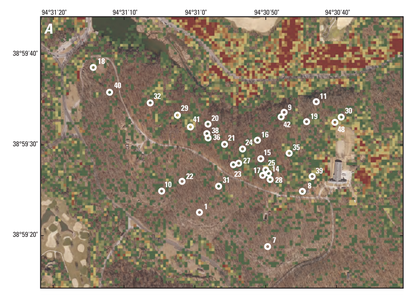
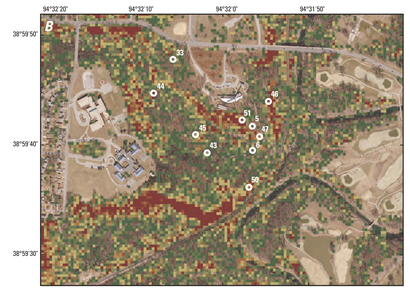
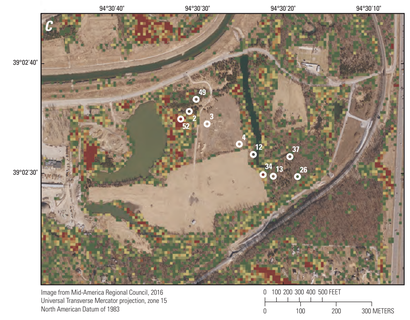


Figure 4. A comparison of the imagery used for analysis of the study area, Jackson County, Missouri. *A*, February 2016, multispectral imagery and *B*, March 2016, true color imagery.

Figure 5. Photographs collected during field verification showing examples of field-estimated bush honeysuckle coverage, in percent.







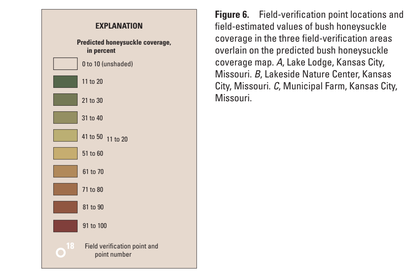


Figure 6. Field-verification point locations and field-estimated values of bush honeysuckle coverage in the three field-verification areas overlain on the predicted bush honeysuckle coverage map. *A*, Lake Lodge, Kansas City, Missouri. *B*, Lakeside Nature Center, Kansas City, Missouri. *C*, Municipal Farm, Kansas City, Missouri.

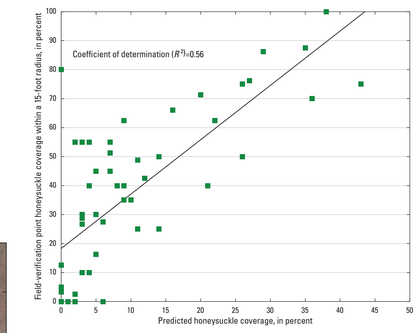


Figure 7. Relation between field-estimated bush honeysuckle coverage and predicted bush honeysuckle coverage, in percent, at points from November 2017 field-verification survey.

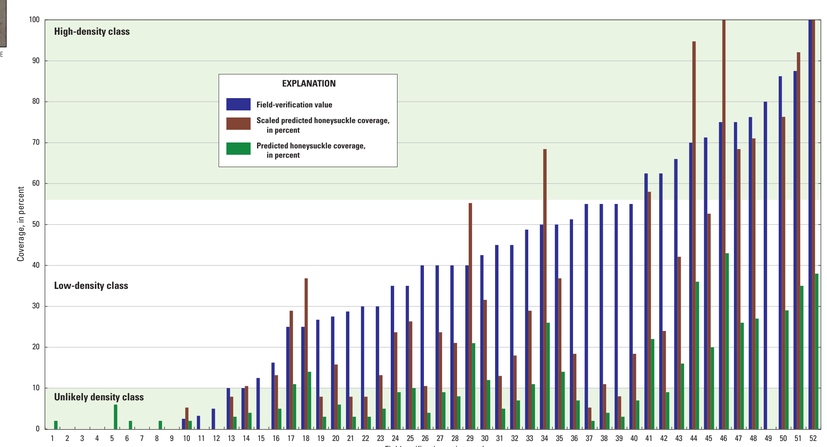


Figure 8. Column graph depicting original 30-foot predicted bush honeysuckle coverage, scaled 30-foot predicted bush honeysuckle coverage, and field-estimated honeysuckle coverage values. Also depicted are the cutoff points for each bin value.

0–10 percent	1	2	3	4
30–50 percent	5	6	7	8
50–70 percent	9	10	11	12
70–90 percent	13	14	15	16

Photographs showing bush honeysuckle (fig. 5). Photographs 3, 4, 8, 9, 10, 11, 12, 13, and 14 by Caitlin Dix, Heartland Conservation Alliance, used with permission. Photographs 1, 5, and 6 by Jarrett T. Ellis; and photograph 16 by John Schumacher, U.S. Geological Survey. Photographs 2, 7, and 15 by Don Wilkison, U.S. Geological Survey volunteer.

Summary

With proper resolution and timing of the imagery, supervised image classification techniques can be used to determine the extent and density of bush honeysuckle. Using February 2016 and March 2016 aerial imagery, areas of high-density bush honeysuckle (greater than 56 to 100 percent) were mapped with 67-percent confidence in the study area, and areas of low-density bush honeysuckle (greater than 10 to 56 percent) were mapped with 73-percent confidence. Predicted bush honeysuckle percent coverage was generally underestimated (mean percent difference −66 percent) when compared with field-verified values. Areas of unlikely bush honeysuckle coverage (0 to 10 percent) were mapped with 86-percent confidence but had poor selectivity, where 4 of 9 field-verification points with no bush honeysuckle present during field verification incorrectly indicated the presence of bush honeysuckle, and 2 of 5 field-verification points with bush honeysuckle present during field verification incorrectly indicated the absence of bush honeysuckle. Archived imagery may be used to estimate the extent of bush honeysuckle at the time of the imagery, but as the period between image acquisition and field-verification increases, the quality of assessment of imagery-derived coverage with the field-observed coverage will degrade because of likely changes in the extent and density of the plants in the interim.

Discussion of Remote-Sensing Results

When field-verification values were compared to the bush honeysuckle coverage values (table 1), the field value was typically greater than the predicted value of bush honeysuckle coverage with a mean percent difference of about −66 percent (table 1). As would be expected, the two datasets were linearly correlated with a coefficient of determination of 0.56 (fig. 7).

The difference between the field values and the bush honeysuckle coverage values indicates that the predicted value was underestimating the coverage of bush honeysuckle at most field-verification points (fig. 8). This underestimation may indicate that the March 2016 imagery that was used no longer accurately represents the bush honeysuckle coverage on the ground at the time of the November 2017 field verification. The imagery used in the analysis was taken approximately 19 months before the field-verification event, and because the growth rate of bush honeysuckle is estimated at 1 ft per year (Deering and Vankat, 1999), field observations were likely to report higher values of coverage than the predicted values. Repeated field-verification estimates at a subset of the field-verification points may help quantify the rate of growth of bush honeysuckle during the period between image acquisition and field verification, as well as document the rate of spread of the species in the study area. The March 2016 imagery also may have been collected too early in the growing season to accurately represent bush honeysuckle coverage during the late season field verification. The March 2016 imagery also had other plant species in various stages of leaf development in addition to bush honeysuckle, which may have masked out or diluted some of the bush honeysuckle occurrences that should have been classified in the imagery. The process of extracting the imagery data from Google Earth™ for use in the supervised classification degraded the image from the original resolution of approximately 0.5 ft to a resolution of approximately 0.65 ft, and then further degrading the imagery to 3 ft could have altered the pixel color values, making the bush honeysuckle more difficult to identify. Field-verification data should optimally be collected as close to the acquisition of the imagery date as possible to increase validity of the comparison between field-observed values and imagery-derived values. Finally, an unknown human error exists when estimating coverage of bush honeysuckle in the field, primarily because the field observer is estimating density based on a near horizontal viewing angle, whereas the computer-derived estimates are from imagery looking vertically downward from above the tree canopy. Although volunteers were instructed in the estimation of coverage of bush honeysuckle in the field, mature bush honeysuckle can reach heights of 7 to 10 ft, which can make estimation of coverage difficult, particularly at a near-horizontal viewing angle. In future field-verification efforts, a subset of points should be estimated by several volunteers to help quantify the variation in human field estimates, as well as provide a more accurate average of field-verification estimates for those points.

The selection of the three classifications used in the bush honeysuckle density map (0 to 10 percent density [bush honeysuckle unlikely], greater than 10 to 56 percent [low-density bush honeysuckle], and greater than 56 to 100 percent [high-density bush honeysuckle]; fig. 3) was made to maximize the accuracy of reported densities in the classes, while differentiating the extent of bush honeysuckle to guide targeted removal. Accuracy was determined by comparing the field-measured and predicted values (fig. 6; table 1). For the high-density bush honeysuckle class, 67 percent (8 of 12) of the tested values were classified into the correct range and the mean percent difference between the field and the imagery predicted data was −67 percent. In this range, there was one error of omission where field observation indicated the presence of bush honeysuckle but the predicted value from the imagery indicated it did not exist in that location. For the low-density bush honeysuckle range, 73 percent (20 of 26) of the tested values were classified into the correct range. In this range, 85 percent (22 of 26) of the predicted data values underestimated the coverage of bush honeysuckle when compared to the field values, and the mean percent difference between the field and the predicted data was −78 percent. In this range, there was one error of omission where field observation indicated the presence of bush honeysuckle but the predicted value from the imagery indicated it did not exist in that location. Although confidence that the presence of bush honeysuckle is high in this range, the mean percent difference indicates that field values are likely to be greater than the predicted values. For the bush honeysuckle unlikely range, 86 percent (12 of 14) of the tested predicted values were classified into the correct bin; however, errors of commission occurred at 44 percent (4 of 9) of field-verification points that had no bush honeysuckle present but were predicted to have bush honeysuckle present. Errors of omission occurred in 40 percent (2 of 5) of field-verification points that indicated bush honeysuckle was present but the predicted value from the imagery indicated it did not exist in that location

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