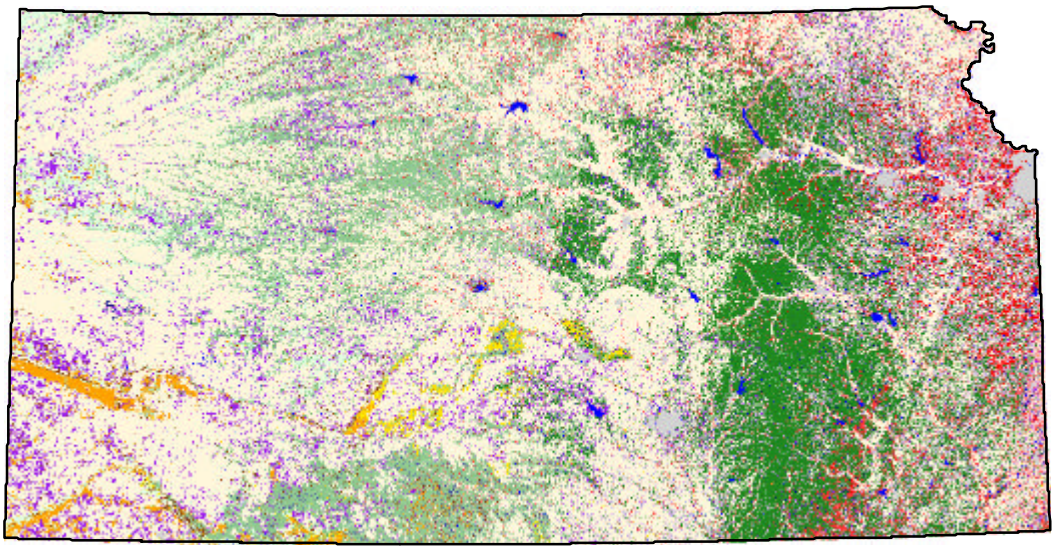
THE KANSAS GAP LAND COVER MAP

FINAL REPORT



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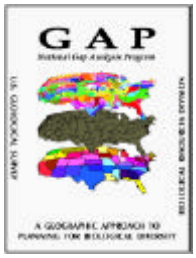
Completion of the Kansas GAP land cover map is a result of the generous sponsorship of numerous federal and state agencies and the work of a large staff of scientists, analysts, and field technicians at the Kansas Applied Remote Sensing Program and the Kansas Biological Survey. Produced over a five-year period, the GAP land cover map represents the first detailed map of the actual vegetation of Kansas and provides a valuable resource for the state of Kansas and those interested in its natural resources.

Sponsoring Agencies

Sponsorship for the Kansas GAP land cover map came from a number of state and federal agencies that provided support through both direct funding and in-kind aid. We wish to thank them and acknowledge them for their support. Kansas state agencies that provided support include the ***State GIS Policy Board***, the ***Department of Wildlife and Parks***, and the ***Kansas Biological Survey***. National partners included the ***National Aeronautics and Space Administration***, the ***Environmental Protection Agency - Region 7***, the ***Biological Resources Division*** of the U.S. Geological Survey, and the ***National Park Service***. In addition, the ***University of Kansas*** and ***Kansas State University*** also provided support. Overall coordination of the Kansas Gap Project was provided by Jack F. Cully, Jr. and Glennis Kaufman at Kansas State University



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PREFACE

This report summarizes the research methods and results for the land cover mapping portion of the Kansas Gap Analysis Project. For the most part, it is identical with the land cover mapping section of the final report for the Kansas Gap Analysis Project. As such, it contains small amounts of general introductory text provided by the national office for Gap Analysis at the University of Idaho and detailed analysis and discussion of the Kansas GAP land cover mapping effort written by staff members of the Kansas Biological Survey and the Kansas Applied Remote Sensing Program. Digital map products may be obtained from the Data Access and Support Center (DASC) web site of the Kansas Geological Survey: http://gisdasc.kgs.ukans.edu. A printed version of the Kansas GAP land cover map will be available from the Publications Desk of the Kansas Geological Survey in Summer 2001.

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INTRODUCTION

Mapping natural land cover requires a higher level of effort than the development of data for animal species, agency ownership, or land management, yet it is no more important for gap analysis than any other data layer. Generally, the mapping of land cover is done by adopting or developing a land cover classification system, delineating areas of relative homogeneity (basic cartographic "objects"), then labeling these areas using categories defined by the classification system. More detailed attributes of the individual areas are added as more information becomes available, and a process of validating both spatial pattern and labels is applied for editing and revising the map. This is done in an iterative fashion, with the results from one step causing re-evaluation of results from another step. Finally, an assessment of the overall accuracy of the data is conducted. The final assessment of accuracy will show where improvements should be made in the next update (Stoms et al.1994).

In its "coarse filter" approach to conservation biology (e.g., Jenkins 1985, Noss 1987), gap analysis relies on maps of dominant natural land cover types as the most fundamental spatial component of the analysis (Scott et al. 1993) for terrestrial environments. For the purposes of GAP, most of the land surface of interest (natural) can be characterized by its dominant vegetation.

Vegetation patterns are an integrated reflection of the physical and chemical factors that shape the environment of a given land area (Whittaker 1965). They also are determinants for overall biological diversity patterns (Franklin 1993, Levin 1981, Noss 1990), and they can be used as a currency for habitat types in conservation evaluations (Specht 1975, Austin 1991). As such, dominant vegetation types need to be recognized over their entire ranges of distribution (Bourgeron et al. 1994) for beta-scale analysis (*sensu* Whittaker 1960, 1977). These patterns cannot be acceptably mapped from any single source of remotely sensed imagery, therefore, ancillary data, previous maps, and field surveys are used. The central concept is that the physiognomic and floristic characteristics of vegetation (and, in the absence of vegetation, other physical structures) across the land surface can be used to define biologically meaningful biogeographic patterns. There may be considerable variation in the floristics of subcanopy vegetation layers (community association) that are not resolved when mapping at the level of dominant canopy vegetation types (alliance), and there is a need to address this part of the diversity of nature. As information accumulates from field studies on patterns of variation in understory layers, it can be attributed to the mapped units of alliances.

Kansas Land Cover Mapping and GAP

The land cover map developed for the Kansas Gap Analysis Project represents the third statewide land cover map created by the Kansas Applied Remote Sensing Program from

Landsat satellite imagery. Previous satellite-derived maps were completed in 1974 and 1993.

The 1974 map was sponsored by the Planning Division of the Kansas Department of Economic Development and was developed through visual interpretation of 18 Landsat-1 Multispectral Scanner (MSS) black and white transparencies. The completed map included the following classes: urban and built-up land, mined land, unirrigated cropland, unirrigated cropland with rangeland, unirrigated cropland with irrigated cropland, irrigated cropland, irrigated cropland with unirrigated cropland, rangeland, rangeland with unirrigated cropland, woodland, water, and wetlands. Although it suffered from the obvious deficiencies of numerous mixed classes, a coarse (and undefined) minimum mapping unit (MMU), and no assessment of accuracy, the 1974 map stood for nearly 20 years as the only satellite-derived land cover map of Kansas, and it was widely distributed in hardcopy form.

The 1993 Kansas land cover map was sponsored by the Kansas GIS Policy Board and the Kansas Department of Wildlife and Parks and was the first satellite-derived digital map of Kansas land cover. Land cover was mapped using digital unsupervised classification of single-date Landsat Thematic Mapper imagery (Whistler, et al., 1995). Ten Anderson level 1 classes were mapped at an MMU of 2 acres, including five urban classes (residential, commercial/industrial, open (grassland), woodland, and water) and five rural classes (cropland, grassland, woodland, water, and other). The map output was tiled by county and delivered in ARC/INFO vector format. Accuracy assessment was conducted using air photos as ground reference data. Overall accuracy for the map statewide was over 85%. The digital files of county land cover are available for public FTP download from the Data Access Support Center (DASC) web site of the Kansas Geological Survey (http://gisdasc.kgs.ukans.edu). A hardcopy version of the statewide land cover map was also produced and can be obtained from the Publications Department of the Kansas Geological Survey, Lawrence, Kansas (Whistler, et al., 1997).

The Kansas GAP land cover map was developed to meet the requirements of Gap Analysis and to fill the need for a detailed map of land cover at the vegetation alliance level. Sponsorship for the Kansas GAP land cover map came from a number of state and federal agencies that provided support through both direct funding and in-kind aid (Table 1). The alliance-level land cover map was developed using multi-seasonal Landsat Thematic Mapper imagery and a hybrid classification approach. Assessment of the map's accuracy was conducted using independent ground verification samples and standard accuracy assessment analysis and reporting procedures. Details of the classification methodology, accuracy assessment, results, and discussion are presented in the following sections of this report.

LAND COVER CLASSIFICATION

Land cover classifications must rely on specified attributes, such as the structural features of plants, their floristic composition, or environmental conditions, to consistently differentiate categories (Kuchler and Zonneveld 1988). The criteria for a land cover classification system for GAP are:

an ability to distinguish areas of different actual dominant vegetation;
a utility for modeling animal species habitats;
a suitability for use within and among biogeographic regions;
an applicability to Landsat Thematic Mapper (TM) imagery for both rendering a base map and from which to extract basic patterns (GAP relies on a wide array of information sources, TM offers a convenient meso-scale base map in addition to being one source of actual land cover information);
a framework that can interface with classification systems used by other organizations and nations to the greatest extent possible; and
a capability to fit, both categorically and spatially, with classifications of other themes such as agricultural and built environments.

Table 1. Kansas GAP Land Cover Mapping Sponsors.

Organization
U.S. Geological Survey, Biological Resources Division
Environmental Protection Agency, Region 7
Kansas Department of Wildlife and Parks
Kansas GIS Policy Board
National Aeronautics and Space Administration
National Park Service
Kansas Biological Survey
University of Kansas
Kansas State University

For GAP, the system that fits best is referred to as the National Vegetation Classification System (NVCS) (FGDC 1997). The origin of this system was referred to as the UNESCO/TNC system (Lins and Kleckner 1996) because it is based on the structural characteristics of vegetation derived by Mueller-Dombois and Ellenberg (1974), adopted by the United Nations Educational, Scientific, and Cultural Organization (UNESCO 1973) and later modified for application to the United States by Driscoll et al. (1983, 1984). The Nature Conservancy and the Natural Heritage Network (Grossman et al. 1994) have been

improving upon this system in recent years with partial funding supplied by GAP. The basic assumptions and definitions for this system have been described by Jennings (1993).

A Vegetation Classification System for Kansas

Extensive grasslands dominate Kansas's natural vegetation. In western Kansas, in the lee of the Rocky Mountains, sparse rainfall results in arid shortgrass prairies, while increased rainfall in the central part of the state yields mixed-grass prairies. In eastern Kansas, sufficient precipitation occurs to support tallgrass prairie that mixes with oak-hickory deciduous forest in the far eastern part of the state. Most of the grasslands in the western two-thirds of the state are native, having never been plowed, and are primarily used for grazing domestic livestock. In the tallgrass prairie region, grazing is also prevalent, but many grasslands (both tame and native) are managed for hay production. Kansas also contains large acreages of former cropland that are now covered with native and non-native grasses as part of the USDA Conservation Reserve Program (CRP).

In 1989, the Kansas Natural Heritage Inventory of the Kansas Biological Survey (KBS) developed a preliminary statewide vegetation classification to identify and plan protection for exemplary occurrences of Kansas' ecological communities. The classification was based on examining Küchler's (1974) potential natural vegetation map in relation to the geology, soils, and physiographic provinces of Kansas. Vegetation types were identified based on variations in physical features (e.g. climate, soils, and topography) that contributed to differences in plant species composition. For example, although sharing the same dominant species, a "northeastern" and "southeastern tallgrass prairie" were formed because of known differences in soil development (i.e., glaciation in the northeast) and the floristic composition of communities in these areas.

The present classification system used in the Kansas GAP Project and by KBS is a conversion of the 1989 system into the National Vegetation Classification System developed by The Nature Conservancy in cooperation with state, federal, and academic partners (Anderson et al., 1998; Grossman et al., 1998). The new classification of the natural vegetation of Kansas (Lauver et al., 1999) contains 40 vegetation alliances in classes of forest, woodland, shrubland, and herbaceous vegetation (Appendix A).

Although the natural vegetation of Kansas has been described (Lauver et al. 1999), an accurate portrayal of vegetation on sites invaded by exotic species or heavily disturbed by agricultural and mining activities has been lacking. With the goal of portraying the actual vegetation on the Kansas landscape, our land cover mapping effort included ten additional cover types found on disturbed sites and composed of mainly semi-natural vegetation (Appendix B). Two types (non-native grassland and CRP lands) were added to our map because of their widespread coverage and potential as wildlife habitat. Eight additional types were added on the basis of the field work conducted during 1996 to 1998, which provided data from disturbed lands across Kansas that were distinguished by their

semi-natural vegetation and land use history. A list of alliances and mapping units used for development of the Kansas GAP land cover maps (omitting the cropland, urban, and water classes) is presented in Table 2.

Table 2. List of Common and Scientific Names of the Alliances Mapped in the Kansas GAP Land Cover Layer (Lauver, et al., 1999). Mapping units preceded by an asterisk (*) are land cover types not formally incorporated into the US National Vegetation Classification system at the time of this report; included under scientific name are the dominant plant species for each alliance. More detail is presented in the Appendix.

Alliance Common Name	Kansas Alliance Scientific Name
Forest Alliances	
Maple - Basswood Forest	Acer saccharum - Tilia americana - (Quercus rubra) Forest Alliance
Oak - Hickory Forest	Quercus alba - (Quercus rubra, Carya spp.) Forest Alliance
Post Oak - Blackjack Oak Forest	Quercus stellata - Quercus marilandica Forest Alliance
Pecan Floodplain Forest	Carya illinoinensis - (Celtis laevigata) Temporarily Flooded Forest Alliance
Ash - Elm - Hackberry Floodplain Forest	Fraxinus pennsylvanica - Ulmus americana - Celtis (occidentalis, laevigata) Temp. Flooded Forest Alliance
Mixed Oak Floodplain Forest	Quercus macrocarpa - Quercus bicolor - (Carya laciniosa) Temporarily Flooded Forest Alliance
* Deciduous Forest - Mined Land	Dominants: Populus deltoides, Salix nigra, Ulmus rubra
* Maple Floodplain Forest	Dominants: Acer saccharinum, Betula nigra
* Evergreen Forest - Disturbed Land	Dominant: Juniperus virginiana
Cottonwood Floodplain Forest	Populus deltoides Temporarily Flooded Forest Alliance
Woodland Alliances	
Bur Oak Floodplain Woodland	Quercus macrocarpa Woodland Alliance
Post Oak - Blackjack Oak Woodland	Quercus stellata - Quercus marilandica Woodland Alliance
Mixed Oak Ravine Woodland	Quercus muehlenbergii Woodland Alliance
* Deciduous Woodland	Dominants: Maclura pomifera, Gleditsia triacanthos
Cottonwood Floodplain Woodland	Populus deltoides Temporarily Flooded Woodland Alliance
Shrubland Alliances	
Sandsage Shrubland	Artemisia filifolia Shrubland Alliance
Willow Shrubland	Salix exigua Temporarily Flooded Shrubland Alliance
Buttonbush (Swamp) Shrubland	Cephalanthus occidentalis Semipermanently Flooded Shrubland Alliance
* Salt Cedar or Tamarisk Shrubland	Dominants: Tamarix spp.
Upland Prairie Alliances	
Tallgrass Prairie	Andropogon gerardii - (Sorghastrum nutans) Herbaceous Alliance
Sand Prairie	Andropogon hallii Herbaceous Alliance
Western Wheatgrass Prairie	Pascopyrum (Agropyron) smithii Herbaceous Alliance
Sandstone Glade/Prairie	Schizachyrium scoparium - Sorghastrum nutans Herbaceous Alliance
Mixed Prairie	Schizachyrium scoparium - Bouteloua curtipendula Herbaceous Alliance
Alkali Sacaton Prairie	Sporobolus airoides Herbaceous Alliance
* Mixed Prairie – Disturbed	Dominants: Sporobolus spp.
Shortgrass Prairie	Bouteloua gracilis Herbaceous Alliance
* Weedy Upland	Dominant: Ambrosia artemisiifolia
Introduced Grasslands	
* Non-Native Grassland	Dominants: Bromus inermis, Festuca arundinacea, Andropogon bladhii

Alliance Common Name	Kansas Alliance Scientific Name
* CRP (Conservation Reserve Program)	Dominants: Andropogon gerardii, Schizachyrium scoparium, Sorghastrum nutans, Panicum virgatum, etc.
Wetland Alliances	
Grass Playa Lake	Pascopyrum smithii Intermittently Flooded Herbaceous Alliance
Salt Marsh/Prairie	Distichlis spicata - (Hordeum jubatum) Temporarily Flooded Herbaceous Alliance
Spikerush Playa Lake	Eleocharis macrostachya Temporarily Flooded Herbaceous Alliance
Playa Lake	Polygonum spp. - Echinochloa spp. Temporarily Flooded Herbaceous Alliance
Low or Wet Prairie	Spartina pectinata Temporarily Flooded Herbaceous Alliance
Freshwater Marsh	Typha spp. - (Scirpus spp., Juncus spp.) Seasonally Flooded Herbaceous Alliance
Bulrush Marsh	Scirpus pungens Semipermanently Flooded Herbaceous Alliance
Cattail Marsh	Typha (angustifolia, latifolia) - (Scirpus spp.) Semipermanently Flooded Herbaceous Alliance
Forb Playa Lake	Heteranthera limosa Permanently Flooded Herbaceous Alliance
* Weedy Marsh	Dominants: Typha spp., Scirpus spp., Ambrosia spp., Rumex spp

METHODS

The alliance-level land cover map for Kansas GAP was developed using three-date multi-seasonal Landsat Thematic Mapper imagery and a hybrid classification approach. Image classification consisted of two primary stages: first, unsupervised classification was used to separate cropland from natural vegetation; then, supervised classification based on field training sites was used to map the natural vegetation alliances. Following the supervised classification, post-hoc, or post-classification, procedures were employed to refine the land cover map. Assessment of the map's accuracy was conducted using independent ground verification samples and standard accuracy assessment analysis and reporting procedures.

Mapping Standards and Data Sources

Mapping standards and data products for the Kansas GAP land cover map are summarized in Table 3. The Kansas GAP land cover map has a minimum mapping unit of 2 ha and is tiled by 1:100,000 USGS 60'x 60' map sheet. Thematic detail is at the vegetation alliance level, with a total of 43 mapped classes. Final map products are in ARC/INFO grid format.

Table 3. Mapping Standards and Products for the Kansas GAP Land Cover Map.

Item	Standard or Product
Minimum Mapping Unit (MMU)	2 hectares (4.94 acres)
Spatial accuracy	15 meters (0.5 pixels)
Thematic detail (classes)	Vegetation alliance level
Thematic accuracy	As determined through accuracy assessment
Tiling method	1:100,000 (60'x60') USGS Map Sheets
Format	ARC/INFO GRID
Product	Digital map of alliance-level land cover

The primary data source for the development of the Kansas land cover map was Landsat Thematic Mapper imagery. We evaluated the potential of airborne videography for land cover mapping, but judged it unsuitable for alliance-level mapping of grasslands and similar land cover types. In addition to satellite imagery, we used a number of ancillary data sources to assist in the digital classification process and in refining the land cover map. Ancillary data sets are listed in Table 4. Specific applications of the ancillary data sets are described in the discussion, below.

Table 4. Ancillary Data Sets Used for the Kansas GAP Land Land Cover Map.

Data Set	Source
Map of Potential Natural Vegetation of Kansas	Kuchler (1974)
SWIMS - Surface Water Information Management System	KDHE and GRAIL
SSURGO - Soil Survey Geographic Database	USDA/NRCS
Kansas Land Cover Patterns Map	Kansas Applied Remote Sensing Program (Whistler, 1995)
PLSS - Public Land Survey System	Kansas Geological Survey
Physiographic Provinces of Kansas	Kansas Geological Survey

Multi-seasonal Landsat Thematic Mapper imagery was used for land cover mapping. In previous work that used a multi-seasonal approach in Finney County in southwest Kansas, we obtained excellent results in separating grasslands from croplands and in mapping individual crop types (Egbert, et al., 1995; Price, et al., 1997). Based on that research, we decided to apply a similar approach to mapping natural vegetation. For each scene center in Kansas, we acquired three dates of Landsat Thematic Mapper imagery over the growing season: spring, summer, and fall. Although we considered using TM imagery from the MRLC (Multi-Resolution Land Characterization) project, in most cases we were unable to do so because of incompatible or inappropriate dates.

Our rationale for using a multi-date approach was that seasonal differences in plant development vary by species, and using multiple dates of imagery increases the likelihood of sensing the differences among vegetation types. For example, we found that when we

used July images to classify vegetation in western Kansas, croplands such as corn and milo were often spectrally confused with some riparian vegetation types, such as cattail and bulrush marshes. When a spring scene was added, however, the differentiation among the classes was simplified because the corn and milo fields are bare soil at that time of year.

Through grants from the National Aeronautics and Space Administration (NASA), we obtained a total of 48 Landsat TM scenes - 3 each for the 16 path/row scenes required for complete coverage of the state (Table 5). Images were selected based on data availability and cloud contamination. In most cases (10 of 16), we were able to acquire multi-seasonal imagery from a single year. For the remaining path/rows, however, scenes from two, or in some cases three, different years were used.

Table 5. Landsat Thematic Mapper Images Used in Map Land Cover for Kansas GAP.

Landsat Path/Row	Spring Image	Summer Image	Fall Image
26/34	23 March 1992	27 June 1992	14 August 1992
27/32	01 May 1992	18 June 1992	21 August 1992
27/33	23 May 1994	10 July 1994	28 September 1994
27/34	10 April 1996	13 July 1995	28 September 1994
28/32	30 May 1994	30 July 1993	16 September 1993
28/33	09 April 1993	30 July 1993	16 September 1993
28/34	22 April 1992	30 July 1993	16 September 1993
29/32	16 April 1993	30 June 1997	13 September 1995
29/33	03 April 1994	26 June 1992	19 August 1992
29/34	14 June 1991	18 July 1992	19 August 1992
30/32	28 May 1994	16 August 1994	17 September 1994
30/33	06 May 1992	25 July 1992	27 September 1992
30/34	06 May 1992	25 July 1992	27 September 1992
31/32	01 April 1994	07 August 1994	08 September 1994
31/33	01 April 1994	22 July 1994	08 September 1994
31/34	27 April 1992	01 August 1992	02 September 1992

Land Cover Map Development

Following acquisition of the satellite data, each scene underwent preprocessing that included checking for data quality, data volume reduction, rectification, subsetting, and masking. Image classification proceeded in two stages: first, unsupervised classification was used to separate cropland from natural vegetation; then, supervised classification was used to map the natural vegetation alliances. Following the supervised classification, post-hoc, or post-classification, procedures were employed to refine the land cover map.

Data Preprocessing

Each TM scene was downloaded from CD-ROM and imported into ERDAS Imagine software. Each scene was inspected for cloud cover, line dropout, and system noise. To reduce the volume of data, only bands 3, 4, 5 and 7 were used. Previous research conducted at the Kansas Applied Remote Sensing (KARS) program had shown that these four bands were most useful in classifying vegetation in Kansas (Egbert, et al., 1995).

One scene for each path/row was then geometrically rectified to a Universal Transverse Mercator (UTM) projection using a minimum of 50 ground control points (GCPs) and the cubic convolution interpolation technique. Public land survey system (PLSS) digital line graphs (DLGs) at a scale of 1:100,000 were used as the reference data for georectification. Only those GCPs that were easily identifiable on the imagery and that were evenly distributed throughout the scene were used for rectification. The majority of GCPs chosen were at road intersections or section corners. After one scene for each path/row was rectified, it was used as the base image to georegister the other two scenes. The cubic convolution transformation model estimated the pixel locations within each scene to within 15 m (0.5 pixels) of the GCPs.

After rectification, the three dates of imagery for each path/row were combined to create one 12-band multitemporal image file using the layer stack utility function in ERDAS Imagine. The edges of each 12-band image were then cleaned so that only those pixels that were present in all three dates were preserved. This was necessary because of slight positional offsets that occur from date to date due to minor variations in the satellite's orbit. A model was used to look for the presence of pixels in the three dates of images. If a pixel was not present in all three dates, it was deleted. To further reduce the data set, each multitemporal scene was then subset to minimize overlap between path/rows and eliminate areas beyond the 10 km buffer outside of the state boundary (Figure 1). The 10 km buffer extending beyond the state boundaries was included in image processing for purposes of permitting edge matching between neighboring states. The final map product was clipped to the state boundary.

Next, to map non-vegetated areas, an urban and water mask was created. A data file generated at the KARS program from the Kansas Land Cover Mapping project (Whistler et al., 1995) was used as a preliminary mask. The mask was then updated to include areas of urban expansion and additional water bodies. Using the satellite data as a backdrop, these areas were screen digitized and added to the urban and water mask. To further classify additional water bodies, an unsupervised classification was employed on the 12-band imagery using the Iterative Self-Organizing Data Analysis Technique (ISODATA) clustering algorithm and the maximum likelihood classifier. One hundred (100) spectral classes were generated and each class was assigned to a water or non-water class. The water classes were then added to the urban and water mask. Urban areas and water bodies were then masked from the 12-band images to eliminate non-vegetated features.

As outlined above, the vegetation in each path/row was classified using a two-stage hybrid classification approach. The first stage classified the data into two classes, cropland and natural vegetation. The second stage classified the natural vegetation into alliance-level vegetation classes.

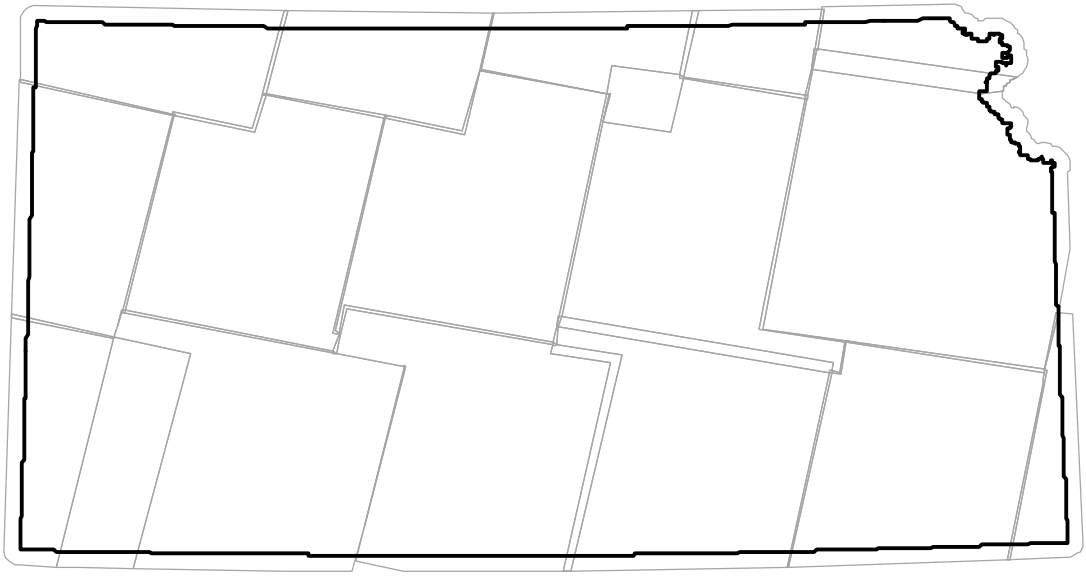

Figure 1. Scene Boundaries for Landsat TM Imagery Used in Kansas GAP.

Stage One: Unsupervised Classification

The first stage classified the 12-band images using an unsupervised classification approach. Each 12-band image was divided into four quadrants allowing easier manipulation of the data. The ISODATA clustering algorithm and maximum likelihood classifier were used to generate 100 spectral classes per scene. If there was no cloud cover in all three dates for a path/row, all 12 bands were used to classify the scene. If there was cloud cover in one or more dates, we digitized clouds and their shadows, masked them out, and classified the remaining cloud-free areas using the 12 bands. Areas containing cloud cover were classified using bands from dates that were cloud-free (e.g. for a path/row with spring clouds, the cloud-covered area was classified using bands from the summer and fall dates). In situations where cloud cover overlapped between two dates, only one date of imagery was used to classify the cloud-covered areas.

Next, with the three dates of imagery displayed in separate windows on-screen, each class was highlighted and assigned as cropland, natural vegetation, or confused. Confused classes were those clusters that contained substantial numbers of pixels in both the cropland and natural vegetation classes. For confused classes, a "cluster-busting" technique (Jensen, et al., 1987) was used, where unsupervised classification was used to break out each confused class into 15 additional classes. Each of the 15 classes was then

individually highlighted and assigned to a class. This process was repeated until no confused classes remained.

Next, we used the MegaMerge program (Ford and Barsnes, n.d.) to generalize the classified image to a 2 ha (22 pixel) minimum mapping unit (MMU). The classified image and the raw imagery in naturally vegetated areas were exported as ERDAS 7.x (.lan) files and were used as input in the MegaMerge program, which merges pixels based on similarity and index matrices generated by the program. We had the program search for pixels in eight adjacent directions (queen's case). Since MegaMerge uses both the classified image and the masked raw data as inputs, we generalized cloud and cloud-free classified images separately and used only the appropriate bands from the raw data as inputs.

After the generalization program was used, each quadrant was visually inspected on-screen for pixels that were classified incorrectly. Pixels that were classified incorrectly were manually digitized and recoded to the appropriate class. Following the manual cleanup, the four classified quadrants were re-joined and the cropland areas were then masked out, leaving only the naturally vegetated areas for further classification (Figure 2).

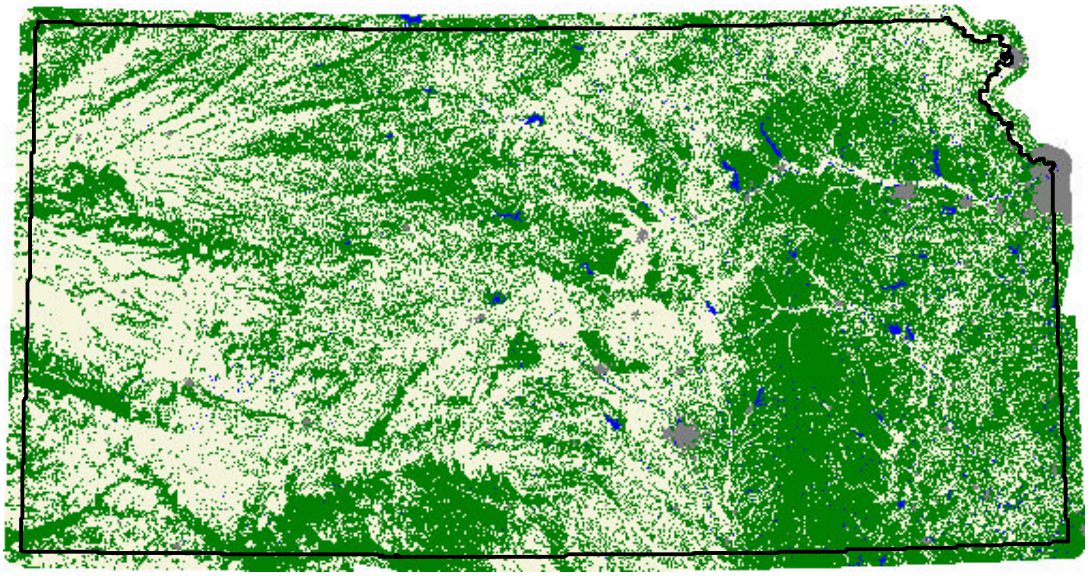

Figure 2. Stage One Land Cover Map.

Stage Two: Supervised Classification

Once the first stage of the classification was completed for each path/row, the second stage of the classification was performed using a supervised approach. To carry out the supervised classification, data from 3572 field sites were collected during three summer field campaigns (1996-1998) to use as training data (Figure 3).

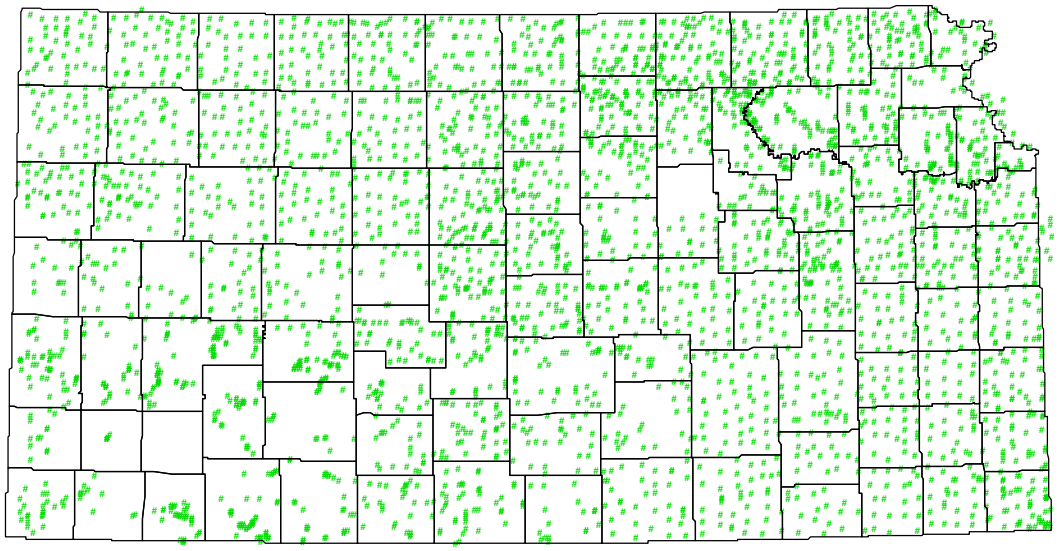

Figure 3. Field Sites Used for Supervised Classification.

The field sampling methods employed a targeted, systematic approach to collecting ground reference data. For each scene, our objective was to collect a minimum of 15 examples of each natural vegetation type. Additional ground reference data were collected for other land cover types, including CRP lands and non-native grasslands and shrublands. Collection of field data was assisted by the use of 1:100,000-scale topographic maps produced by the USGS. Prior to the field work, we produced map overlays for the topographic maps depicting land classified as either cropland or natural vegetation (i.e., the stage-one classified map). The overlays accompanied the base maps to guide field personnel into areas with natural vegetation.

In the field, analysts collected data on upland vegetation types in a targeted systematic fashion using a grid composed of section line roads. Starting points were randomly selected, while data collection points were spaced roughly 7 to 8 miles apart to ensure the characterization of the variability of the dominant land cover types that occur throughout the region covered by each TM scene. While driving along the grid, data on wetland vegetation types were collected when natural lowland areas were encountered. We used this "opportunistic" approach because examples of wetlands are rare compared to the upland vegetation types.

Because of time and labor constraints and the need to cover large areas in a limited amount of time, we adopted a rapid assessment technique for collecting field data. At each sampling location, the following data were collected: the type of vegetation classified to the alliance level (and to the plant community type if possible); notes on the general condition or quality of the vegetation (e.g., intensity of grazing; presence of exotic species cover); and georeferencing data (UTM and latitude/longitude) using a GPS unit. In addition to field sites collected by field survey personnel working for Kansas GAP, a number of sites were also collected by employees of the Kansas Department of Wildlife and Parks using the same field survey forms. All field site survey forms were reviewed and cross-checked in the laboratory by KBS and KARS scientists.

Using field data sheets as a reference, training sites were screen digitized for each path/row using the imagery as a backdrop. In addition to the field data sheets, digital PLSS vector data files were used as a reference tool. The PLSS files were overlaid on top of the satellite images to provide additional reference. If the field site fell on cloud cover, it was named accordingly so that it would be used appropriately in the classification. (For example, if a field site fell on spring clouds, it would be used to classify summer and fall cloud areas, but not used to classify spring cloud areas or cloud-free areas.)

The digitized sites were then used to train the maximum likelihood classifier for each path/row. For path/rows with cloud cover, we used the same methodology as described in the first classification stage. The naturally vegetated areas of the 12-band image were classified into classes corresponding to the field sites (for example, if there were 300 field sites, the resulting image would have 300 classes). The classes within each classified image were then recoded to reflect the alliance-level vegetation class number. For example, all tallgrass prairie classes were recoded to class 17 and all cattail marsh classes were recoded to class 33.

Each image was generalized to an MMU of 2 ha using the same methodology as described in the first classification stage. Next, the cloudy and cloud-free images were put together and the urban, water, and cropland classes were added to the classified images. Following this, an initial mosaic of the vegetation of the state was created by combining the individual classified scenes using the mosaic tool in ERDAS Imagine.

After the mosaic was created, the statewide map was inspected by ecologists and biologists from the Kansas Biological Survey and remote sensing analysts from the Kansas Applied Remote Sensing Program. In addition, a “small multiples” poster was generated. According to Tufte (1983), "small multiples resemble the frames of a movie," the purpose of which is to put "emphasis on changes in data, not changes in data frames." The objective is to put multiple versions of a single map adjacent to each other in such a manner as to permit easy visualization of spatial patterns. In this case, the small multiples poster consisted of 15 separate maps of the state in a matrix of five rows with three maps each. On each of the small multiple maps, two to four vegetation alliance classes were highlighted in shades of green and red, while other classes were displayed in neutral colors (cropland in tan, and all other classes in gray). Ecologists and remote sensing

scientists also examined these maps and found them helpful in identifying errors in the initial classification. Potential regions of error were further explored using on-screen displays of individual scenes. Based on the regions identified, a number of post-hoc, or post classification, procedures were employed to refine the land cover map. While some refinements were conducted on a statewide basis or a county-level basis, the majority of refinements were performed on a scene by scene basis.

Post-Classification Refinements

Statewide Refinements:

(1) Due to the small number of training sites for pondweed aquatic wetland and the small number of pixels classified as pondweed aquatic wetland, this class was recoded to weedy marsh.
(2) Ongoing work with the US National Vegetation Classification System folded the cottonwood savanna class into the cottonwood floodplain woodland class. Cottonwood savanna was therefore recoded to the appropriate class, either shortgrass prairie or mixed prairie, depending on location.
(3) Due to the small number of training sites for the rock outcrop class, this class was recoded to the appropriate land cover classes (crop or shortgrass prairie).
(4) Ongoing work with the US National Vegetation Classification System folded the Dakota tallgrass prairie alliance into the tallgrass prairie alliance. Dakota tallgrass prairie was recoded to tallgrass prairie.

Regional Refinements

(1) Vegetation within the Smoky Hills Air National Guard Range was initially classified incorrectly as CRP land. The boundary of this area was hand digitized and CRP was recoded to tallgrass prairie.

(2) There was a scene boundary problem between 28-34 and 29-34. A distinct line existed between the two scenes where tallgrass prairie changed to mixed prairie. Kuchler's Potential Natural Vegetation map (1974) was used to refine the boundary between tallgrass and mixed prairie.

(3) There was an overestimation of CRP land. A new CRP map was created by differencing the two classified images of Kansas. The Kansas Land Cover Patterns (KLCP) database developed in 1993 used late 1980s satellite imagery to map land cover types. The CRP program was initiated in 1986 and therefore, the satellite imagery for the KLCP dataset was earlier than most CRP enrollments. A comparison between the KLCP and the GAP cropland/natural vegetation map (stage-one classification) showed areas

that had been taken out of agriculture and enrolled into CRP. This derived CRP map was used in several areas of the state, especially in the west, where CRP enrollments are highest. (See additional discussion of CRP under Special Feature Mapping, below.)

Scene Refinements

(1) 26-34, 27-34: There was an overestimation of floodplain forest and woodland types in areas outside of floodplains. To refine the map, areas classified as floodplain forest types outside of the floodplains were reclassified to upland forest types. To do this, first a 250 meter buffer of the Surface Water Information Management System (SWIMS) hydrologic data set was created and then used to identify floodplain forest pixels that were classified outside of the floodplains. These areas were then masked out of the raw data. Only the upland forest field training sites were used to train the classifier in a re-classification of the masked data set (i.e., the upland areas). Following the supervised classification, the reclassified area was generalized and added back to the initial classified image.

(2) 27-33: There was an overestimation of forest and woodland types in areas outside of floodplains. To refine the map, areas classified as floodplain forest types outside of the floodplains were reclassified to upland forest types. To do this, first a 250 meter buffer of the Surface Water Information Management System (SWIMS) hydrologic data set was created and then used to identify floodplain forest pixels that were classified outside of the floodplains. These areas were then masked out of the raw data. Only the upland forest field training sites were used to train the classifier in a re-classification of the masked data set (i.e., the upland areas). Following the supervised classification, the reclassified area was generalized and added back to the initial classified image.

Incorrectly classified CRP pixels were identified using the derived CRP map, masked from the satellite imagery, and classified using tallgrass prairie and non-native grassland field sites (classes 17 and 40, respectively) to train the classifier. Following the classification refinements, the reclassified area was generalized and added back to the initial classified image.

(3) 28-32, 28-33: There was an overestimation of non-native grassland within the Flint Hills. Areas classified as non-native grassland within the Flint Hills physiographic province were recoded to tallgrass prairie (Wilson, 1978).

(4) 29-33: Incorrectly classified CRP pixels were identified using the derived CRP map, masked from the satellite imagery, and recoded to mixed prairie.

(5) 29-34: There was an overestimation of ash-elm-hackberry and cottonwood floodplain forests outside of the floodplains. A 250 meter buffer of the SWIMS hydrologic data set was used to identify floodplain forest pixels outside of the floodplains. These pixels were then recoded to mixed prairie.

Playa lakes were overestimated throughout the scene. The Soil Survey Geographic (SSURGO) database was used to identify Randall Clay, Ness Silty Clay, and Pleasant soils where playa lakes are likely to occur. Pixels classified as playa lakes outside of these soil types were recoded to mixed prairie.

There was an overestimation of sand prairie in the southern portion of the scene. A digitized coverage of Kuchler's potential vegetation of Kansas (1974) was used to delineate areas to change from sand prairie to mixed prairie. Pixels classified as sand prairie that Kuchler mapped as mixed prairie were recoded to mixed prairie.

There was an overestimation of alkaline marsh in upland areas. A 250 meter buffer of the SWIMS hydrologic data set was used to identify alkaline marsh pixels in upland areas. Pixels classified as alkaline marsh in the uplands were recoded to mixed prairie. The alkaline marsh class was then renamed to bulrush marsh.

Problems were also identified with the mapped distribution of CRP land. Areas identified as CRP in the derived CRP map were inserted into the classified image. Areas incorrectly identified as CRP were recoded to mixed prairie.

(6) 30-32: There were pixels around the Kerwin Reservoir that were classified as cattail marsh that should have been classified as water. Using the multitemporal satellite data as a reference, these areas were manually digitized and recoded to water.

(7) 30-33: Pixels classified as cottonwood savanna were recoded to mixed prairie.

(8) 30-34: There was an overestimation of floodplain forest types in areas outside of floodplains. A 250 meter buffer of the SWIMS hydrologic data set was used to identify floodplain forest pixels that were classified outside of the floodplains. Additional floodplain areas were screen digitized around the Arkansas lowlands and the Cimarron floodplain and were also used to identify floodplain forest pixels that were classified outside of the floodplains. These areas were then masked out of raw data and reclassified using only the upland forest field sites. Following the supervised reclassification, the reclassified area was generalized using MegaMerge.

The CRP class was confused with other vegetation classes. Incorrectly classified CRP pixels identified by comparing the derived CRP map with the initial classified map were masked from the satellite imagery and were reclassified using all other grassland field sites (classes 12-25) to train the classifier. Following the classification refinements, the reclassified image was generalized, then added back to the initial classified image.

There was an overestimation of sandsage prairie and sand prairie in the south central and southwestern portions of the image. A digitized coverage of Kuchler's potential vegetation of Kansas was used to delineate areas that should be changed from sandsage prairie and sand prairie to shortgrass prairie. Pixels that were classified as sandsage or sand prairie in these areas were recoded to shortgrass prairie.

There was an overestimation of shortgrass and sand prairie in the southeastern and southwestern portions of the image. Pixels classified as shortgrass and sand prairie in the southeast were recoded to mixed prairie. Pixels classified as sand prairie in the southwest were recoded to sandsage shrubland. The recodes were carried out on the generalized image.

(9) 31-32: There was an overestimation of spikerush playa lakes. The spikerush play lake training sites were deleted from the signature file and the new signature file was used to reclassify the entire image. The image was then generalized.

(10) 31-33: The cottonwood savanna class was eliminated by recoding pixels classified as cottonwood savanna to shortgrass prairie.

(11) 31-34: Alkali sacaton prairie was eliminated by recoding pixels classified as alkali sacaton prairie to shortgrass prairie. The rock outcrop class was eliminated by recoding pixels to either cropland or shortgrass prairie. Using the raw data as a visual reference, feedlots mapped as rock outcrop pixels were recoded to cropland.

County Level Refinements

County level refinements addressed the overestimation or underestimation of classified CRP lands. Using the derived CRP map along with reported CRP land area totals per county, counties for which CRP was grossly overestimated or underestimated on the initial classification map were identified. The derived CRP map was used to recode pixels that had changed from cropland to natural vegetation from the KCLP to the GAP map. Incorrectly classified CRP pixels were masked from the satellite

imagery and were recoded to an appropriate class. County totals of grassland classes were used to select the appropriate class.

Cowley, Butler, Greenwood, Elk: Incorrectly classified CRP was recoded to tallgrass prairie.
Sumner: Incorrectly classified CRP was recoded to non-native grassland.
Reno, Kingman, Jewel, and Smith: Incorrectly classified CRP was recoded to mixed prairie.

Special Feature Mapping

Of special interest in Kansas are grasslands created by the Conservation Reserve Program (CRP). Instituted in 1985, the Conservation Reserve Program resulted in the conversion of approximately 14.8 million ha (36.5 million acres) of cropland to grassland, woodland, and other conservation uses between 1986 and 1992 throughout the United States. In Kansas, 1,170,034 ha (2,888,974 acres) of cropland were converted to CRP grassland, increasing the total area in grassland in the state by 14%. This represents, among other things, an addition of millions of hectares of potential wildlife habitat. Numerous studies already have demonstrated the use of CRP grasslands by a wide variety of bird and other species (e.g., Berthelson and Smith, 1995; Kantrud, 1993; Roseberry, et al., 1994).

CRP grasslands generally are not regarded as permanent, since their continued existence relies on ongoing government subsidies to the agricultural producers who own them. However, because of their potential value as wildlife habitat and because they cover a substantial area spatially, we decided to map CRP as a separate grassland type. It is anticipated that including CRP as a separate map class will be especially valuable to wildlife managers and scientists by providing a tool for studying species that may use CRP for nesting, forage, and other uses.

Initially, we attempted to map CRP with supervised image classification using training sites collected during field sampling. Our results, however, were somewhat disappointing, most likely because CRP in reality is a land use, consisting of a number of different grassland mixtures, rather than a land cover. Therefore, there was a considerable degree of confusion between CRP and several other grassland alliances in the initial classification. Consequently we decided to use a post-classification differencing technique to derive a map of CRP grasslands. To do this, we compared the stage-one map of cropland and natural vegetation created for GAP with the Kansas Land Cover Patterns (KLCP) map created several years earlier. Pixels that had changed from cropland on the KLCP map to natural vegetation on the GAP stage-one map were identified as CRP. This derived CRP map was used in several areas of the state as described above, especially in the west, where CRP enrollments are highest.

RESULTS

The end product of the Kansas GAP land cover mapping project is the first detailed digital vegetation map of Kansas. A summary of the alliance-level land cover types, their area mapped in square kilometers, and the percent of the total area in Kansas represented by each alliance is presented in Table 6. The Kansas GAP land cover map is depicted in Figure 4. Although a detailed analysis of the distribution of vegetation in Kansas is beyond the scope of this report and will be discussed in separately published articles, the broad patterns of land cover are readily apparent in the table and map. The effects of human activity are clearly reflected in the fact that over 48% of the state's land area is devoted to cropland. Further evidence of human activity can be seen in non-native grassland and CRP, the combined area of which (over 10%) exceeds the area covered by either shortgrass prairie or mixed prairie.

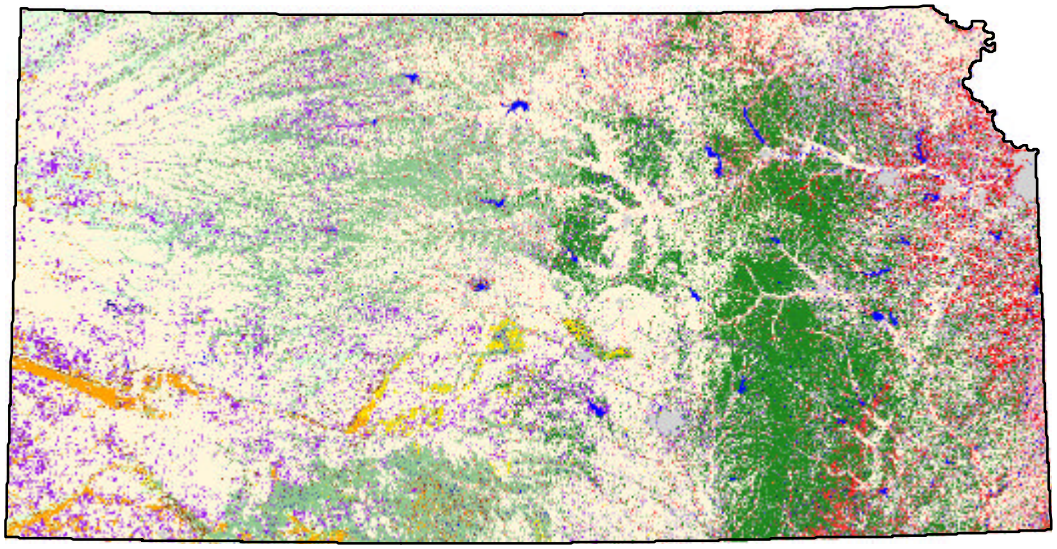

Figure 4. Final GAP Land Cover Map.

In terms of natural vegetation, tallgrass prairie, mixed prairie, and shortgrass prairie dominant the Kansas landscape, combining for approximately 26% of the total land area of the state. Floodplain forests and floodplain woodlands dominate the wooded landscape, although there are also substantial areas of upland oak-dominated forests. Even a casual glance at the map reveals distinct spatial patterns. The tallgrass prairies of the Flint Hills in the east and the mixed prairies of the Red Hills in the south-central part of the state outline and highlight those physiographic provinces. Eastern Kansas shows as a complex mosaic of forests and woodlands, tallgrass prairies, introduced non-native grasslands, and cropland, while southwestern Kansas is characterized by sandsage shrubland, shortgrass prairie, large tracts of CRP, and even larger tracts of contiguous cropland.

Table 6. Alliance-Level Land Cover Types, Their Area Mapped (sq. km.), and the Percent of the State's Total Area Represented by Each Alliance.

Land Cover Type	Sq Km	% Area
Forest Alliances		
Maple-Basswood Forest	467,064	0.02
Oak-Hickory Forest	35,178,759	1.65
Post Oak-Blackjack Oak Forest	18,450,819	0.87
Pecan Floodplain Forest	3,178,197	0.15
Ash-Elm-Hackberry Floodplain Forest	40,031,415	1.88
Mixed Oak Floodplain Forest	6,289,227	0.30
Deciduous Forest-Mined Land	5,607,396	0.26
Maple Floodplain Forest	221,454	0.01
Evergreen Forest-Disturbed Land	263,592	0.01
Cottonwood Floodplain Forest	24,279,786	1.14
Woodland Alliances		
Bur Oak Floodplain Woodland	1,407,069	0.07
Post Oak-Blackjack Oak Woodland	1,056,141	0.05
Mixed Oak Ravine Woodland	9,086,292	0.43
Deciduous Woodland	1,687,041	0.08
Cottonwood Floodplain Woodland	24,167,628	1.13
Shrubland Alliances		
Sandsage Shrubland	26,823,366	1.26
Willow Shrubland	363,924	0.02
Buttonbush (Swamp) Shrubland	203,427	0.01
Salt Cedar or Tamarisk Shrubland	1,282,608	0.06
Upland Prairie Alliances		
Tallgrass Prairie	281,920,347	13.23
Sand Prairie	11,556,486	0.54
Western Wheatgrass Prairie	31,319,973	1.47
Sandstone Glade/Prairie	1,287	0.00
Mixed Prairie	207,811,242	9.75
Alkali Sacaton Prairie	606,060	0.03
Mixed Prairie-Disturbed Land	14,718,213	0.69
Shortgrass Prairie	75,764,421	3.55
Weedy Upland	1,446,588	0.07
Introduced Grasslands		
Non-native Grassland	111,061,260	5.21
CRP	104,757,066	4.92
Wetland Alliances		
Grass Playa Lake	113,832	0.01
Salt Marsh/Prairie	532,062	0.02
Spikerush Playa Lake	82,341	0.00
Playa Lake	12,501	0.00
Low or Wet Prairie	4,026,825	0.19
Freshwater Marsh	1,127,700	0.05

Land Cover Type	Sq Km	% Area
Bulrush Marsh	5,210,442	0.24
Cattail Marsh	6,503,481	0.31
Forb Playa Lake	21,114	0.00
Weedy Marsh	1,349,082	0.06
Other Classes		
Cropland	1,031,854,851	48.42
Urban Areas	23,384,448	1.10
Water	15,989,175	0.75

ACCURACY ASSESSMENT

GAP land cover maps are primarily compiled to answer the fundamental question in gap analysis: what is the current distribution and management status of the nation's major natural land cover types and wildlife habitats? Besides giving a measure of overall reliability of the land cover map for Gap Analysis, the assessment also identifies which general classes or which regions of the map do not meet the accuracy objectives for the Gap Analysis Program. Thus the assessment identifies where additional effort will be required when the map is updated. We report the results of the accuracy assessment, believing that the map is the best map currently available for the project area.

The purpose of accuracy assessment is to allow a potential user to determine the map's "fitness for use" for their application. It is impossible for the original cartographer to anticipate all future applications of a land cover map, so the assessment should provide enough information for the user to evaluate fitness for their unique purpose. This can be described as the degree to which the data quality characteristics collectively suit an intended application. The information reported includes details on the database's spatial, thematic, and temporal characteristics and their accuracy.

Assessment data are valuable for purposes beyond their immediate application to estimating accuracy of a land cover map. The reference data is therefore made available to other agencies and organizations for use in their own land cover characterization and map accuracy assessments (see Data Availability for access information). The data set will also serve as an important training data source for later updates.

Even though we have reached an endpoint in the mapping process where products are made available to others, the gap analysis process should be considered dynamic. We envision that maps will be refined and updated on a regular schedule. The assessment data will be used to refine GAP maps iteratively by identifying where the land cover map is inaccurate and where more effort is required to bring the maps up to accuracy standards. In addition, the field sampling may identify new classes that were not identified at all during the initial mapping process.

Accuracy Assessment Methods

Accuracy assessment of the Kansas GAP land cover map was conducted at three levels of land cover generalization using three different approaches. Details of the assessment methodology and a summary of the results are presented below. Full accuracy assessment figures are contained in Appendix C of this report and are also available through the Kansas Data Access Support Center web site (http://gisdasc.kgs.ukans.edu).

Accuracy levels were calculated by comparing the classified data with 829 field or ground verification sites that were collected throughout the state in 2000 (Table 7 and Figure 5). Ground verification sites were chosen in two steps. First, 70 random USGS 7.5-minute quad maps (1:24,000 scale), stratified by physiographic province, were chosen from the state. The number of quads chosen from each physiographic province was in proportion to the total area of that province in the state (Table 8). Only quads that were classified as over 50% natural vegetation were included.

Table 7. Number of Field Verification Sites Collected, by Alliance Type.

Alliance Name (Common)	Samples	Alliance Name (Common)	Samples
Maple - Basswood Forest	0	Salt Marsh/Prairie	0
Oak - Hickory Forest	7	Spikerush Playa Lake	0
Post Oak - Blackjack Oak Forest	7	Playa Lake	0
Pecan Floodplain Forest	1	Low or Wet Prairie	2
Ash - Elm - Hackberry Floodplain Forest	32	Freshwater Marsh	0
Cottonwood Floodplain Forest	1	Bulrush Marsh	0
Mixed Oak Floodplain Forest	0	Cattail Marsh	3
Bur Oak Floodplain Woodland	3	Forb Playa Lake	0
Mixed Oak Ravine Woodland	2	Non-Native Grassland	105
Post Oak - Blackjack Oak Woodland	3	CRP (Conservation Reserve Program)	131
Cottonwood Floodplain Woodland	11	Salt Cedar or Tamarisk Shrubland	2
Sandsage Shrubland	29	Cropland	50
Willow Shrubland	0	Deciduous Forest - Mined Land	1
Buttonbush (Swamp) Shrubland	0	Maple Floodplain Forest	0
Tallgrass Prairie	106	Evergreen Forest - Disturbed Land	0
Sand Prairie	28	Deciduous Woodland	10
Western Wheatgrass Prairie	25	Mixed Prairie – Disturbed	26
Sandstone Glade/Prairie	0	Weedy Marsh	3
Mixed Prairie	125	Weedy Upland	9
Alkali Sacaton Prairie	0	Urban Areas	0
Shortgrass Prairie	106	Water	1
Grass Playa Lake	0	**TOTAL**	**343**

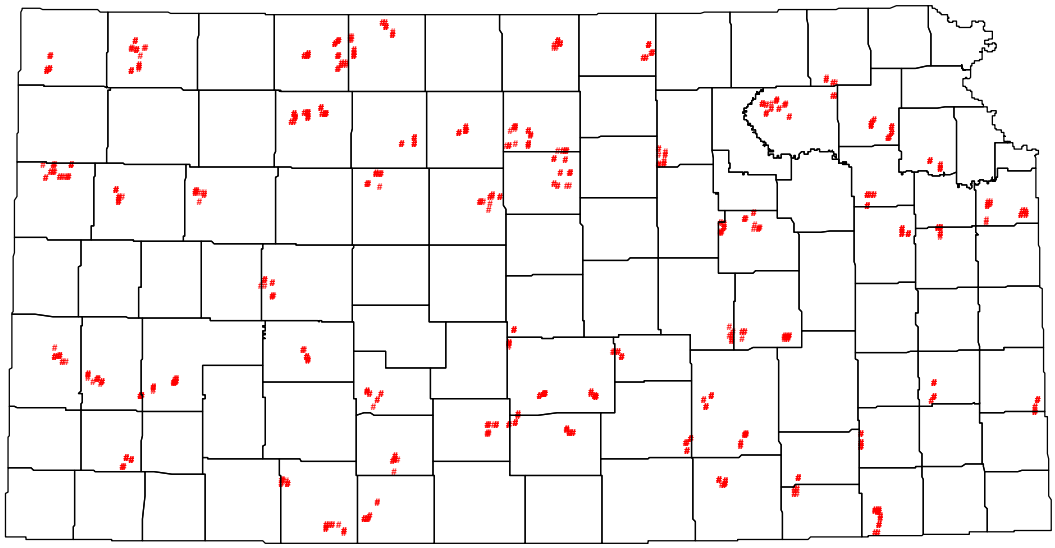

Figure 5. Field Verification Sites for Accuracy Assessment.

Table 8. Number of USGS Topographic Quad Sheets Used in Accuracy Assessment, by Physiographic Province.

Physiographic Province	% of Kansas	# of Quads
Ozark Plateau	0.08	0
High Plains	31.29	22
Glaciated Region	8.19	6
Smoky Hills	20.94	14
Flint Hills Uplands	10.85	7
Osage Cuestas	12.97	9
Wellington-McPherson Lowlands	3.80	3
Arkansas River Lowlands	6.66	5
Chautauqua Hills	0.93	1
Cherokee Lowlands	1.10	1
Red Hills	3.18	2

Information collected in the field included primary, secondary, and tertiary alliance vegetation types, GPS readings, and descriptions and sketches of field sites. After the field data collection was completed, a database was created containing the information from the field sheets. Using the database, point files were created and used as a guide for digitizing the field sites. To digitize the field sites, the three dates of imagery were displayed onscreen in ERDAS Imagine, along with public land survey system (PLSS) vectors and ground verification points. Each ground verification site was then screen digitized into a polygon vector file. Some sites that contained more than one vegetation alliance type were divided into two field sites and were digitized individually. For quality

assurance/quality control purposes, over fifty percent of the digitized field sites were inspected for positional accuracy. To check the positional accuracy, the imagery was displayed onscreen along with the digitized field sites. Then, using the field data information, we assessed whether the field site was digitized in an accurate location. Finally, the centered point within each polygon file was extracted and converted to a raster file, and a three-by-three window was then generated around each center-point pixel and saved to file.

We used three approaches for calculating accuracy levels: (1) a centered point within the digitized polygon, (2) a three-by-three window buffered around the centered point, and (3) a centered point compared to the focal majority within the polygon. The centered point within the polygon method compared the center pixel in the field site with the corresponding pixel in the classified data. The three-by-three window compared nine pixels positioned around the center point in the polygon with the corresponding nine pixels in the classified data. The focal majority function calculated the dominant land cover type for each field polygon overlaid on the classified data, which was then compared to the land cover type for the centered point in the field verification data.

In addition, three levels of land cover generalization were used to evaluate the accuracy of the Kansas GAP land cover database: alliance level, formation level and Anderson Level I land cover. The alliance level land cover map was recoded to create both a formation level land cover map and an Anderson Level I land cover map. Each of the three land cover maps was then cross-tabulated with the field sites to generate accuracy statistics. For each accuracy approach and each land cover map, we created a co-occurrence matrix (also commonly referred to as a contingency table or error matrix) and calculated omission and commission accuracy by land cover class, overall accuracy, and the Kappa (khat) statistic. If field data were not collected for a land cover class, errors of omission are not reported. There are, however, cases where no field data were collected for a land cover class, but errors of commission were possible. For example, if there were no field sites collected for water, then errors of omission for water were not reported. However, if field sites for other classes contain water pixels, errors of commission for water were reported.

A brief discussion of overall accuracy, errors of omission, errors of commission, and the Kappa statistic are given here. For a more complete discussion, *Assessing the Accuracy of Remotely Sensed Data: Principles and Practices* by Congalton and Green (1999) is recommended. As described above, accuracy assessment checks the accuracy of a land cover map by comparing map classes against ground verification sample sites. The overall accuracy number for a land cover map is calculated by dividing the total number of sample sites that were classified correctly by the total number of sample sites. Although an overall accuracy figure may give a general view of the level of accuracy achieved, it says nothing about the accuracy of individual map classes; for individual classes, accuracy may be described both in terms of errors of omission or errors of commission.

Error of omission describes how well the classification process has classified a given class within the verification sample sites. Some authors also refer to this as *producer accuracy* (Story and Congalton, 1986; Congalton, 1991); it is calculated by dividing the number of correctly classified field verification samples by the total number of field verification samples for the target class. If there are 100 field verification sample sites of shortgrass prairie and the classification process failed to identify 25 of them, the producer accuracy is 75% (75/100) and the error of omission is 25% (i.e., the classification process failed to correctly identify 25% of the shortgrass prairie verification samples).

Error of commission describes the extent to which verification samples other than those of the target class were classified as the target class. This is sometimes referred to as *user accuracy;* it is calculated by dividing the number of correctly classified field verification samples (75 in this case) by the number of all field verification samples classified as the target class. Continuing with the shortgrass prairie example, if the classification process incorrectly classifies 15 sandsage shrubland verification samples and 35 mixed prairie verification samples as shortgrass prairie (in addition to the 75 shortgrass prairie samples correctly classified), the user accuracy is 60% (75/125) and the error of commission is 40%).

KAPPA analysis produces the KHAT statistic and is a single summary statistic for the entire accuracy matrix; it is given as a decimal number. Its purpose is to give an indication of the possibility that some portion of the accuracy occurred by random chance. Therefore, the KHAT statistic will always be equal to or lower than the overall accuracy figure of the matrix.

Accuracy Assessment Results

Accuracy results for the Kansas GAP land cover map are summarized in four tables in this section. (Contingency tables, along with full accuracy figures, are included in the appendices.)

With regard to overall accuracy of the land cover map, it is clear that the appropriate number to use depends on the intended use of the map. At the Anderson Level 1 level of generalization, overall accuracy is 88-89% (comparable to accuracy results achieved for the earlier Kansas Land Cover Patterns map), while at the formation level accuracy is 64-66% (Table 9). Although the alliance level map yielded an overall accuracy of 49-51%, a number of the key individual classes had much higher accuracy figures. Furthermore, the relationship of key classes (e.g., tallgrass prairie and mixed prairie) to each other in the accuracy matrices provides additional information on how the map may be used to create user-defined classes with substantially higher effective accuracies (see also the discussion on fuzzy set analysis, below).

Tables 10, 11, and 12 present accuracy figures, by class and comparison method, for their respective levels of classification aggregation (i.e., Anderson Level 1, Formation Level,

and Alliance Level). For each class, both omission accuracy (referred to by some authors as *producer accuracy*) and commission accuracy (*user accuracy*) are presented.

Table 9. Overall Accuracy, by Classification Level and Comparison Method.

Classification Level	Comparison Method	Overall Accuracy	Kappa
Anderson Level I	Point	88.0%	0.66
	3-by-3 Window	88.3%	0.65
	Focal Majority	89.4%	0.69
Formation Level	Point	64.5%	0.52
	3-by-3 Window	64.5%	0.52
	Focal Majority	66.2%	0.54
Alliance Level	Point	49.3%	0.43
	3-by-3 Window	49.8%	0.44
	Focal Majority	51.7%	0.46

Table 10. Anderson Level 1 Accuracy, by Cover Type and Comparison Method.

Land Cover Type	Point		3-by-3 Window		Focal Majority	
	Commission Accuracy	Omission Accuracy	Commission Accuracy	Omission Accuracy	Commission Accuracy	Omission Accuracy
Herbaceous	93.9%	92.2%	93.6%	93.1%	94.4%	93.6%
Cropland	82.9%	68.0%	81.1%	65.8%	81.0%	68.0%
Urban Areas	na	na	na	na	na	na
Water	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Forest/Woodland	65.3%	82.1%	66.3%	78.9%	69.9%	83.3%
Shrubland	45.5%	48.4%	48.5%	47.0%	51.6%	51.6%

Table 11. Formation-Level Accuracy, by Formation Class and Comparison Method.

Land Cover Type	Point		3-by-3 Window		Focal Majority	
	Commission Accuracy	Omission Accuracy	Commission Accuracy	Omission Accuracy	Commission Accuracy	Omission Accuracy
Temperate or subpolar needle-leaved evergreen forest	na	na	na	na	na	na
Lowland and submontane cold-deciduous forest	32.4%	73.3%	35.8%	75.6%	35.3%	80.0%
Temporarily flooded cold-deciduous forest	41.0%	47.1%	40.2%	42.8%	43.2%	47.1%

Land Cover Type	Point		3-by-3 Window		Focal Majority	
	Commission Accuracy	Omission Accuracy	Commission Accuracy	Omission Accuracy	Commission Accuracy	Omission Accuracy
Cold-deciduous woodland	22.2%	11.1%	26.7%	16.7%	50.0%	22.2%
Temporarily flooded cold-deciduous woodland	25.0%	36.4%	25.2%	31.3%	30.8%	36.4%
Microphyllous evergreen shrubland	46.9%	51.7%	48.1%	49.4%	51.6%	55.2%
Temporarily flooded microphyllous shrubland	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Temporarily flooded cold-deciduous shrubland	na	na	na	na	na	na
Semipermanently flooded cold-deciduous shrubland	na	na	na	na	na	na
Tall sod temperate grassland	81.9%	75.7%	81.6%	75.3%	83.2%	77.8%
Medium-tall sod temperate or subpolar grassland	53.6%	68.6%	53.0%	71.0%	54.3%	72.6%
Medium-tall bunch temperate or subpolar grassland	na	na	na	na	na	na
Short sod temperate or subpolar grassland	68.0%	48.1%	68.8%	48.4%	67.1%	44.3%
Intermittently flooded temperate grassland	na	na	na	na	na	na
Temporarily flooded temperate or subpolar grassland	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Seasonally flooded temperate or subpolar grassland	50.0%	33.3%	19.0%	14.8%	0.0%	0.0%
Semipermanently flooded temperate or subpolar grassland	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Permanently flooded temperate or subpolar hydromorphic	na	na	na	na	na	na

Land Cover Type	Point		3-by-3 Window		Focal Majority	
	Commission Accuracy	Omission Accuracy	Commission Accuracy	Omission Accuracy	Commission Accuracy	Omission Accuracy
rooted vegetation						
Temperate or subpolar annual grassland or forb vegetation	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Cropland	82.9%	68.0%	81.1%	65.8%	81.0%	68.0%
Urban Areas	na	na	na	na	na	na
Water	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Table 12. Alliance-Level Accuracy, by Alliance Class and Comparison Method.

Land Cover Type	Point		3-by-3 Window		Focal Majority	
	Commission Accuracy	Omission Accuracy	Commission Accuracy	Omission Accuracy	Commission Accuracy	Omission Accuracy
Maple-Basswood Forest	na	na	na	na	na	na
Oak-Hickory Forest	26.3%	71.4%	25.7%	71.4%	26.3%	71.4%
Post Oak-Blackjack Oak Forest	38.5%	71.4%	49.4%	68.3%	46.2%	85.7%
Pecan Floodplain Forest	0.0%	0.0%	0.0%	0.0%	na	0.0%
Ash-Elm-Hackberry Floodplain Forest	42.3%	34.4%	41.0%	33.3%	41.4%	37.5%
Cottonwood Floodplain Forest	8.3%	100.0%	11.4%	100.0%	12.5%	100.0%
Mixed Oak Floodplain Forest	0.0%	na	0.0%	na	0.0%	0.0%
Bur Oak Floodplain Woodland	0.0%	0.0%	0.0%	0.0%	na	0.0%
Mixed Oak Ravine Woodland	0.0%	0.0%	15.7%	61.1%	40.0%	100.0%
Post Oak-Blackjack Oak Woodland	50.0%	33.3%	31.8%	25.9%	33.3%	33.3%
Cottonwood Floodplain Woodland	25.0%	36.4%	25.2%	31.3%	30.8%	36.4%
Sandsage Shrubland	46.9%	51.7%	48.1%	49.4%	51.6%	55.2%
Willow Shrubland	na	na	na	na	na	na
Buttonbush (Swamp) Shrubland	na	na	na	na	na	na

Land Cover Type	Point		3-by-3 Window		Focal Majority	
	Commission Accuracy	Omission Accuracy	Commission Accuracy	Omission Accuracy	Commission Accuracy	Omission Accuracy
Tallgrass Prairie	48.0%	68.9%	49.1%	72.0%	47.6%	73.6%
Sand Prairie	61.1%	39.3%	61.6%	40.1%	61.1%	39.3%
Western Wheatgrass Prairie	10.0%	8.0%	15.1%	12.9%	15.8%	12.0%
Sandstone Glade/Prairie	na	na	na	na	na	na
Mixed Prairie	43.2%	63.7%	41.6%	64.6%	44.4%	70.2%
Alkali Sacaton Prairie	na	na	na	na	na	na
Shortgrass Prairie	68.0%	48.1%	68.8%	48.4%	66.2%	44.3%
Grass Playa Lake	na	na	na	na	na	na
Salt Marsh/Prairie	na	na	na	na	na	na
Spikerush Playa Lake	na	na	na	na	na	na
Playa Lake	na	na	na	na	na	na
Low or Wet Prairie	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Freshwater Marsh	na	na	na	na	na	na
Bulrush Marsh	0.0%	na	0.0%	na	0.0%	0.0%
Cattail Marsh	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Forb Playa Lake	na	na	na	na	na	na
Non-native Grassland	60.0%	42.9%	62.1%	45.2%	69.1%	44.8%
CRP (Conservation Reserve Program)	68.0%	50.4%	69.1%	48.3%	76.4%	51.9%
Salt Cedar or Tamarisk Shrubland	0.0%	0.0%	0.0%	0.0%	na	0.0%
Cropland	82.9%	68.0%	81.1%	65.8%	81.0%	68.0%
Deciduous Forest-Mined Land	50.0%	0.0%	39.1%	0.0%	0.0%	100.0%
Maple Floodplain Forest	na	na	na	na	na	na
Evergreen Forest-Disturbed Land	na	na	na	na	na	na
Deciduous Woodland	0.0%	0.0%	0.0%	0.0%	na	0.0%
Mixed Prairie-Disturbed Land	14.3%	0.0%	18.1%	0.0%	0.0%	19.2%
Weedy Marsh	50.0%	33.3%	19.0%	14.8%	0.0%	0.0%
Weedy Upland	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Urban Areas	na	na	na	na	na	na
Water	0.0%	0.0%	0.0%	0.0%	na	0.0%

Discussion of Accuracy Results

As a review of the accuracy tables shows, in most cases (point-based, 3x3 window, and focal majority) each of the three methods of accuracy comparison produced similar results. This is particularly true for classes that cover large areas or for classes at a more generalized level of aggregation (i.e., formation or Anderson Level 1). There are, however, certain cautions that must be kept in mind when interpreting the accuracy results.

The major caveat to consider in using the accuracy figures is that even though we collected over 800 field sites for accuracy assessment, this number is inadequate given the number of classes mapped and the land area of the state. Some experts in the field of accuracy assessment recommend no fewer than 30-50 sites per cover class, while others recommend 100 or more, indicating that anywhere from 1200 to 4000 field sites were needed for assessing the Kansas GAP land cover map. We had initially planned a much more comprehensive field campaign using more robust sampling methods, but a shortfall in anticipated funding for the accuracy assessment necessitated a revised methodology and a reduced number of field sites. Therefore, of 43 land cover types mapped in the alliance map, 30 had fewer than 10 field sites and 15 had no field sites at all (Table 7). Eleven (11) land cover classes had more than 25 field sites, while six (6) of those had more than 50. Not surprisingly, given the sampling method used, land cover types with the most field sites were those covering the greatest land area, i.e., tallgrass prairie (106 sites), mixed prairie (125 sites), shortgrass prairie (106 sites), non-native grasslands (105 sites) and CRP (131 sites).

For cropland, the accuracy figures should be viewed with some degree of caution because relatively few accuracy sites were collected, especially in comparison to the area covered by cropland in Kansas. Because we were primarily interested in mapping non-cropland vegetation, we sampled cropland opportunistically during the accuracy assessment field sampling rather than as a part of the sampling scheme. Another caveat in using accuracy figures for cropland is that the dates of collection for the field sites (2000) vary from the dates of the TM imagery by anywhere from four to eight years. In most cases, this difference is of little consequence with natural vegetation classes - for example, tallgrass prairie is unlikely to change to another vegetation class (other than perhaps cropland) within such a time span. On the other hand, cropland can (and does) change rapidly to grassland. In short, although accuracy figures for cropland are relatively high, we believe them to underestimate the true accuracy.

It also should be noted that we collected no samples for urban areas and only one sample for water land cover types during the accuracy assessment field sampling. Our rationale for omitting urban and water sites was that, in the majority, they were taken from the Kansas Land Cover Patterns map completed in 1993, and the overall accuracy figures for that map, including the urban and water classes were over 85%.

To make land cover accuracy figures more meaningful, some researchers have suggested the use of fuzzy set analysis. Fuzzy set analysis relies on verbal descriptors of the quality of a land cover classification, rather than purely on numbers. Descriptors might include "Absolutely correct," "Incorrect, but acceptable," "Absolutely incorrect" and others. We have not included a fuzzy set analysis in this report, because we feel that the assignment of labels such as "Incorrect, but acceptable" is highly dependent on the analysis being conducted by the end user. For example, a wildlife analyst doing habitat research on a certain species might consider confusion of the tallgrass prairie and mixed prairie classes to be "Incorrect, but acceptable," while a grassland ecologist performing a different analysis might consider confusion between the two classes as "Absolutely incorrect."

Although we have not included fuzzy set accuracy analysis, a look at the accuracy matrices in the appendix suggests that such analysis may be useful in many cases. For example, shortgrass prairie was most often confused with mixed prairie - of 106 shortgrass prairie sample sites, 51 were classified as shortgrass prairie, while 28 were classified as mixed prairie (alliance-level, point-based comparison method; see Appendix C). Furthermore, nine sites were classified as western wheatgrass prairie and seven sites were classified as sandsage shrubland. Depending on the analysis being conducted by the map user, any or all of these classes may be combined into an "acceptable" class, with correspondingly increased accuracy. We have included the full set of accuracy matrices in the appendix not only so users of the land cover map can view the accuracy figures for a particular class or set of classes, but so they can create their own accuracy tables by aggregating classes that are acceptable for their needs and recomputing the accuracy figures accordingly.

LIMITATIONS AND DISCUSSION

In creating the Kansas GAP land cover map, our philosophy from the outset was that we would attempt to map all classes at the alliance level, even though we knew that factors such as small patch size of some cover types (e.g., many wetland types), management practices (see below), and spectral inseparability of some classes would make it difficult to map some of the alliances. Despite this, we believed it best to map at the greatest level of detail feasible, thereby permitting the end user to either work with the detailed alliance-level classes or to aggregate to more general classes, as needed.

Mapping land cover is never simple, but the Kansas grasslands offered particular challenges because in most cases they are actively managed. Common grassland management practices in Kansas include the periodic use of fire, grazing, haying, overseeding, and weed control with herbicides. The challenge for remote sensing analysts is that the results of the management practices are visible in the landscape and affect the spectral responses viewed by remote sensing devices. The end result is that in many cases management practices may have more effect on the spectral response of a grassland tract than does the species composition. It is very difficult, for example, to

spectrally distinguish tracts of shortgrass prairie from mixed prairie if both have similar management practices. It is for this reason, as much as any other, that extensive use of ancillary data sources (e.g., the Kuchler map) and post-hoc refinements was required.

In addition to mapping natural vegetation, we also adapted our classification scheme to add disturbed or managed areas with semi-natural or exotic vegetation. While this made our mapping task more difficult, it also created both a vegetation classification system and a land cover map that are more reflective of vegetation as it actually exists on the ground. Particularly notable in this regard is our success in mapping CRP. CRP represents one of the largest and most rapid conversions of cropland to grassland in history and CRP grasslands now comprise approximately 4.92% of the total land area of Kansas. When compared to areas of shortgrass prairie (3.55%) and sandsage shrubland (1.26%), for example, the significance of CRP as potential wildlife habitat comes into even sharper focus.

Because the Kansas GAP land cover map is the most detailed land cover map yet produced for the state and is likely to retain that status for a number of years, it is anticipated that it will be put to a number of uses beyond gap analysis. In that light, a few comments are offered here in regard to appropriate and inappropriate uses of the map.

In general, the map is appropriate for use in large-area resource planning (such as at the watershed or county level or higher). In terms of scale, the map can generally be used for analysis at the 1:100,000 or, in some cases, 1:50,000 scale. Often it will be more appropriate to work in terms of probabilities of occurrence rather than precise occurrence or non-occurrence of a given land cover type. Using the GAP land cover map at scales of 1:24,000 or finer is usually not appropriate. Other inappropriate uses might include using the map to define precise boundaries between mapped features, especially for regulation or acquisition; generating specific areal measurements for small features; or using GAP data to establish the accuracy of other data. An additional caveat to end users is that although the grid cell size of the digital land cover files is 30 m x 30 m (based on the pixel size of Landsat TM imagery), the minimum mapping unit for the Kansas GAP land cover map is 2 ha. ***In all cases, we strongly recommend that users of the Kansas GAP land cover map use it in conjunction with this report and the land cover metadata.***

Due to its level of detail, we fully anticipate that the Kansas GAP land cover map will be used in a wide range of analyses for a diverse group of end users. Lauver, et al. (2000) for example, used the GAP land cover map in conjunction with Kuchler's map of potential natural vegetation to evaluate the extent and nature of vegetation change in Kansas. They found that nearly 70% of the original 6.3 million ha of tallgrass prairie has been converted to agricultural land, invaded by woody vegetation, or used for urban or other purposes. On the other hand, they found that nearly 2 million ha of tallgrass prairie remain, primarily in the Flint Hills region. In a similar vein, Peterson et al. (2001) examined short-term land cover change by comparing the Kansas GAP map with the Kansas Land Cover Patterns map produced in 1993. Key findings included the conversion of large areas of

cropland to CRP, especially in the west, and the continued expansion of woodland in the eastern part of the state.

In a more detailed look at CRP, Egbert et al. (2001) examined changes in landscape structure due to CRP in southwestern Kansas. In findings potentially of significance to wildlife managers, they found that CRP has not only increased the total area in grassland and the number of grassland patches, but the core area of grassland patches has increased substantially, while the nearest neighbor distance between grassland patches has decreased. Wardlow and Egbert (2001) compared the GAP land cover map with the recently completed (2000) National Land Cover Data map of vegetation for Kansas. They found that although the maps were similar in many respects, the NLCD map overestimated grassland area in Kansas by approximately 2 million ha, apparently because the NLCD mapping methodology was restricted in most cases to only a single date of satellite imagery. In addition to the research cited above, other research projects employing the land cover map are planned or underway.

Given the open and public availability of the Kansas GAP land cover map, we encourage its widest dissemination and use. All map products, metadata, and accuracy assessment files relating to Kansas GAP land cover mapping are available for public FTP download from the Data Access Support Center (DASC) web site of the Kansas Geological Survey (http://gisdasc.kgs.ukans.edu).

ACRONYM LIST

CRP: Conservation Reserve Program
DASC: Data Access Support Center of the Kansas Geological Survey
DLG: Digital Line Graph
GCP: Ground Control Point
GRAIL: Geographic Research, Applications, and Information Laboratory
ISODATA: Iterative Self-Organizing Data Analysis Technique
KARS: Kansas Applied Remote Sensing
KBS: Kansas Biological Survey
KDHE: Kansas Department of Health and Environment
KDWP: Kansas Department of Wildlife and Parks
KLCP: Kansas Land Cover Patterns
MMU: Minimum Mapping Unit
MRLC: Multi-Resolution Land Characterization
MSS: Multispectral Scanner
NASA: National Aeronautics and Space Administration
NLCD: National Land Cover Dataset (formerly MRLC)
NVCS: National Vegetation Classification System
PLSS: Public Land Survey System
SSURGO: Soil Survey Geographic database
SWIMS: Surface Water Information Management System
TM: Thematic Mapper
USGS: U.S. Geological Survey
UTM: Universal Transverse Mercator

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APPENDIX A

Classification of the Natural Vegetation of Kansas

Appendix A is an extract (Table 1) from "A Classification of the Natural Vegetation of Kansas" by C.L. Lauver, K. Kindscher, D. Faber-Langendoen, and R. Schneider published in *The Southwestern Naturalist* 44(4):421-442, 1999.

Lauver, C. L., K. Kindscher, D. Faber-Langendoen, and R. Schneider. (1999). A Classification of the Natural Vegetation of Kansas. *The Southwestern Naturalist* 44(4):421-443.

TABLE 1—The classification of the natural vegetation of Kansas. Community types are listed in bold text followed by a unique TNC code (Anderson et al., 1998). Types marked with an asterisk (*) are wetlands. Plant species occurring in the same stratum are separated by " - ", and species occurring in different strata are separated by the " / " symbol. Species listed in parentheses are typical of a majority of stands, but are not found consistently in the type. Species listed within the [ ] symbols are regionally significant but are not generally found in Kansas.

United States National Vegetation Classification	Kansas community types
I.	**FOREST** (61 to 100% tree cover; trees >5m tall)
I.B.	Deciduous forest (deciduous species contribute >75% of total tree cover)
I.B.2.	Cold-deciduous forest
I.B.2.N.a.	Lowland and submontane cold-deciduous forest
I.B.2.N.a.	ACER SACCHARUM - TILIA AMERICANA - (QUERCUS RUBRA) FOREST ALLIANCE
I.B.2.N.a.	**Acer saccharum - [Acer nigrum] - Tilia americana - Quercus rubra / Ostrya virginiana Forest** (2061) Common name: maple - basswood forest Distribution: Glaciated Region (restricted to the eastern third of this region) Other states: IA, MO, NE Pattern: small-patch Habitat: moderate to steep slopes on uplands and valley sides Soils: well drained silts and loams, formed in loess or glacial till Other species: Asimina triloba, Carya cordiformis, Celtis occidentalis, Fraxinus americana, Gymnocladus dioica, Juglans nigra, Prunus serotina, Quercus macrocarpa, Staphylea trifolia, Ulmus americana, Viburnum

prunifolium

Note: In general, Acer nigrum is not part of the Kansas community type but is a regional co-dominant.

I.B.2.N.a. QUERCUS ALBA - (QUERCUS RUBRA, CARYA SP.) FOREST ALLIANCE

I.B.2.N.a. **Quercus alba / Cornus florida Unglaciated Forest** (2066)

Common names: oak - dogwood forest, Ozark forest

Distribution: Ozark Plateau

Other states: IL, IN, MO

Pattern: large-patch

Habitat: level to steep uplands

Soils: cherty, silty well drained soils, formed from cherty limestone

Other species: Carya cordiformis, Carya ovata, Danthonia spicata, Euonymus atropurpureus, Ostrya virginiana, Sassafras albidum, Staphylea trifolia, Vaccinium arboreum

I.B.2.N.a. **Quercus alba - (Quercus velutina) - Carya ovata / Ostrya virginiana Forest** (2011)

Common name: oak - hickory forest

Distribution: Glaciated Region, Osage Cuestas

Other States: IA, MO, NE, OK

Pattern: large-patch

Habitat: gentle to moderately steep slopes on uplands and valley sides

Soils: poorly drained to well drained silts and loams, formed in loess, glacial till, or from shale or limestone

Other species: Carya cordiformis, Cercis canadensis, Fraxinus americana, Prunus serotina, Quercus rubra, Ulmus americana, Viburnum rufidulum

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I.B.2.N.a. QUERCUS STELLATA - QUERCUS MARILANDICA FOREST ALLIANCE

I.B.2.N.a. **Quercus stellata - Quercus marilandica - [(Carya texana)] Forest** (2074)

Common names: post oak - blackjack oak forest, Cross Timbers forest

Distribution: Chautauqua Hills, Osage Cuestas

Other states: OK, TX

Pattern: large-patch

Habitat: ridgetops and nearly level to steep hillsides

Soils: shallow to moderately deep, sandy and loamy soils from sandstone

Other species: Carya cordiformis, Quercus prinoides, Quercus velutina, Rhus copallina, Rhus glabra, Schizachyrium scoparium

I.B.2.N.d. Temporarily flooded cold-deciduous forest

I.B.2.N.d. CARYA ILLINOINENSIS - (CELTIS LAEVIGATA) TEMPORARILY FLOODED FOREST ALLIANCE

I.B.2.N.d.* **Carya illinoinensis - Celtis occidentalis Forest** (2087)

Common name: pecan - hackberry floodplain forest

Distribution: Cherokee Lowlands, Glaciated Region, Osage Cuestas

Other states: AR, MO (possible), OK, TX

Pattern: small-patch

Habitat: nearly level floodplains along major streams and rivers

Soils: deep, poorly drained to well drained, formed in silty and clayey recent alluvium

Other species: Acer negundo, Carex grayi, Fraxinus pennsylvanica, Juglans nigra, Parthenocissus quinquefolia, Platanus occidentalis, Toxicodendron radicans, Ulmus americana

I.B.2.N.d. FRAXINUS PENNSYLVANICA - ULMUS AMERICANA - CELTIS

(OCCIDENTALIS, LAEVIGATA) TEMPORARILY FLOODED FOREST ALLIANCE

I.B.2.N.d.* **Fraxinus pennsylvanica - Ulmus sp. - Celtis occidentalis Forest** (2014)

Common name: ash - elm - hackberry floodplain forest

Distribution: eastern half of Kansas

Other states: IA, IL, IN, MI, NE, OH

Pattern: large-patch

Habitat: nearly level bottoms and terraces along major streams and rivers

Soils: deep, poorly drained to well drained, formed in silty and clayey recent alluvium

Other species: Juglans nigra, Parthenocissus quinquefolia, Populus deltoides, Quercus palustris, Quercus shumardii, Toxicodendron radicans, Ulmus americana, Ulmus rubra

I.B.2.N.d. POPULUS DELTOIDES TEMPORARILY FLOODED FOREST ALLIANCE

I.B.2.N.d.* **Populus deltoides - Platanus occidentalis Forest** (2095)

Common name: cottonwood - sycamore floodplain forest

Distribution: Cherokee Lowlands, Flint Hills Uplands, Glaciated Region, Osage Cuestas

Other states: MO (possible)

Pattern: large-patch

Habitat: nearly level and undulating soils on floodplains along major rivers and streams

Soils: deep, poorly drained to well drained, formed in silty and clayey recent alluvium

Other species: Acer negundo, Carya illinoinensis, Celtis occidentalis, Salix

nigra

I.B.2.N.d.* **Populus deltoides - Salix nigra Forest** (2018)

Common name: cottonwood - black willow floodplain forest

Distribution: statewide

Other states: AR, IA, IL, KY, MN, MO, NE, OH, OK, TN, WI

Pattern: small-patch

Habitat: nearly level to undulating floodplains along the fronts and banks of most major rivers and streams throughout the central and southern U.S.

Soils: deep, medium-textured, formed in alluvium

Other species: Acer negundo, Acer saccharinum, Aster simplex, Bidens sp., Carex sp., Fraxinus pennsylvanica, Leersia oryzoides, Platanus occidentalis, Salix eriocephala, Ulmus americana

I.B.2.N.d. QUERCUS MACROCARPA - QUERCUS BICOLOR - (CARYA LACINIOSA) TEMPORARILY FLOODED FOREST ALLIANCE

I.B.2.N.d.* **Quercus macrocarpa - Quercus shumardii - Carya cordiformis / Chasmanthium latifolium Forest** (4544)

Common name: mixed oak floodplain forest

Distribution: Glaciated Region, Osage Cuestas

Other states: AR, MO, OK

Pattern: small-patch

Habitat: nearly level to undulating floodplains

Soils: deep, medium-textured, formed in alluvium

Other species: Acer negundo, Acer saccharinum, Carex sp., Fraxinus pennsylvanica, Leersia oryzoides, Platanus occidentalis, Ulmus americana

II. **WOODLAND** (26 to 60% tree cover; trees >5m tall)

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II.B. Deciduous woodland (deciduous species contribute >75% of total tree cover)

II.B.2. Cold-deciduous woodland

II.B.2.N.a. Cold-deciduous woodland

II.B.2.N.a. QUERCUS MACROCARPA WOODLAND ALLIANCE

II.B.2.N.a. **Quercus macrocarpa / Andropogon gerardii - Panicum virgatum Woodland** (2052)

Common name: mixed oak floodplain woodland

Distribution: Glaciated Region, Osage Cuestas

Other states: NE, OK

Pattern: small-patch

Habitat: nearly level to gently sloping soils on floodplains along major rivers and streams

Soils: deep, somewhat poorly drained, formed in silty and clayey recent alluvium

Other species: Carya illinoinensis, Fraxinus sp., Salix nigra, Spartina pectinata

II.B.2.N.a. **Quercus macrocarpa / Andropogon gerardii - Stipa spartea Woodland** (2053)

Common name: oak floodplain woodland

Distribution: Glaciated Region, north half of Osage Cuestas

Other states: IA, MO, NE, SD (possible)

Pattern: small-patch

Habitat: floodplains of rivers and streams with gentle to steep slopes

Soils: silts or loams, formed from loess or glacial till

Other species: Fraxinus sp., Panicum virgatum, Quercus rubra, Schizachyrium scoparium, Sorghastrum nutans

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II.B.2.N.a. QUERCUS MUEHLENBERGII WOODLAND ALLIANCE

II.B.2.N.a. **Quercus muehlenbergii - Quercus macrocarpa / Andropogon gerardii Ravine Woodland** (2145)

Common name: mixed oak ravine woodland

Distribution: Flint Hills Uplands, Glaciated Region, Osage Cuestas

Other states: NE (possible)

Pattern: small-patch

Habitat: ravines and valleys of rivers and major streams

Soils: shallow to moderately deep, silty clay loams and cherty silt loams, formed from shale and limestone

Other species: Cercis canadensis, Panicum virgatum, Schizachyrium scoparium, Ulmus sp.

II.B.2.N.a. QUERCUS STELLATA - QUERCUS MARILANDICA WOODLAND ALLIANCE

II.B.2.N.a. **Quercus stellata - Quercus marilandica / Schizachyrium scoparium Woodland** (2147)

Common names: post oak - blackjack oak woodland, Cross Timbers woodland

Distribution: Chautauqua Hills, Osage Cuestas

Other states: OK, TX

Pattern: large-patch

Habitat: ridgetops and gently sloping to steep hillsides

Soils: shallow to moderately deep, sandy and loamy, somewhat poorly drained to well drained, from sandstone

Other species: Andropogon gerardii, Celtis tenuifolia, Quercus prinoides, Sorghastrum nutans

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II.B.2.N.b. Temporarily flooded cold-deciduous woodland

II.B.2.N.b. POPULUS DELTOIDES TEMPORARILY FLOODED WOODLAND ALLIANCE

II.B.2.N.b. * **Populus deltoides - (Salix amygdaloides) / Salix exigua Woodland** (0659)

Common name: cottonwood - willow floodplain woodland

Distribution: Arkansas River Lowlands, High Plains, Red Hills, Smoky Hills, Wellington-McPherson Lowlands

Other states: CO, ND, NE, NM, OK, SD, TX

Pattern: small-patch

Habitat: nearly level floodplains along major rivers and streams

Soils: deep loams, silts, and sands, somewhat poorly drained to well drained, formed in sandy recent alluvium or in calcareous silty or loamy recent alluvium

Other species: Amorpha fruticosa, Elymus virginicus, Muhlenbergia sp.

II.B.2.N.b. * **Populus deltoides - (Salix nigra) / Spartina pectinata - Carex sp. Woodland** (2017)

Common name: cottonwood floodplain woodland

Distribution: eastern third of Kansas

Other states: MO, NE, SD

Pattern: small-patch

Habitat: floodplains near the lower Missouri River and its tributaries

Soils: deep sandy loam to sand, somewhat poorly drained, formed from alluvium

Other species: Acer negundo, Andropogon gerardii, Fraxinus pennsylvanica, Panicum virgatum, Quercus macrocarpa

II.B.2.N.b. * **Populus deltoides / Panicum virgatum - Schizachyrium scoparium**

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Woodland (1454)

Common name: cottonwood - switchgrass floodplain woodland

Distribution: High Plains

Other states: CO, NE, OK, SD, TX

Pattern: small-patch

Habitat: swales and depressions along streams

Soils: poorly drained sands and clays

Other species: Chrysothamnus nauseosus, Pascopyrum smithii

III. **SHRUBLAND** (Shrubs or trees 0.5 to 5m tall forming >25% canopy cover)

III.A. Evergreen shrubland (evergreen species contribute >75% of total shrub and/or tree cover)

III.A.4. Microphyllous evergreen shrubland

III.A.4.N.a. Microphyllous evergreen shrubland

III.A.4.N.a. ARTEMISIA FILIFOLIA SHRUBLAND ALLIANCE

III.A.4.N.a. **Artemisia filifolia / Andropogon hallii Shrubland** (1459)

Common name: sandsage - sand bluestem shrubland

Distribution: Arkansas River Lowlands, High Plains, Red Hills, Smoky Hills

Other states: CO, NE, NM, OK, TX, WY

Pattern: matrix

Habitat: gentle to moderately sloping loamy soils and rolling to hummocky sandy soils on uplands

Soils: deep, well drained to excessively drained, formed in loamy or sandy eolian sediments

Other species: Asclepias arenaria, Calamovilfa gigantea, Cyperus schweinitzii, Eragrostis secundiflora, Eriogonum annuum, Paspalum setaceum, Prionopsis ciliata

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III.A.4.N.a. **Artemisia filifolia / Schizachyrium scoparium - Andropogon hallii Shrubland** (2178)

Common name: sandsage - little bluestem shrubland

Distribution: Arkansas River Lowlands, High Plains, Red Hills, Smoky Hills (primarily located in the southern half of these regions)

Other states: OK, TX

Pattern: large-patch

Habitat: sandy, rolling hills

Soils: loamy fine sand to sandy soils, excessively drained, formed in loamy or sandy eolian sediments

Other species: Bouteloua curtipendula, Calamovilfa gigantea, Cyperus schweinitzii, Eriogonum annuum, Helianthus petiolaris, Paspalum setaceum, Prionopsis ciliata, Yucca glauca

III.A.4.N.a. **Artemisia filifolia / Bouteloua (curtipendula, gracilis) Shrubland** (2176)

Common name: sandsage - grama shrubland

Distribution: Arkansas River Lowlands, High Plains, Red Hills, Smoky Hills (primarily located in the southern half of these regions)

Other states: OK, TX

Pattern: large-patch

Habitat: sandy, rolling hills

Soils: loamy fine sand to sandy soils, excessively drained, formed in loamy or sandy eolian sediments

Other species: Andropogon hallii, Cyperus schweinitzii, Eriogonum annuum, Helianthus petiolaris, Paspalum setaceum, Prionopsis ciliata, Schizachyrium scoparium

III.A.5. Extremely xeromorphic evergreen shrubland

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III.A.5.N.b. Facultatively deciduous extremely xeromorphic subdesert shrubland

III.A.5.N.b. ATRIPLEX CANESCENS SHRUBLAND ALLIANCE

III.A.5.N.b. **Atriplex canescens / Bouteloua gracilis Shrubland** (1283)

Common name: saltbush - grama shrubland

Distribution: High Plains

Other states: AZ, CO, NM, TX

Pattern: small-patch

Habitat: dry barren flats, slopes, and bluffs

Soils: shallow, rocky, alkaline

Other species: Bouteloua curtipendula, Bouteloua hirsuta, Rhus aromatica, Toxicodendron rydbergii, Yucca glauca

III.B. Deciduous shrubland (deciduous species contribute >75% of total shrub and/or tree cover)

III.B.2. Cold-deciduous shrubland

III.B.2.N.d. Temporarily flooded cold-deciduous shrubland

III.B.2.N.d. SALIX EXIGUA TEMPORARILY FLOODED SHRUBLAND ALLIANCE

III.B.2.N.d. * **Salix exigua / Mesic Graminoids Shrubland** (1203)

Common name: willow - grass shrubland

Distribution: High Plains, Red Hills, Smoky Hills

Other states: CO, NE, OK, UT, WY

Pattern: small-patch

Habitat: sandbars, islands, and shorelines of streams and rivers

Soils: poorly developed, composed of sand, clay, silt, or gravel, formed in alluvium

Other species: Andropogon gerardii, Eleocharis sp., Scirpus sp.

III.B.2.N.f. Semipermanently flooded cold-deciduous shrubland

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III.B.2.N.f. CEPHALANTHUS OCCIDENTALIS SEMIPERMANENTLY FLOODED SHRUBLAND ALLIANCE

III.B.2.N.f. * **Cephalanthus occidentalis / Carex sp. Southern Shrubland** (2191)

Common name: buttonbush swamp

Distribution: Cherokee Lowlands, Osage Cuestas

Other states: AR, IL, IN, KY, MO, OK, SC, TN, TX

Pattern: small-patch

Habitat: inundated depressions, oxbow ponds, and sloughs of stream and river floodplains

Soils: deep, very poorly drained soils of peat or muck, formed in alluvium

Other species: Eleocharis sp., Leersia sp., Salix amygdaloides, Salix nigra, Scirpus sp.

V. **HERBACEOUS** (Graminoids and/or forbs form >25% cover; woody cover <25%)

V.A. Perennial vegetation graminoid

V.A.5. Temperate or subpolar grassland

V.A.5.N.a. Tall sod temperate grassland (includes mixed sod and bunch graminoids)

V.A.5.N.a. ANDROPOGON GERARDII - (SORGHASTRUM NUTANS) HERBACEOUS ALLIANCE

V.A.5.N.a. **Andropogon gerardii - Panicum virgatum - Schizachyrium scoparium Dakota Sandstone Herbaceous Vegetation** (5231)

Common name: Dakota Hills tallgrass prairie

Distribution: Smoky Hills

Other states: NE

Pattern: large-patch

Habitat: moderately sloping to steep side slopes and ridgetops on uplands; hills and mounds with numerous sandstone outcrops are common

Soils: shallow, somewhat excessively drained to moderately deep, well drained loamy soils, formed in material weathered from sandstone and sandy shale

Other species: Bouteloua curtipendula, Clematis fremontii, Schizachyrium scoparium, Sorghastrum nutans, Tradescantia occidentalis, Tradescantia tharpii

Comments: In Kansas, this type is limited to soils underlain by the Dakota (sandstone) Formation in the north-central part of the state.

V.A.5.N.a. **Andropogon gerardii - Sorghastrum nutans - Schizachyrium scoparium Flint Hills Herbaceous Vegetation** (2201)

Common name: Flint Hills tallgrass prairie

Distribution: Flint Hills Uplands

Other states: OK

Pattern: matrix

Habitat: nearly level to steep slopes on uplands

Soils: shallow to deep, somewhat poorly to somewhat excessively drained, loams, clays, and silts, formed in shale or limestone, or interbedded limestone and clayey shale

Other species: Amorpha canescens, Aster ericoides, Bouteloua curtipendula, Panicum virgatum, Psoralidium tenuiflorum, Sporobolus asper

V.A.5.N.a. **Andropogon gerardii - Sorghastrum nutans - (Sporobolus heterolepis) - Liatris sp. - Ratibida pinnata Herbaceous Vegetation** (2203)

Common names: glaciated tallgrass prairie, northeastern (KS) tallgrass prairie

Distribution: Glaciated Region

Other states: IA, IL, IN, MI, MN, MO, NE, OH, WI

Pattern: matrix

Habitat: nearly level to steep slopes on uplands

Soils: deep, somewhat poorly drained to well drained, silty and loamy soils from loess, glacial till, or clayey colluvium

Other species: Amorpha canescens, Dalea candida, Dalea purpurea, Salix humilis

V.A.5.N.a. **Andropogon gerardii - Sorghastrum nutans Unglaciated Herbaceous Vegetation** (2204)

Common names: unglaciated tallgrass prairie, southeastern (KS) tallgrass prairie

Distribution: Chautauqua Hills, Cherokee Lowlands, Osage Cuestas, Smoky Hills (eastern quarter), Wellington-McPherson Lowlands

Other states: AR, MO, OK

Pattern: matrix

Habitat: nearly level to moderately steep slopes on uplands

Soils: moderately deep to deep, somewhat poorly drained to well drained silts and loams, formed in clayey, old alluvium or from shale, limestone, or sandstone

Other species: Amorpha canescens, Dalea candida, Dalea purpurea, Psoralidium tenuiflorum, Schizachyrium scoparium, Scleria triglomerata

V.A.5.N.a. **Andropogon gerardii - Sorghastrum nutans - Stipa spartea Loess Hills Herbaceous Vegetation** (2025)

Common names: loess hills tallgrass prairie, hill prairie

Distribution: Glaciated Region (primarily in the eastern third of this region)

Other states: IA, MO, NE, SD

Pattern: small-patch

Habitat: bluff tops along larger streams or rivers and moderately steep to very steep exposed slopes, typically with S- or W-facing aspects, of dissected hills or plains

Soils: deep, well drained silty loams, formed in loess or glacial till

Other species: Amorpha canescens, Bouteloua curtipendula, Dalea candida, Psoralidium tenuiflorum, Schizachyrium scoparium

Comments: In Kansas, this type is limited to the loess hills along the bluffs of the Missouri and Kansas Rivers and the glacial drift / till hills in the northeast.

V.A.5.N.a. **Andropogon gerardii - Sorghastrum nutans Western Great Plains Herbaceous Vegetation** (1464)

Common names: western tallgrass prairie, subirrigated tallgrass prairie

Distribution: High Plains

Other states: CO, OK

Pattern: small-patch

Habitat: valley bottoms and terraces along larger streams or rivers

Soils: deep, somewhat poorly drained loam to sandy loam, formed in loamy and sandy alluvium

Other species: Desmanthus illinoensis, Glycyrrhiza lepidota, Panicum virgatum, Pascopyrum smithii, Schoenoplectus pungens, Sporobolus cryptandrus

V.A.5.N.a. ANDROPOGON HALLII HERBACEOUS ALLIANCE

V.A.5.N.a. **Andropogon hallii - Calamovilfa longifolia Herbaceous Vegetation** (1467)

Common name: sand prairie

Distribution: Arkansas River Lowlands, Red Hills, Smoky Hills, Wellington-McPherson Lowlands

Other states: MT, ND, NE, SD

Pattern: matrix

Habitat: undulating to hummocky sandy soils; nearly level to moderately-sloping loamy soils

Soils: deep, well drained to excessively drained, sand, loamy sand and sandy loams formed in sandy eolian sediments or in loamy alluvium

Other species: Calamovilfa gigantea (southern part of range), Helianthus petiolaris, Monarda punctata, Oenothera rhombipetala, Panicum virgatum, Prunus angustifolia, Schizachyrium scoparium

V.A.5.N.a. SCHIZACHYRIUM SCOPARIUM - SORGHASTRUM NUTANS HERBACEOUS ALLIANCE

V.A.5.N.a. **Schizachyrium scoparium - Sorghastrum nutans - Andropogon ternarius - Coreopsis grandiflora Sandstone - Shale Herbaceous Vegetation** (2212)

Common name: sandstone prairie

Distribution: Chautauqua Hills, Osage Cuestas

Other states: MO

Pattern: small-patch

Habitat: level to nearly level plains and terraces on uplands

Soils: impermeable to semi-permeable clay and loamy soils, from shale or sandstone

Other species: Bouteloua curtipendula, Liatris pycnostachya, Panicum virgatum, Sabatia campestris, Viola sagittata

V.A.5.N.c. Medium-tall sod temperate or subpolar grassland (includes mixed sod and bunch graminoids)

V.A.5.N.c. PASCOPYRUM (AGROPYRON) SMITHII HERBACEOUS ALLIANCE

V.A.5.N.c. **Pascopyrum smithii - Bouteloua gracilis Herbaceous Vegetation** (1578)

Common name: wheatgrass - grama prairie

Distribution: High Plains

Other states: CO, NM

Pattern: small-patch

Habitat: nearly level ground or shallow depressions on uplands

Soils: silty clay loam with a impermeable or slowly permeable clay pan subsoil layer

Other species: Bouteloua curtipendula, Buchloë dactyloides, Ratibida columnifera

V.A.5.N.c. SCHIZACHYRIUM SCOPARIUM - BOUTELOUA CURTIPENDULA HERBACEOUS ALLIANCE

V.A.5.N.c. **Schizachyrium scoparium - Bouteloua curtipendula - Bouteloua gracilis Central Plains Herbaceous Vegetation** (2246)

Common name: mixed prairie

Distribution: High Plains, Smoky Hills

Other states: OK

Pattern: matrix

Habitat: level to moderately sloping uplands and steep ravine slopes

Soils: shallow to moderately deep, well drained loam, clay loam, silty loam, or silt formed from limestone

Other species: Ambrosia psilostachya, Andropogon gerardii, Astragalus crassicarpus var. crassicarpus, Bouteloua hirsuta, Buchloë dactyloides, Calylophus serrulatus, Dalea enneandra, Liatris punctata, Sorghastrum nutans

V.A.5.N.c. **Schizachyrium scoparium - Bouteloua curtipendula Chalkflat Herbaceous Vegetation** (2247)

Common name: chalkflat mixed prairie

Distribution: Smoky Hills (restricted to the valleys of Hackberry Creek and the Smoky Hill River)

Pattern: large-patch

Habitat: nearly level to gently sloping terraces below chalk or limestone outcrops

Soils: strongly calcareous silt or loam, moderately deep to deep, well drained, formed from chalky shale and soft limestone

Other species: Andropogon gerardii, Bouteloua gracilis, Bouteloua hirsuta, Buchloë dactyloides, Distichlis spicata, Eriogonum effusum, Gutierrezia sarothrae, Oenothera macrocarpa, Stanleya pinnata

V.A.5.N.c. **Schizachyrium scoparium - Bouteloua curtipendula Red Hills Herbaceous Vegetation** (2248)

Common name: Red Hills mixed prairie

Distribution: Red Hills

Other states: OK

Pattern: large-patch

Habitat: gently sloping to strongly dissected steep hills and escarpments on uplands

Soils: shallow to deep, well drained, silty, loamy and clayey soils formed from red silty shale, red silty sandstone, red sandstone, or clayey shale

Other species: Andropogon gerardii, Aster ericoides, Bouteloua gracilis, Bouteloua hirsuta, Callirhoe involucrata, Gutierrezia sarothrae, Sporobolus cryptandrus

Comments: Woody vegetation is scattered across the landscape, including Juniperus virginiana and groves of small deciduous trees and shrubs (Celtis occidentalis, Prunus angustifolia, Rhus glabra, Sapindus saponaria,

Symphoricarpos occidentalis) on north-facing slopes and in valleys.

V.A.5.N.c. **Schizachyrium scoparium - Bouteloua curtipendula Loess Mixedgrass Herbaceous Vegetation** (2036)

Common name: loess mixed prairie

Distribution: High Plains (primarily in the northern third of this region)

Other states: CO, ND, NE, SD

Pattern: large-patch

Habitat: loess deposits on level to steep uplands

Soils: deep loam or silt loam formed in loess material

Other species: Andropogon gerardii, Artemisia dracunculus, Asclepias pumila, Bouteloua gracilis, Lygodesmia juncea, Panicum virgatum, Pascopyrum smithii, Ratibida columnifera, Solidago missouriensis

V.A.5.N.c. **Schizachyrium scoparium - Bouteloua curtipendula - Agrostis hyemalis - Eleocharis sp. Hardpan Herbaceous Vegetation** (2249)

Common name: hardpan prairie

Distribution: Cherokee Lowlands, Osage Cuestas

Other states: MO

Pattern: small-patch

Habitat: level to gently sloping ground on upland plains, ridges, and terraces

Soils: silty loam, with an impermeable or slowly permeable silty clay subsoil layer

Other species: Andropogon gerardii, Camassia scilloides, Carex sp., Cicuta maculata, Desmanthus illinoensis, Panicum virgatum, Polygala verticillata, Sporobolus vaginiflorus

V.A.5.N.c. STIPA COMATA - BOUTELOUA GRACILIS HERBACEOUS

Lauver, C. L., K. Kindscher, D. Faber-Langendoen, and R. Schneider. (1999). A Classification of the Natural Vegetation of Kansas. *The Southwestern Naturalist* 44(4):421-443.

ALLIANCE

V.A.5.N.c. **Stipa comata - Bouteloua gracilis - [Carex filifolia] Herbaceous Vegetation** (2037)

Common name: northern mixed prairie

Distribution: High Plains, Smoky Hills (northern half of these regions)

Other states: CO, MT, ND, NE, SD, WY

Pattern: large-patch

Habitat: rolling hills and plains

Soils: deep loess, well drained

Other species: Buchloë dactyloides, Pascopyrum smithii, Psoralea argophylla, Ratibida columnifera, Yucca glauca

V.A.5.N.d. Medium-tall bunch temperate or subpolar grassland

V.A.5.N.d. SPOROBOLUS AIROIDES HERBACEOUS ALLIANCE

V.A.5.N.d. **Sporobolus airoides Herbaceous Vegetation** (1685)

Common name: alkali sacaton lowland prairie

Distribution: High Plains, Smoky Hills (restricted to salty flats)

Other states: CO, MT, NM, TX

Pattern: small-patch

Habitat: nearly level bottomland and terraces

Soils: shallow, moderately-well to poorly drained silty clays, formed in alluvium

Other species: Aster subulatus, Buchloë dactyloides, Distichlis spicata, Hordeum jubatum, Pascopyrum smithii

V.A.5.N.e. Short sod temperate or subpolar grassland

V.A.5.N.e. BOUTELOUA GRACILIS HERBACEOUS ALLIANCE

V.A.5.N.e. **Bouteloua gracilis - Buchloë dactyloides Herbaceous Vegetation** (1756)

Common name: shortgrass prairie

Distribution: High Plains

Other states: CO, NE, NM, OK, TX, WY

Pattern: matrix

Habitat: nearly level to moderately steep slopes on rolling plains and uplands

Soils: deep loams and silts, well drained, formed in loess or in loamy, eolian sediments

Other species: Aristida purpurea, Gutierrezia sarothrae, Psoralidium tenuiflorum, Ratibida columnifera

V.A.5.N.i Intermittently flooded temperate grassland

V.A.5.N.i. PASCOPYRUM SMITHII INTERMITTENTLY FLOODED HERBACEOUS ALLIANCE

V.A.5.N.i. **Pascopyrum smithii - Buchloë dactyloides - (Phyla cuneifolia, Oenothera canescens) Herbaceous Vegetation** (2038)

Common name: grass playa lake

Distribution: High Plains (restricted to upland depressional basins)

Other states: NE, OK, TX

Pattern: small-patch

Habitat: depressional features in plains (playas)

Soils: dense clays, poorly drained

Other species: Ambrosia grayi, Eleocharis macrostachya, Hordeum jubatum, Rorippa sinuata

V.A.5.N.j. Temporarily flooded temperate or subpolar grassland

V.A.5.N.j. DISTICHLIS SPICATA - (HORDEUM JUBATUM) TEMPORARILY

FLOODED HERBACEOUS ALLIANCE

V.A.5.N.j. * **Distichlis spicata - (Hordeum jubatum, Poa arida, Sporobolus airoides) Herbaceous Vegetation** (2042)

Common names: saltflat mixed prairie, saline playa lake

Distribution: High Plains (restricted to the shallow Scott-Finney depression, Scott and Finney Counties)

Other states: NE, OK, TX

Pattern: large-patch

Habitat: nearly level to gently sloping areas on uplands in or adjacent to broad depressions

Soils: deep, somewhat poorly to well drained, saline and saline-alkali loams and silts, formed in loess or alluvium

Other species: Bouteloua curtipendula, Pascopyrum smithii

V.A.5.N.j. * **Distichlis spicata - Scirpus maritimus - Salicornia rubra Herbaceous Vegetation** (2043)

Common name: salt marsh

Distribution: Arkansas River Lowlands, Smoky Hills

Other states: MO, NE, OK

Pattern: small-patch

Habitat: swales and depressions of floodplains and their terraces, and valley basins

Soils: deep, very poorly drained, consisting of peat, muck, or mineral materials, formed in alluvium or loess

Other species: Scirpus sp., Suaeda depressa

Comments: Distinguished from the freshwater marsh community by its restriction to salty seepage areas that often contain brackish or stagnant water.

Lauver, C. L., K. Kindscher, D. Faber-Langendoen, and R. Schneider. (1999). A Classification of the Natural Vegetation of Kansas. *The Southwestern Naturalist* 44(4):421-443.

V.A.5.N.j. ELEOCHARIS MACROSTACHYA TEMPORARILY FLOODED HERBACEOUS ALLIANCE

V.A.5.N.j. * **Eleocharis macrostachya - (Eleocharis compressa) - Leptochloa fascicularis Herbaceous Vegetation** (2259)

Common name: spikerush playa lake

Distribution: High Plains, Smoky Hills (restricted to upland depressional basins)

Other states: OK

Pattern: small-patch

Habitat: depressional features in plains (playas)

Soils: dense clays, poorly drained

Other species: Ambrosia grayi, Aster subulatus, Hordeum jubatum, Polygonum bicorne

V.A.5.N.j. POLYGONUM SP. - ECHINOCHLOA SP. TEMPORARILY FLOODED HERBACEOUS ALLIANCE

V.A.5.N.j. * **Polygonum sp. - Echinochloa sp. - Distichlis spicata Playa Lake Herbaceous Vegetation** (2039)

Common name: playa lake

Distribution: High Plains, Smoky Hills (restricted to upland depressional basins)

Other states: NE, OK

Pattern: small-patch

Habitat: nearly level to gently sloping shallow depressions or saucer-shaped basins

Soils: deep to moderately deep loams and clay loams, usually containing a dense clay subsoil layer

Other species: Ambrosia grayi, Aster subulatus, Chenopodium berlandieri,

Hordeum jubatum

Comments: For all playa lake communities, shallow ponds often form after large rainfall events due to poor drainage and are subject to natural drawdown and replenishment cycles during the year.

V.A.5.N.j. SPARTINA PECTINATA TEMPORARILY FLOODED HERBACEOUS ALLIANCE

V.A.5.N.j. * **Spartina pectinata - Eleocharis sp. - Carex sp. Herbaceous Vegetation** (2223)

Common names: low prairie, wet prairie

Distribution: eastern third of Kansas

Other states: OK

Pattern: small-patch

Habitat: nearly level soils on floodplains along rivers, streams, and creeks

Soils: deep, poorly drained, formed in alluvium

Other species: Asclepias incarnata, Aster lanceolatus, Baptisia lactea, Helianthus grosseserratus, Scirpus atrovirens

Comments: These communities are nearly always saturated with water, or are temporarily inundated with surface water during the winter and/or spring seasons. Short-term flooding of 1 to 3 days at depths less than 0.6 m occurs periodically (2 to 12 times) through the year.

V.A.5.N.j. * **Calamagrostis canadensis - Juncus sp. - Carex sp. Sandhills Herbaceous Vegetation** (2028)

Common name: sandhills wet prairie

Distribution: Arkansas River Lowlands, High Plains

Other states: ND, NE

Pattern: small-patch

Habitat: interdunal sandhill valleys on terraces and floodplains

Soils: poorly drained silty loams and sandy soils

Other species: Amorpha fruticosa, Eleocharis atropurpurea, Panicum virgatum, Salix exigua

V.A.5.N.k. Seasonally flooded temperate or subpolar grassland

V.A.5.N.k. TYPHA SP. - (SCIRPUS SP., JUNCUS SP.) SEASONALLY FLOODED HERBACEOUS ALLIANCE

V.A.5.N.k. * **Scirpus validus - Typha sp. - (Sparganium sp., Juncus sp.) Herbaceous Vegetation** (2026)

Common names: freshwater marsh, bulrush - cattail marsh

Distribution: Chautauqua Hills, Cherokee Lowlands, Flint Hills Uplands, Glaciated Region, Osage Cuestas

Other states: IA, IL, IN, MO, ND, NE, OH, OK, SD, WI

Pattern: small-patch

Habitat: swales and depressions associated with river systems

Soils: deep, very poorly drained, consisting of peat, muck, or mineral materials, formed in alluvium

Other species: Carex sp., Typha latifolia

V.A.5.N.l. Semipermanently flooded temperate or subpolar grassland

V.A.5.N.l. SCIRPUS PUNGENS SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE

V.A.5.N.l. * **Scirpus pungens - Suaeda depressa Alkaline Herbaceous Vegetation** (2040)

Common name: alkaline marsh

Distribution: Arkansas River Lowlands, High Plains, Smoky Hills

Other states: NE

Pattern: small-patch

Habitat: depressional basins on uplands and along stream terraces

Soils: poorly drained clays to loams

Other species: Coreopsis tinctoria, Polygonum bicorne, Sagittaria longiloba, Schoenoplectus acutus, Schoenoplectus tabernaemontani, Typha angustifolia

V.A.5.N.l. * **Scirpus pungens - (Eleocharis sp.) Herbaceous Vegetation** (1587)

Common name: bulrush - spikerush marsh

Distribution: statewide

Other states: MT, NV, UT

Pattern: small-patch

Habitat: basins, oxbows, and lowlands along stream courses

Soils: silty clays, poorly drained

Other species: Bolboschoenus maritimus, Lemna minor, Sagittaria latifolia, Typha sp.

V.A.5.N.l. TYPHA (ANGUSTIFOLIA, LATIFOLIA) - (SCIRPUS SP.) SEMIPERMANENTLY FLOODED HERBACEOUS ALLIANCE

V.A.5.N.l. * **Typha (angustifolia, domingensis, latifolia) - [Scirpus americanus] Herbaceous Vegetation** (2032)

Common name: cattail - bulrush marsh

Distribution: eastern half of Kansas

Other states: OK, TX

Pattern: small-patch

Habitat: oxbows and low areas along creeks and streams

Soils: poorly drained clays and silty clays

Other species: Carex hyalinolepis, Eleocharis sp., Lemna minor, Sagittaria latifolia

Note: Scirpus americanus is very rare in Kansas, but is a regional co-dominant.

V.A.5.N.l. * **Typha sp. Great Plains Herbaceous Vegetation** (2389)

Common name: western cattail marsh

Distribution: western two-thirds of Kansas

Other states: ND, NE, OK, SD

Pattern: small-patch

Habitat: oxbows and low areas along creeks and streams

Soils: poorly drained clays and silty clays

Other species: Eleocharis sp., Sagittaria latifolia

V.A.5.N.l. * **Typha sp. Midwest Herbaceous Vegetation** (2233)

Common name: eastern cattail marsh

Distribution: eastern third of Kansas

Other states: IA, IL, IN, MI, MN, MO, ND, NE, OH, SD, WI

Pattern: small-patch

Habitat: basins and low areas

Soils: poorly drained clays and silty clays

Other species: Eleocharis sp., Scirpus pungens

V.A.5.N.m. Saturated temperate or subpolar grassland

V.A.5.N.m. CAREX LANUGINOSA - (CAREX NEBRASCENSIS) - SCIRPUS SP. SATURATED HERBACEOUS ALLIANCE

V.A.5.N.m. * **Carex lanuginosa - Carex sp. - Scirpus sp. Plains Fen Herbaceous Vegetation** (2041)

Common name: fen

Distribution: Glaciated Region

Other states: IA, MO, NE

Pattern: small-patch

Habitat: moderately sloping to steep hillsides in narrow valleys, bases of river bluffs, and floodplain terraces

Soils: deep, saturated mucky peat, formed in gravelly alluvium or colluvium over limestone bedrock

Other species: Eleocharis sp., Eupatorium maculatum, Scirpus validus, Typha latifolia

Comments: A calcareous groundwater seepage community where subsurface recharge may occur through localized artesian conditions.

Note: Carex nebrascensis is very rare in Kansas, but is a regional co-dominant.

V.A.5.N.m. CAREX SP. - TYPHA SP. SATURATED HERBACEOUS ALLIANCE

V.A.5.N.m. * **Typha sp. - Equisetum hyemale - Carex sp. Seep Herbaceous Vegetation** (2033)

Common name: neutral seep

Distribution: Glaciated Region, Osage Cuestas

Other states: IA, MO, NE, SD

Pattern: small-patch

Habitat: hillsides and bluffs in river valleys

Soils: shallow to deep (varying with degree of slope), formed from loess or shale

Other species: Equisetum sp., Typha angustifolia, Typha latifolia

Comments: A circumneutral community where the pH of the groundwater and its mineral content are caused by rainwater permeating loess or glacial till and contacting an impervious shale layer. Groundwater flows outward where the loess-shale interface is exposed on hillsides and bluffs.

Lauver, C. L., K. Kindscher, D. Faber-Langendoen, and R. Schneider. (1999). A Classification of the Natural Vegetation of Kansas. *The Southwestern Naturalist* 44(4):421-443.

V.A.5.N.m. * **Typha sp. - Carex sp. Acid Seep Herbaceous Vegetation** (2235)

Common name: acid seep

Distribution: Cherokee Lowlands, Osage Cuestas, Ozark Plateau

Other states: MO

Pattern: small-patch

Habitat: bases of gentle to moderately steep slopes in river valleys and canyons

Soils: shallow to deep with deposits of peat or muck, formed in sandstone or sandy colluvium

Other species: Lindera benzoin, Sassafras albidum, Sphagnum sp., Vaccinium arboreum

Comments: The soils are constantly saturated by acidic groundwater that flows from gravelly or sandy substrates.

V.A.6. Temperate or subpolar grassland with a sparse tree layer

V.A.6.N.q. Bedrock temperate or subpolar grassland with a sparse tree layer

V.A.6.N.q. (QUERCUS STELLATA - QUERCUS MARILANDICA) / SCHIZACHYRIUM SCOPARIUM WOODED HERBACEOUS ALLIANCE

V.A.6.N.q. **Schizachyrium scoparium - Aristida dichotoma - Croton willdenowii / Lichens Wooded Herbaceous Vegetation** (2242)

Common name: Ozark sandstone glade / prairie

Distribution: Chautauqua Hills, Cherokee Lowlands, Osage Cuestas, Ozark Plateau

Other states: AR, MO

Pattern: small-patch

Habitat: gently rolling plains, gentle to moderately-sloping hills and knobs, and steep upper slopes of south-facing escarpments

Soils: shallow, sandy, rapidly drained with vernally inundated depressions, formed from sandstone

Other species: Chaetopappa asteroides, Isoetes butleri, Saxifraga texana, Sedum nuttallianum, Sedum pulchellum, Talinum parviflorum

Comments: Often contains large areas of exposed bedrock with stunted xerophytic trees and shrubs.

V.A.6.N.q. (JUNIPERUS VIRGINIANA) / SCHIZACHYRIUM SCOPARIUM - (BOUTELOUA CURTIPENDULA) WOODED HERBACEOUS ALLIANCE

V.A.6.N.q. **Schizachyrium scoparium - Bouteloua curtipendula - [Rudbeckia missouriensis] - Mentzelia oligosperma Wooded Herbaceous Vegetation** (2251)

Common name: Ozark limestone glade

Distribution: Cherokee Lowlands, Osage Cuestas, Ozark Plateau

Other states: MO

Pattern: small-patch

Habitat: nearly level to steep upland south- or west-facing slopes and bluffs of dissected hills and valleys

Soils: shallow, rocky, well drained and usually clayey, formed from limestone

Other species: Heliotropium tenellum, Isoetes butleri, Ophioglossum engelmannii, Sedum pulchellum, Talinum parviflorum

Comments: In general, Rudbeckia missouriensis is not part of the Kansas community type but is a co-dominant in Missouri. Exposed horizontal layers of limestone (outcrops) are common to abundant.

V.A.8. Temperate or subpolar grassland with a sparse dwarf-shrub layer

V.A.8.N.a. Short temperate or subpolar lowland grassland with a sparse needle-leaved or microphyllous dwarf-shrub layer

V.A.8.N.a. KRASCHENINNIKOVIA (CERATOIDES) LANATA DWARF-SHRUB HERBACEOUS ALLIANCE

V.A.8.N.a. **Krascheninnikovia lanata / Bouteloua gracilis Dwarf-Shrub Herbaceous Vegetation** (1321)

Common name: winterfat - blue grama prairie

Distribution: High Plains (primarily in the north half of this region)

Other states: AZ, CO, NM

Pattern: small-patch

Habitat: areas with sparse vegetation on uplands and flats

Soils: shallow, rocky, alkaline

Other species: Buchloë dactyloides, Echinacea angustifolia, Liatris punctata, Stanleya pinnata

V.C. Hydromorphic rooted vegetation (non-emergent graminoids and forbs structurally supported by water and rooted in substrate)

V.C.2. Temperate or subpolar hydromorphic rooted vegetation

V.C.2.N.a. Permanently flooded temperate or subpolar hydromorphic rooted vegetation

V.C.2.N.a. HETERANTHERA LIMOSA PERMANENTLY FLOODED HERBACEOUS ALLIANCE

V.C.2.N.a. * **Heteranthera limosa - Bacopa rotundifolia - Sagittaria latifolia Herbaceous Vegetation** (2279)

Common name: forb playa lake

Distribution: High Plains (restricted to upland depressional basins)

Other states: OK, TX

Pattern: small-patch

Habitat: depressional features in plains (playas)

Soils: dense clays, poorly drained

Other species: Eleocharis macrostachya, Hordeum jubatum, Polygonum bicorne, Rorippa sinuata

V.C.2.N.a. POTAMOGETON SP. - CERATOPHYLLUM SP. - ELODEA SP. PERMANENTLY FLOODED HERBACEOUS ALLIANCE

V.C.2.N.a. * **Potamogeton sp. - Ceratophyllum demersum Great Plains Herbaceous Vegetation** (2044)

Common name: pondweed aquatic wetland

Distribution: Arkansas River Lowlands, Smoky Hills, Wellington-McPherson Lowlands

Other states: ND, NE, SD

Pattern: small-patch

Habitat: interdunal swales and depressions along streams

Soils: poorly drained sands and clays

Other species: Schoenoplectus sp., Scirpus sp., Typha sp.

VII. **SPARSE VEGETATION** (vegetation scattered or nearly absent; total vegetation cover less than 10%)

VII.A. Consolidated rock sparse vegetation

VII.A.1. Sparsely vegetated cliffs

VII.A.1.N.a. Cliffs with sparse vascular vegetation

VII.A.1.N.a. OPEN BLUFF / CLIFF SPARSELY VEGETATED ALLIANCE

VII.A.1.N.a. **Chert Ozark Moist Cliff Sparse Vegetation** (2288)

VII.A.1.N.a. **Limestone / Dolostone Midwest Dry Cliff Sparse Vegetation** (2291)

VII.A.1.N.a. **Limestone / Dolostone Midwest Moist Cliff Sparse Vegetation** (2292)

VII.A.1.N.a. **Sandstone Dry Cliff Sparse Vegetation** (2045)

VII.A.1.N.a. **Sandstone Moist Cliff Sparse Vegetation** (2287)

Lauver, C. L., K. Kindscher, D. Faber-Langendoen, and R. Schneider. (1999). A Classification of the Natural Vegetation of Kansas. *The Southwestern Naturalist* 44(4):421-443.

VII.A.1.N.a. ROCK OUTCROP / BUTTE SPARSELY VEGETATED ALLIANCE

VII.A.1.N.a. **Limestone Caprock Butte Sparse Vegetation** (2296)

VII.A.1.N.a. **Sandstone Caprock Butte Sparse Vegetation** (2297)

VII.C. Unconsolidated material sparse vegetation

VII.C.2. Sparsely vegetated sand flats

VII.C.2.N.c. Temporarily flooded sand flats

VII.C.2.N.c. SAND FLATS TEMPORARILY FLOODED SPARSELY VEGETATED ALLIANCE

VII.C.2.N.c. **Riverine Sand Flats - Bars Sparse Vegetation** (2049)

APPENDIX B

Additional Vegetation Types Mapped for Kansas GAP Land Cover

For each vegetation type, we list the U.S. National Vegetation Classification (NVC) Code, the Kansas common name, a description, the vegetation formation to which the class belongs, scientific names of dominant species, common names of dominant species, and the distribution in Kansas. Note that most of these represent "semi-natural" vegetation classes that have resulted from human activity, and they have not yet been incorporated into the NVC.

NVC Code: I.A.8.
Kansas Common Name: Evergreen Forest - Disturbed Land
Description: Abandoned or neglected cropland (or grassland) upland sites in eastern and central KS that have been invaded by red cedar trees
Formation: Temperate or subpolar needle-leaved evergreen forest
Dominant: Juniperus virginiana
Common Names of Dominants: Eastern red cedar
Distribution: Eastern half of Kansas

NVC Code: I.B.2.
Kansas Common Name: Deciduous Forest - Mined Land
Description: Reclaimed mined lands in SE KS; heterogeneous landscape composed of narrow, deep ponds alternating with high ridges and associated steep slopes
Formation: Cold-deciduous forest
Dominants: Populus deltoides, Salix nigra, Ulmus rubra
Common Names of Dominants: Cottonwood, Black willow, Slippery elm
Distribution: Cherokee Lowlands, Osage Cuestas, Ozark Plateau

NVC Code: I.B.2.N.d
Kansas Common Name: Maple Floodplain Forest
Description: Riparian forest type common in Cherokee County (SE corner of KS)
Formation: Temporarily flooded cold-deciduous forest
Dominants: Acer saccharinum, Betula nigra
Common Names of Dominants: Silver maple, River birch
Distribution: Cherokee Lowlands, Glaciated Region, Osage Cuestas

NVC Code: II.B.2.
Kansas Common Name: Deciduous Woodland
Description: Grazed to overgrazed wooded pastures dominated by invasive tree species and non-native understory species; on gentle slopes, in swales, and riparian areas; often located near farmhouse areas or are abandoned, old farmhouse sites
Formation: Cold-deciduous woodland
Dominants: Maclura pomifera, Gleditsia triacanthos
Common Names of Dominants: Osage orange, Honey locust
Distribution: Eastern half of Kansas

NVC Code: III.A.2.
Kansas Common Name: Salt Cedar or Tamarisk Shrubland
Description: Riparian areas in western KS invaded by salt cedar
Formation: Temperate broad-leaved evergreen shrubland
Dominants: Tamarix spp.
Common Names of Dominants: Salt cedar
Distribution: Cherokee Lowlands, Osage Cuestas, Ozark Plateau

NVC Code: V.A.5.
Kansas Common Name: Non-Native Grassland

Formation: Temperate or subpolar grassland
Description: Areas seeded to and dominated by non-native grasses including smooth brome and tall fescue
Dominants: Bromus inermis, Festuca arundinacea, Andropogon bladhii
Common Names of Dominants: Smooth brome, Tall fescue, Caucasian bluestem
Distribution: Statewide

NVC Code: V.A.5.
Kansas Common Name: CRP (Conservation Reserve Program)
Description: Former cultivated areas re-seeded with (usually) native tall and mid-tall grasses
Formation: Temperate or subpolar grassland
Dominants: Andropogon gerardii, Schizachyrium scoparium, Sorghastrum nutans, Panicum virgatum, etc.
Common Names of Dominants: Big bluestem, Little bluestem, Indian grass, Switchgrass
Distribution: Statewide, major concentrations in southwestern Kansas

NVC Code: V.A.5.
Kansas Common Name: Mixed Prairie – Disturbed
Description: Former cropland (plowed at least 30 years ago) now resembling successional grasslands (= "go-back"); prairies with a history of heavy grazing; and areas where soil has been disturbed (e.g., roadsides, bulldozed areas), now dominated by grasses and annual weeds
Formation: Temperate or subpolar grassland
Dominants: Sporobolus spp.
Common Names of Dominants: Dropseed
Distribution: High Plains, Smoky Hills

NVC Code: V.A.5.
Kansas Common Name: Weedy Marsh
Description: Lake margins in state wildlife areas and along state hunting/fishing lakes; soil is usually dry but occasionally wet
Formation: Seasonally flooded temperate or subpolar grassland
Dominants: Typha spp., Scirpus spp., Ambrosia spp., Rumex spp.
Common Names of Dominants: Cattail, Bulrush, Ragweed, Dock
Distribution: Statewide

NVC Code: V.D.2.
Kansas Common Name: Weedy Upland
Description: Heavily grazed (or otherwise disturbed) pastures dominated by invasive forbs (mainly ragweed; plus ironweed, thistle, verbena)
Formation: Temperate or subpolar annual grassland or forb vegetation
Dominant: Ambrosia artemisiifolia
Common Names of Dominants: Ragweed
Distribution: Statewide

APPENDIX C

Kansas GAP Land Cover Database Accuracy Report

Appendix C contains the full accuracy data for the Kansas GAP land cover map: overall accuracy, Kappa (or khat), omission and commission accuracy, and contingency tables (also known as error matrices or confusion matrices). The appendix is organized into three sections, representing different levels of generalization or aggregation of the land cover classes: (1) Anderson Level 1, (2) formation, and (3) alliance. Within each of the three levels of aggregation, accuracy figures are presented for each of the three accuracy comparison methods employed: point-based, 3-by-3, and focal majority.

Kansas GAP Land Cover Database Accuracy Report

Anderson Level I: Point Based

Anderson Level I: Point Based	
1	Herbaceous
2	Cropland
3	Urban
4	Water
5	Forest/Woodland
6	Shrubland

Accuracy Information	
Overall Accuracy	88.0%
Kappa	0.66

	1	**2**	**3**	**4**	**5**	**6**
Commission Accuracy	93.9%	82.9%	na	0.0%	65.3%	45.5%
Omission Accuracy	92.2%	68.0%	na	0.0%	82.1%	48.4%

Classification Matrix (Raw):						
Class	**1**	**2**	**3**	**4**	**5**	**6**
1	**616**	14	0	1	13	12
2	6	**34**	0	0	0	1
3	0	0	**0**	0	0	0
4	0	0	0	**0**	0	0
5	29	2	0	0	**64**	3
6	17	0	0	0	1	**15**
Total	668	50	0	1	78	31

Classification Matrix (%):						
Class	**1**	**2**	**3**	**4**	**5**	**6**
1	**92.2**	28.0	0.0	100.0	16.7	38.7
2	0.9	**68.0**	0.0	0.0	0.0	3.2
3	0.0	0.0	**0.0**	0.0	0.0	0.0
4	0.0	0.0	0.0	**0.0**	0.0	0.0
5	4.3	4.0	0.0	0.0	**82.1**	9.7
6	2.5	0.0	0.0	0.0	1.3	**48.4**
Total	100.0	100.0	0.0	100.0	100.0	100.0

Anderson Level I: 3-by-3 Window

Anderson Level I: 3-by-3 Window	
1	Herbaceous
2	Cropland
3	Urban
4	Water
5	Forest/Woodland
6	Shrubland

Accuracy Information	
Overall Accuracy	88.3%
Kappa	0.65

	1	**2**	**3**	**4**	**5**	**6**
Commission Accuracy	93.6%	81.1%	na	0.0%	66.3%	48.5%
Omission Accuracy	93.1%	65.8%	na	0.0%	78.9%	47.0%

Classification Matrix (Raw):						
Class	**1**	**2**	**3**	**4**	**5**	**6**
1	**5589**	135	0	8	125	116
2	48	**296**	0	0	12	9
3	0	0	**0**	0	0	0
4	0	0	0	**0**	0	0
5	238	19	0	1	**554**	23
6	128	0	0	0	11	**131**
Total	6003	450	0	9	702	279

Classification Matrix (%):						
Class	**1**	**2**	**3**	**4**	**5**	**6**
1	**93.1**	30.0	0.0	88.9	17.8	41.6
2	0.8	**65.8**	0.0	0.0	1.7	3.2
3	0.0	0.0	**0.0**	0.0	0.0	0.0
4	0.0	0.0	0.0	**0.0**	0.0	0.0
5	4.0	4.2	0.0	11.1	**78.9**	8.2
6	2.1	0.0	0.0	0.0	1.6	**47.0**
Total	100.0	100.0	0.0	100.0	100.0	100.0

Anderson Level I: Focal Majority

Anderson Level I: Focal Majority	
1	Herbaceous
2	Cropland
3	Urban
4	Water
5	Forest/Woodland
6	Shrubland

Accuracy Information	
Overall Accuracy	89.4%
Kappa	0.69

	1	**2**	**3**	**4**	**5**	**6**
Commission Accuracy	94.4%	81.0%	na	0.0%	69.9%	51.6%
Omission Accuracy	93.6%	68.0%	na	0.0%	83.3%	51.6%

Classification Matrix (Raw):						
Class	**1**	**2**	**3**	**4**	**5**	**6**
1	**625**	14	0	1	11	11
2	6	**34**	0	0	1	1
3	0	0	**0**	0	0	0
4	0	0	0	**0**	0	0
5	23	2	0	0	**65**	3
6	14	0	0	0	1	**16**
Total	668	50	0	1	78	31

Classification Matrix (%):						
Class	**1**	**2**	**3**	**4**	**5**	**6**
1	**93.6**	28.0	0.0	100.0	14.1	35.5
2	0.9	**68.0**	0.0	0.0	1.3	3.2
3	0.0	0.0	**0.0**	0.0	0.0	0.0
4	0.0	0.0	0.0	**0.0**	0.0	0.0
5	3.4	4.0	0.0	0.0	**83.3**	9.7
6	2.1	0.0	0.0	0.0	1.3	**51.6**
Total	100.0	100.0	0.0	100.0	100.0	100.0

Formation Level: Point Based

Formation Level: Point Based			
1	Temperate or subpolar needle-leaved evergreen forest	**12**	Medium-tall bunch temperate or subpolar grassland
2	Lowland and submontane cold-deciduous forest	**13**	Short sod temperate or subpolar grassland
3	Temporarily flooded cold-deciduous forest	**14**	Intermittently flooded temperate grassland
4	Cold-deciduous woodland	**15**	Temporarily flooded temperate or subpolar grassland
5	Temporarily flooded cold-deciduous woodland	**16**	Seasonally flooded temperate or subpolar grassland
6	Microphyllous evergreen shrubland	**17**	Semipermanently flooded temperate or subpolar grassland
7	Temporarily flooded microphyllous shrubland	**18**	Permanently flooded temperate or subpolar hydromorphic rooted vegetation
8	Temporarily flooded cold-deciduous shrubland	**19**	Temperate or subpolar annual grassland or forb vegetation
9	Semipermanently flooded cold-deciduous shrubland	**20**	Cropland
10	Tall sod temperate grassland	**21**	Urban
11	Medium-tall sod temperate or subpolar grassland	**22**	Water

Accuracy Information	
Overall Accuracy	64.5%
Kappa	0.52

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Commission Accuracy	na	32.4%	41.0%	22.2%	25.0%	46.9%	0.0%	na	na	81.9%	53.6%
Omission Accuracy	na	73.3%	47.1%	11.1%	36.4%	51.7%	0.0%	na	na	75.7%	68.6%
	12	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**
Commission Accuracy	na	68.0%	na	0.0%	50.0%	0.0%	na	0.0%	82.9%	na	0.0%
Omission Accuracy	na	48.1%	na	0.0%	33.3%	0.0%	na	0.0%	68.0%	na	0.0%

Classification Matrix (Raw):											
Class	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1	**0**	0	0	0	0	0	0	0	0	0	0
2	0	**11**	11	4	0	0	0	0	0	5	0
3	0	1	**16**	7	2	0	1	0	0	6	1
4	0	1	3	**2**	0	0	0	0	0	3	0
5	0	0	2	0	**4**	1	1	0	0	5	1
6	0	0	0	0	1	**15**	0	0	0	8	1
7	0	0	0	0	0	0	**0**	0	0	0	0
8	0	0	0	0	0	0	0	**0**	0	0	0
9	0	0	0	0	0	0	0	0	**0**	0	0
10	0	1	2	3	0	0	0	0	0	**280**	35
11	0	0	0	1	2	6	0	0	0	49	**120**
12	0	0	0	0	0	0	0	0	0	0	0
13	0	1	0	0	0	6	0	0	0	3	12
14	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	1	0	0	0	0	0	1	0
16	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	2	0	0	0	0	3	0
18	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	1	5
20	0	0	0	0	0	1	0	0	0	6	0
21	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0
Total	0	15	34	18	11	29	2	0	0	370	175
Class	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**
1	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	2	1	0	0
3	0	1	0	0	2	2	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	1	0	0	1	0	0
6	0	7	0	0	0	0	0	0	0	0	0
7	0	1	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0
10	0	5	0	2	0	0	0	5	9	0	0
11	0	41	0	0	0	0	0	1	3	0	1
12	**0**	0	0	0	0	0	0	0	0	0	0
13	0	**51**	0	0	0	0	0	1	1	0	0
14	0	0	**0**	0	0	0	0	0	0	0	0
15	0	0	0	**0**	0	0	0	0	0	0	0
16	0	0	0	0	**1**	0	0	0	1	0	0

Class	12	13	14	15	16	17	18	19	20	21	22
17	0	0	0	0	0	**0**	0	0	0	0	0
18	0	0	0	0	0	0	**0**	0	0	0	0
19	0	0	0	0	0	0	0	**0**	0	0	0
20	0	0	0	0	0	0	0	0	**34**	0	0
21	0	0	0	0	0	0	0	0	0	**0**	0
22	0	0	0	0	0	0	0	0	0	0	**0**
Total	0	106	0	2	3	3	0	9	50	0	1

Classification Matrix (%):											
Class	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	**73.3**	32.4	22.2	0.0	0.0	0.0	0.0	0.0	1.4	0.0
3	0.0	6.7	**47.1**	38.9	18.2	0.0	50.0	0.0	0.0	1.6	0.6
4	0.0	6.7	8.8	**11.1**	0.0	0.0	0.0	0.0	0.0	0.8	0.0
5	0.0	0.0	5.9	0.0	**36.4**	3.4	50.0	0.0	0.0	1.4	0.6
6	0.0	0.0	0.0	0.0	9.1	**51.7**	0.0	0.0	0.0	2.2	0.6
7	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0
10	0.0	6.7	5.9	16.7	0.0	0.0	0.0	0.0	0.0	**75.7**	20.0
11	0.0	0.0	0.0	5.6	18.2	20.7	0.0	0.0	0.0	13.2	**68.6**
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	6.7	0.0	0.0	0.0	20.7	0.0	0.0	0.0	0.8	6.9
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	5.6	0.0	0.0	0.0	0.0	0.0	0.3	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	18.2	0.0	0.0	0.0	0.0	0.8	0.0
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	2.9
20	0.0	0.0	0.0	0.0	0.0	3.4	0.0	0.0	0.0	1.6	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	0	100	100	100	100	100	100	0	0	100	100
Class	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22.2	2.0	0.0	0.0
3	0.0	0.9	0.0	0.0	66.7	66.7	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	33.3	0.0	0.0	2.0	0.0	0.0
6	0.0	6.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	4.7	0.0	100.0	0.0	0.0	0.0	55.6	18.0	0.0	0.0
11	0.0	38.7	0.0	0.0	0.0	0.0	0.0	11.1	6.0	0.0	100.0
12	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	**48.1**	0.0	0.0	0.0	0.0	0.0	11.1	2.0	0.0	0.0
14	0.0	0.0	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Class	12	13	14	15	16	17	18	19	20	21	22
16	0.0	0.0	0.0	0.0	**33.3**	0.0	0.0	0.0	2.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**68.0**	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
Total	0	100	0	100	100	100	0	100	100	0	100

Formation Level: 3-by-3 Window

Formation Level: 3-by-3 Window			
1	Temperate or subpolar needle-leaved evergreen forest	**12**	Medium-tall bunch temperate or subpolar grassland
2	Lowland and submontane cold-deciduous forest	**13**	Short sod temperate or subpolar grassland
3	Temporarily flooded cold-deciduous forest	**14**	Intermittently flooded temperate grassland
4	Cold-deciduous woodland	**15**	Temporarily flooded temperate or subpolar grassland
5	Temporarily flooded cold-deciduous woodland	**16**	Seasonally flooded temperate or subpolar grassland
6	Microphyllous evergreen shrubland	**17**	Semipermanently flooded temperate or subpolar grassland
7	Temporarily flooded microphyllous shrubland	**18**	Permanently flooded temperate or subpolar hydromorphic rooted vegetation
8	Temporarily flooded cold-deciduous shrubland	**19**	Temperate or subpolar annual grassland or forb vegetation
9	Semipermanently flooded cold-deciduous shrubland	**20**	Cropland
10	Tall sod temperate grassland	**21**	Urban
11	Medium-tall sod temperate or subpolar grassland	**22**	Water

Accuracy Information	
Overall Accuracy	64.5%
Kappa	0.52

	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
Commission Accuracy	na	35.8%	40.2%	26.7%	25.2%	48.1%	0.0%	na	na	81.6%	53.0%
Omission Accuracy	na	75.6%	42.8%	16.7%	31.3%	49.4%	0.0%	na	na	75.3%	71.0%
	12	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**
Commission Accuracy	na	68.8%	na	0.0%	19.0%	0.0%	na	0.0%	81.1%	na	0.0%
Omission Accuracy	na	48.4%	na	0.0%	14.8%	0.0%	na	0.0%	65.8%	na	0.0%

Classification Matrix (Raw):											
Class	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1	**0**	0	0	0	0	0	0	0	0	0	0
2	0	**102**	94	24	0	0	0	0	0	47	0
3	0	5	**131**	55	27	0	6	0	0	44	9
4	0	12	26	**27**	0	0	0	0	0	32	0
5	0	3	17	0	**31**	8	9	0	0	34	5
6	0	0	0	0	11	**129**	2	0	0	74	8
7	0	0	0	0	0	0	**0**	0	0	0	0
8	0	0	0	0	0	0	0	**0**	0	0	0
9	0	0	0	0	0	0	0	0	**0**	0	0
10	0	7	23	40	0	5	0	0	0	**2507**	299
11	0	0	4	9	15	55	0	0	0	458	**1112**
12	0	0	0	0	0	0	0	0	0	0	0
13	0	6	0	0	0	55	0	0	0	32	93
14	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	6	0	0	0	0	0	9	0
16	0	0	0	0	0	0	0	0	0	10	0
17	0	0	1	0	14	0	1	0	0	28	0
18	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	11	40
20	0	0	10	1	1	9	0	0	0	44	0
21	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0
Total	0	135	306	162	99	261	18	0	0	3330	1566
Class	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**
1	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	13	5	0	0
3	0	7	0	0	23	18	0	0	1	0	0
4	0	0	0	0	0	0	0	0	4	0	0
5	0	0	0	0	0	5	0	1	9	0	1
6	0	44	0	0	0	0	0	0	0	0	0
7	0	2	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0
10	0	43	0	18	0	0	0	45	86	0	0
11	0	392	0	0	0	4	0	10	30	0	8
12	**0**	0	0	0	0	0	0	0	0	0	0
13	0	**462**	0	0	0	0	0	12	12	0	0
14	0	0	**0**	0	0	0	0	0	0	0	0

Class	12	13	14	15	16	17	18	19	20	21	22
15	0	0	0	**0**	0	0	0	0	0	0	0
16	0	0	0	0	**4**	0	0	0	7	0	0
17	0	0	0	0	0	**0**	0	0	0	0	0
18	0	0	0	0	0	0	**0**	0	0	0	0
19	0	0	0	0	0	0	0	**0**	0	0	0
20	0	4	0	0	0	0	0	0	**296**	0	0
21	0	0	0	0	0	0	0	0	0	**0**	0
22	0	0	0	0	0	0	0	0	0	0	**0**
Total	0	954	0	18	27	27	0	81	450	0	9

Classification Matrix (%):											
Class	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	**75.6**	30.7	14.8	0.0	0.0	0.0	0.0	0.0	1.4	0.0
3	0.0	3.7	**42.8**	34.0	27.3	0.0	33.3	0.0	0.0	1.3	0.6
4	0.0	8.9	8.5	**16.7**	0.0	0.0	0.0	0.0	0.0	1.0	0.0
5	0.0	2.2	5.6	0.0	**31.3**	3.1	50.0	0.0	0.0	1.0	0.3
6	0.0	0.0	0.0	0.0	11.1	**49.4**	11.1	0.0	0.0	2.2	0.5
7	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0
10	0.0	5.2	7.5	24.7	0.0	1.9	0.0	0.0	0.0	**75.3**	19.1
11	0.0	0.0	1.3	5.6	15.2	21.1	0.0	0.0	0.0	13.8	**71.0**
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	4.4	0.0	0.0	0.0	21.1	0.0	0.0	0.0	1.0	5.9
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	3.7	0.0	0.0	0.0	0.0	0.0	0.3	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0
17	0.0	0.0	0.3	0.0	14.1	0.0	5.6	0.0	0.0	0.8	0.0
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	2.6
20	0.0	0.0	3.3	0.6	1.0	3.4	0.0	0.0	0.0	1.3	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	0	100	100	100	100	100	100	0	0	100	100
Class	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	16.0	1.1	0.0	0.0
3	0.0	0.7	0.0	0.0	85.2	66.7	0.0	0.0	0.2	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	18.5	0.0	1.2	2.0	0.0	11.1
6	0.0	4.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	4.5	0.0	100.0	0.0	0.0	0.0	55.6	19.1	0.0	0.0
11	0.0	41.1	0.0	0.0	0.0	14.8	0.0	12.3	6.7	0.0	88.9
12	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	**48.4**	0.0	0.0	0.0	0.0	0.0	14.8	2.7	0.0	0.0
14	0.0	0.0	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Class	12	13	14	15	16	17	18	19	20	21	22
15	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	**14.8**	0.0	0.0	0.0	1.6	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0
20	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	**65.8**	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
Total	0	100	0	100	100	100	0	100	100	0	100

Formation Level: Focal Majority

Formation Level: Focal Majority			
1	Temperate or subpolar needle-leaved evergreen forest	12	Medium-tall bunch temperate or subpolar grassland
2	Lowland and submontane cold-deciduous forest	13	Short sod temperate or subpolar grassland
3	Temporarily flooded cold-deciduous forest	14	Intermittently flooded temperate grassland
4	Cold-deciduous woodland	15	Temporarily flooded temperate or subpolar grassland
5	Temporarily flooded cold-deciduous woodland	16	Seasonally flooded temperate or subpolar grassland
6	Microphyllous evergreen shrubland	17	Semipermanently flooded temperate or subpolar grassland
7	Temporarily flooded microphyllous shrubland	18	Permanently flooded temperate or subpolar hydromorphic rooted vegetation
8	Temporarily flooded cold-deciduous shrubland	19	Temperate or subpolar annual grassland or forb vegetation
9	Semipermanently flooded cold-deciduous shrubland	20	Cropland
10	Tall sod temperate grassland	21	Urban
11	Medium-tall sod temperate or subpolar grassland	22	Water

Accuracy Information	
Overall Accuracy	66.2%
Kappa	0.54

	1	2	3	4	5	6	7	8	9	10	11
Commission Accuracy	na	35.3%	43.2%	50.0%	30.8%	51.6%	0.0%	na	na	83.2%	54.3%
Omission Accuracy	na	80.0%	47.1%	22.2%	36.4%	55.2%	0.0%	na	na	77.8%	72.6%
	12	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**
Commission Accuracy	na	67.1%	na	0.0%	0.0%	0.0%	na	0.0%	81.0%	na	0.0%
Omission Accuracy	na	44.3%	na	0.0%	0.0%	0.0%	na	0.0%	68.0%	na	0.0%

Classification Matrix (Raw):											
Class	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1	**0**	0	0	0	0	0	0	0	0	0	0
2	0	**12**	12	2	0	0	0	0	0	6	0
3	0	1	**16**	7	2	0	1	0	0	4	1
4	0	1	2	**4**	0	0	0	0	0	1	0
5	0	0	2	0	**4**	1	1	0	0	3	0
6	0	0	0	0	1	**16**	0	0	0	7	1
7	0	0	0	0	0	0	**0**	0	0	0	0
8	0	0	0	0	0	0	0	**0**	0	0	0
9	0	0	0	0	0	0	0	0	**0**	0	0
10	0	0	1	3	0	1	0	0	0	**288**	33
11	0	0	0	1	2	4	0	0	0	46	**127**
12	0	0	0	0	0	0	0	0	0	0	0
13	0	1	0	0	0	6	0	0	0	4	9
14	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	1	0	0	0	0	0	1	0
16	0	0	0	0	0	0	0	0	0	1	0
17	0	0	0	0	2	0	0	0	0	3	0
18	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	4
20	0	0	1	0	0	1	0	0	0	6	0
21	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	0
Total	0	15	34	18	11	29	2	0	0	370	175
Class	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**
1	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	1	1	0	0
3	0	0	0	0	3	2	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	1	0	0	1	0	0
6	0	6	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0
10	0	4	0	2	0	0	0	5	9	0	0
11	0	49	0	0	0	0	0	1	3	0	1
12	**0**	0	0	0	0	0	0	0	0	0	0
13	0	**47**	0	0	0	0	0	2	1	0	0
14	0	0	**0**	0	0	0	0	0	0	0	0

Class	12	13	14	15	16	17	18	19	20	21	22
15	0	0	0	**0**	0	0	0	0	0	0	0
16	0	0	0	0	**0**	0	0	0	1	0	0
17	0	0	0	0	0	**0**	0	0	0	0	0
18	0	0	0	0	0	0	**0**	0	0	0	0
19	0	0	0	0	0	0	0	**0**	0	0	0
20	0	0	0	0	0	0	0	0	**34**	0	0
21	0	0	0	0	0	0	0	0	0	**0**	0
22	0	0	0	0	0	0	0	0	0	0	**0**
Total	0	106	0	2	3	3	0	9	50	0	1

Classification Matrix (%):											
Class	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	**80.0**	35.3	11.1	0.0	0.0	0.0	0.0	0.0	1.6	0.0
3	0.0	6.7	**47.1**	38.9	18.2	0.0	50.0	0.0	0.0	1.1	0.6
4	0.0	6.7	5.9	**22.2**	0.0	0.0	0.0	0.0	0.0	0.3	0.0
5	0.0	0.0	5.9	0.0	**36.4**	3.4	50.0	0.0	0.0	0.8	0.0
6	0.0	0.0	0.0	0.0	9.1	**55.2**	0.0	0.0	0.0	1.9	0.6
7	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0
10	0.0	0.0	2.9	16.7	0.0	3.4	0.0	0.0	0.0	**77.8**	18.9
11	0.0	0.0	0.0	5.6	18.2	13.8	0.0	0.0	0.0	12.4	**72.6**
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	6.7	0.0	0.0	0.0	20.7	0.0	0.0	0.0	1.1	5.1
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	5.6	0.0	0.0	0.0	0.0	0.0	0.3	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0
17	0.0	0.0	0.0	0.0	18.2	0.0	0.0	0.0	0.0	0.8	0.0
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3
20	0.0	0.0	2.9	0.0	0.0	3.4	0.0	0.0	0.0	1.6	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	0	100	100	100	100	100	100	0	0	100	100
Class	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.1	2.0	0.0	0.0
3	0.0	0.0	0.0	0.0	100.0	66.7	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	33.3	0.0	0.0	2.0	0.0	0.0
6	0.0	5.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	3.8	0.0	100.0	0.0	0.0	0.0	55.6	18.0	0.0	0.0
11	0.0	46.2	0.0	0.0	0.0	0.0	0.0	11.1	6.0	0.0	100.0
12	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	**44.3**	0.0	0.0	0.0	0.0	0.0	22.2	2.0	0.0	0.0
14	0.0	0.0	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Class	12	13	14	15	16	17	18	19	20	21	22
15	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0	2.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**68.0**	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
Total	0	100	0	100	100	100	0	100	100	0	100

Alliance Level: Point Based

Alliance Level: Point Based			
1	Maple-Basswood Forest	27	Salt Marsh/Prairie
2	Oak-Hickory Forest	28	Spikerush Playa Lake
3	Post Oak-Blackjack Oak Forest	29	Playa Lake
4	Pecan Floodplain Forest	30	Low or Wet Prairie
5	Ash-Elm-Hackberry Floodplain Forest	31	Freshwater Marsh
6	Cottonwood Floodplain Forest	32	Bulrush Marsh
7	Mixed Oak Floodplain Forest	33	Cattail Marsh
8	Bur Oak Floodplain Woodland	38	Forb Playa Lake
9	Mixed Oak Ravine Woodland	40	Non-native Grassland
10	Post Oak-Blackjack Oak Woodland	41	CRP (Conservation Reserve Program)
11	Cottonwood Floodplain Woodland	42	Salt Cedar or Tamarisk Shrubland
12	Sandsage Shrubland	44	Cropland
14	Willow Shrubland	50	Deciduous Forest-Mined Land
15	Buttonbush (Swamp) Shrubland	51	Maple Floodplain Forest
17	Tallgrass Prairie	52	Evergreen Forest-Disturbed Land
18	Sand Prairie	55	Deciduous Woodland
20	Western Wheatgrass Prairie	60	Mixed Prairie-Disturbed Land
21	Sandstone Glade/Prairie	70	Weedy Marsh
22	Mixed Prairie	71	Weedy Upland
24	Alkali Sacaton Prairie	81	Urban
25	Shortgrass Prairie	82	Water
26	Grass Playa Lake		

Accuracy Information	
Overall	49.3%
Kappa	0.43

	1	2	3	4	5	6	7	8	9	10	11
Commission Accuracy	na	26.3%	38.5%	0.0%	42.3%	8.3%	0.0%	0.0%	0.0%	50.0%	25.0%
Omission Accuracy	na	71.4%	71.4%	0.0%	34.4%	100.0%	na	0.0%	0.0%	33.3%	36.4%
	12	**14**	**15**	**17**	**18**	**20**	**21**	**22**	**24**	**25**	**26**
Commission Accuracy	46.9%	na	na	48.0%	61.1%	10.0%	na	43.2%	na	68.0%	na
Omission Accuracy	51.7%	na	na	68.9%	39.3%	8.0%	na	63.7%	na	48.1%	na

	27	28	29	30	31	32	33	38	40	41	42
Commission Accuracy	na	na	na	0.0%	na	0.0%	0.0%	na	60.0%	68.0%	0.0%
Omission Accuracy	na	na	na	0.0%	na	na	0.0%	na	42.9%	50.4%	0.0%
	44	**50**	**51**	**52**	**55**	**60**	**70**	**71**	**81**	**82**	
Commission Accuracy	82.9%	50.0%	na	na	0.0%	14.3%	50.0%	0.0%	na	0.0%	
Omission Accuracy	68.0%	0.0%	na	na	0.0%	0.0%	33.3%	0.0%	na	0.0%	

Classification Matrix (Raw):

Class	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1	**0**	0	0	0	0	0	0	0	0	0	0
2	0	**5**	0	0	8	0	0	0	2	0	0
3	0	0	**5**	1	2	0	0	0	0	1	0
4	0	0	0	**0**	0	0	0	0	0	0	0
5	0	0	0	0	**11**	0	0	1	0	0	2
6	0	1	0	0	4	**1**	0	1	0	0	0
7	0	0	0	0	0	0	**0**	0	0	0	0
8	0	0	0	0	0	0	0	**0**	0	0	0
9	0	0	0	0	3	0	0	0	**0**	0	0
10	0	0	1	0	0	0	0	0	0	**1**	0
11	0	0	0	0	2	0	0	0	0	0	**4**
12	0	0	0	0	0	0	0	0	0	0	1
14	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	1	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	2
24	0	0	0	0	0	0	0	0	0	0	0
25	0	1	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	1	0
31	0	0	0	0	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0	0	0	0	2

33	0	0	0	0	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0	0	0	0	0
40	0	0	1	0	0	0	0	0	0	0	0
41	0	0	0	0	2	0	0	0	0	0	0
42	0	0	0	0	0	0	0	0	0	0	0
44	0	0	0	0	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0	0	0	0	0
51	0	0	0	0	0	0	0	0	0	0	0
52	0	0	0	0	0	0	0	0	0	0	0
55	0	0	0	0	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	0	0	0
71	0	0	0	0	0	0	0	0	0	0	0
81	0	0	0	0	0	0	0	0	0	0	0
82	0	0	0	0	0	0	0	0	0	0	0
Total	0	7	7	1	32	1	0	3	2	3	11
Class	**12**	**14**	**15**	**17**	**18**	**20**	**21**	**22**	**24**	**25**	**26**
1	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	1	0	0	0	0	0	0	0
3	0	0	0	1	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	1	0	0	0	0	0	1	0
6	0	0	0	1	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	1	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0
11	1	0	0	1	0	0	0	1	0	0	0
12	**15**	0	0	0	7	0	0	1	0	7	0
14	0	**0**	0	0	0	0	0	0	0	0	0
15	0	0	**0**	0	0	0	0	0	0	0	0
17	0	0	0	**73**	1	0	0	9	0	1	0
18	0	0	0	2	**11**	0	0	2	0	0	0
20	0	0	0	0	1	**2**	0	3	0	9	0
21	0	0	0	0	0	0	**0**	0	0	0	0
22	3	0	0	5	4	12	0	**79**	0	28	0
24	0	0	0	0	0	0	0	0	**0**	0	0
25	6	0	0	0	2	6	0	6	0	**51**	0
26	0	0	0	0	0	0	0	0	0	0	**0**
27	0	0	0	0	0	0	0	0	0	0	0

28	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0
31	0	0	0	0	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0	0	0	0	0
33	0	0	0	1	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	13	0	2	0	5	0	1	0
41	0	0	0	4	0	2	0	7	0	3	0
42	0	0	0	0	0	0	0	0	0	1	0
44	1	0	0	0	0	0	0	0	0	0	0
50	0	0	0	0	0	0	0	0	0	0	0
51	0	0	0	0	0	0	0	0	0	0	0
52	0	0	0	0	0	0	0	0	0	0	0
55	0	0	0	1	0	0	0	0	0	0	0
60	3	0	0	1	2	1	0	6	0	4	0
70	0	0	0	0	0	0	0	0	0	0	0
71	0	0	0	0	0	0	0	5	0	0	0
81	0	0	0	0	0	0	0	0	0	0	0
82	0	0	0	0	0	0	0	0	0	0	0
Total	29	0	0	106	28	25	0	124	0	106	0
Class	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**38**	**40**	**41**	**42**
1	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	2	0	0
3	0	0	0	0	0	0	0	0	1	0	0
4	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	2	0	0	1	0
6	0	0	0	0	0	0	0	0	1	1	1
7	0	0	0	0	0	0	0	0	1	0	0
8	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	1	0	0
10	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	1	0	0	4	1
12	0	0	0	0	0	0	0	0	0	1	0
14	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	2	0	0	0	0	37	20	0
18	0	0	0	0	0	0	0	0	2	0	0
20	0	0	0	0	0	0	0	0	1	1	0
21	0	0	0	0	0	0	0	0	0	0	0

22	0	0	0	0	0	0	0	0	4	29	0
24	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	1	0	0
26	0	0	0	0	0	0	0	0	0	0	0
27	**0**	0	0	0	0	0	0	0	0	0	0
28	0	**0**	0	0	0	0	0	0	0	0	0
29	0	0	**0**	0	0	0	0	0	0	0	0
30	0	0	0	**0**	0	0	0	0	1	0	0
31	0	0	0	0	**0**	0	0	0	0	0	0
32	0	0	0	0	0	**0**	0	0	0	0	0
33	0	0	0	0	0	0	**0**	0	1	1	0
38	0	0	0	0	0	0	0	**0**	0	0	0
40	0	0	0	0	0	0	0	0	**45**	2	0
41	0	0	0	0	0	0	0	0	4	**66**	0
42	0	0	0	0	0	0	0	0	0	0	**0**
44	0	0	0	0	0	0	0	0	2	4	0
50	0	0	0	0	0	0	0	0	0	0	0
51	0	0	0	0	0	0	0	0	0	0	0
52	0	0	0	0	0	0	0	0	0	0	0
55	0	0	0	0	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0	0	0	1	0
70	0	0	0	0	0	0	0	0	0	0	0
71	0	0	0	0	0	0	0	0	1	0	0
81	0	0	0	0	0	0	0	0	0	0	0
82	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	2	0	0	3	0	105	131	2
Class	**44**	**50**	**51**	**52**	**55**	**60**	**70**	**71**	**81**	**82**	
1	0	0	0	0	0	0	0	0	0	0	
2	0	0	0	0	1	0	0	0	0	0	
3	1	0	0	0	0	0	0	1	0	0	
4	0	0	0	0	0	0	0	0	0	0	
5	0	0	0	0	4	1	2	0	0	0	
6	0	0	0	0	1	0	0	0	0	0	
7	0	0	0	0	0	0	0	0	0	0	
8	0	0	0	0	0	0	0	0	0	0	
9	0	0	0	0	1	0	0	0	0	0	
10	0	0	0	0	0	0	0	0	0	0	
11	1	0	0	0	0	0	0	0	0	0	
12	0	0	0	0	0	0	0	0	0	0	
14	0	0	0	0	0	0	0	0	0	0	

15	0	0	0	0	0	0	0	0	0	0	
17	1	0	0	0	2	3	0	2	0	0	
18	0	0	0	0	0	0	0	1	0	0	
20	0	0	0	0	0	2	0	1	0	0	
21	0	0	0	0	0	0	0	0	0	0	
22	3	0	0	0	1	12	0	0	0	1	
24	0	0	0	0	0	0	0	0	0	0	
25	1	0	0	0	0	0	0	1	0	0	
26	0	0	0	0	0	0	0	0	0	0	
27	0	0	0	0	0	0	0	0	0	0	
28	0	0	0	0	0	0	0	0	0	0	
29	0	0	0	0	0	0	0	0	0	0	
30	0	0	0	0	0	0	0	0	0	0	
31	0	0	0	0	0	0	0	0	0	0	
32	0	0	0	0	0	0	0	0	0	0	
33	0	0	0	0	0	0	0	0	0	0	
38	0	0	0	0	0	0	0	0	0	0	
40	2	0	0	0	0	4	0	0	0	0	
41	6	0	0	0	0	1	0	2	0	0	
42	0	0	0	0	0	0	0	0	0	0	
44	**34**	0	0	0	0	0	0	0	0	0	
50	0	**1**	0	0	0	0	0	1	0	0	
51	0	0	**0**	0	0	0	0	0	0	0	
52	0	0	0	**0**	0	0	0	0	0	0	
55	0	0	0	0	**0**	0	0	0	0	0	
60	0	0	0	0	0	**3**	0	0	0	0	
70	1	0	0	0	0	0	**1**	0	0	0	
71	0	0	0	0	0	0	0	**0**	0	0	
81	0	0	0	0	0	0	0	0	**0**	0	
82	0	0	0	0	0	0	0	0	0	**0**	
Total	50	1	0	0	10	26	3	9	0	1	

Classification Matrix (%):											
Class	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	**71.4**	0.0	0.0	25.0	0.0	0.0	0.0	100.0	0.0	0.0
3	0.0	0.0	**71.4**	100.0	6.2	0.0	0.0	0.0	0.0	33.3	0.0
4	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	**34.4**	0.0	0.0	33.3	0.0	0.0	18.2
6	0.0	14.3	0.0	0.0	12.5	**100.0**	0.0	33.3	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	9.4	0.0	0.0	0.0	**0.0**	0.0	0.0
10	0.0	0.0	14.3	0.0	0.0	0.0	0.0	0.0	0.0	**33.3**	0.0
11	0.0	0.0	0.0	0.0	6.2	0.0	0.0	0.0	0.0	0.0	**36.4**
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.1
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33.3	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.2
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	0.0	14.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33.3	0.0
31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.2
33	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	0.0	0.0	14.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
41	0.0	0.0	0.0	0.0	6.2	0.0	0.0	0.0	0.0	0.0	0.0
42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
51	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
52	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
71	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
81	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
82	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	0	100	100	100	100	100	0	100	100	100	100
Class	**12**	**14**	**15**	**17**	**18**	**20**	**21**	**22**	**24**	**25**	**26**
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.9	0.0
6	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	3.4	0.0	0.0	0.9	0.0	0.0	0.0	0.8	0.0	0.0	0.0
12	**51.7**	0.0	0.0	0.0	25.0	0.0	0.0	0.8	0.0	6.6	0.0
14	0.0	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	**68.9**	3.6	0.0	0.0	7.3	0.0	0.9	0.0
18	0.0	0.0	0.0	1.9	**39.3**	0.0	0.0	1.6	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	3.6	**8.0**	0.0	2.4	0.0	8.5	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0	0.0
22	10.3	0.0	0.0	4.7	14.3	48.0	0.0	**63.7**	0.0	26.4	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0
25	20.7	0.0	0.0	0.0	7.1	24.0	0.0	4.8	0.0	**48.1**	0.0
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
33	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	0.0	0.0	0.0	12.3	0.0	8.0	0.0	4.0	0.0	0.9	0.0
41	0.0	0.0	0.0	3.8	0.0	8.0	0.0	5.6	0.0	2.8	0.0
42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.0
44	3.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
51	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
52	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
60	10.3	0.0	0.0	0.9	7.1	4.0	0.0	4.8	0.0	3.8	0.0
70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
71	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	0.0	0.0	0.0
81	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
82	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	100	0	0	100	100	100	0	100	0	100	0
Class	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**38**	**40**	**41**	**42**
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	66.7	0.0	0.0	0.8	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.8	50.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	33.3	0.0	0.0	3.1	50.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	35.2	15.3	0.0
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.8	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.8	22.1	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	0.0	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	0.0	0.0	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0	0.0	1.0	0.0	0.0
31	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0	0.0	0.0
33	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	1.0	0.8	0.0

38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0
40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**42.9**	1.5	0.0
41	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.8	**50.4**	0.0
42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9	3.1	0.0
50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
51	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
52	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0
70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
71	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
81	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
82	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	0	0	0	100	0	0	100	0	100	100	100
Class	**44**	**50**	**51**	**52**	**55**	**60**	**70**	**71**	**81**	**82**	
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
2	0.0	0.0	0.0	0.0	10.0	0.0	0.0	0.0	0.0	0.0	
3	2.0	0.0	0.0	0.0	0.0	0.0	0.0	11.1	0.0	0.0	
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
5	0.0	0.0	0.0	0.0	40.0	3.8	66.7	0.0	0.0	0.0	
6	0.0	0.0	0.0	0.0	10.0	0.0	0.0	0.0	0.0	0.0	
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
9	0.0	0.0	0.0	0.0	10.0	0.0	0.0	0.0	0.0	0.0	
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
11	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
17	2.0	0.0	0.0	0.0	20.0	11.5	0.0	22.2	0.0	0.0	
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.1	0.0	0.0	
20	0.0	0.0	0.0	0.0	0.0	7.7	0.0	11.1	0.0	0.0	
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
22	6.0	0.0	0.0	0.0	10.0	46.2	0.0	0.0	0.0	100.0	
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
25	2.0	0.0	0.0	0.0	0.0	0.0	0.0	11.1	0.0	0.0	
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
33	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
40	4.0	0.0	0.0	0.0	0.0	15.4	0.0	0.0	0.0	0.0	
41	12.0	0.0	0.0	0.0	0.0	3.8	0.0	22.2	0.0	0.0	
42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
44	**68.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
50	0.0	**100.0**	0.0	0.0	0.0	0.0	0.0	11.1	0.0	0.0	
51	0.0	0.0	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
52	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	
55	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0	0.0	0.0	
60	0.0	0.0	0.0	0.0	0.0	**11.5**	0.0	0.0	0.0	0.0	
70	2.0	0.0	0.0	0.0	0.0	0.0	**33.3**	0.0	0.0	0.0	
71	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	
81	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	
82	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	
Total	100	100	0	0	100	100	100	100	0	100	

Alliance Level: 3-by-3 Window

Alliance Level: 3-by-3 Window			
1	Maple-Basswood Forest	27	Salt Marsh/Prairie
2	Oak-Hickory Forest	28	Spikerush Playa Lake
3	Post Oak-Blackjack Oak Forest	29	Playa Lake
4	Pecan Floodplain Forest	30	Low or Wet Prairie
5	Ash-Elm-Hackberry Floodplain Forest	31	Freshwater Marsh
6	Cottonwood Floodplain Forest	32	Bulrush Marsh
7	Mixed Oak Floodplain Forest	33	Cattail Marsh
8	Bur Oak Floodplain Woodland	38	Forb Playa Lake
9	Mixed Oak Ravine Woodland	40	Non-native Grassland
10	Post Oak-Blackjack Oak Woodland	41	CRP (Conservation Reserve Program)
11	Cottonwood Floodplain Woodland	42	Salt Cedar or Tamarisk Shrubland
12	Sandsage Shrubland	44	Cropland
14	Willow Shrubland	50	Deciduous Forest-Mined Land
15	Buttonbush (Swamp) Shrubland	51	Maple Floodplain Forest
17	Tallgrass Prairie	52	Evergreen Forest-Disturbed Land
18	Sand Prairie	55	Deciduous Woodland
20	Western Wheatgrass Prairie	60	Mixed Prairie-Disturbed Land
21	Sandstone Glade/Prairie	70	Weedy Marsh
22	Mixed Prairie	71	Weedy Upland
24	Alkali Sacaton Prairie	81	Urban
25	Shortgrass Prairie	82	Water
26	Grass Playa Lake		

Accuracy Information	
Overall Accuracy	49.8%
Kappa	0.44

	1	2	3	4	5	6	7	8	9	10	11
Commission Accuracy	na	25.7%	49.4%	0.0%	41.0%	11.4%	0.0%	0.0%	15.7%	31.8%	25.2%
Omission Accuracy	na	71.4%	68.3%	0.0%	33.3%	100.0%	na	0.0%	61.1%	25.9%	31.3%
	12	**14**	**15**	**17**	**18**	**20**	**21**	**22**	**24**	**25**	**26**
Commission Accuracy	48.1%	na	na	49.1%	61.6%	15.1%	na	41.6%	na	68.8%	na
Omission Accuracy	49.4%	na	na	72.0%	40.1%	12.9%	na	64.6%	na	48.4%	na

	27	28	29	30	31	32	33	38	40	41	42
Commission Accuracy	na	na	na	0.0%	na	0.0%	0.0%	na	62.1%	69.1%	0.0%
Omission Accuracy	na	na	na	0.0%	na	na	0.0%	na	45.2%	48.3%	0.0%
	44	**50**	**51**	**52**	**55**	**60**	**70**	**71**	**81**	**82**	
Commission Accuracy	81.1%	39.1%	na	na	0.0%	18.1%	19.0%	0.0%	na	0.0%	
Omission Accuracy	65.8%	0.0%	na	na	0.0%	0.0%	14.8%	0.0%	na	0.0%	

Classification Matrix (Raw):

Class	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1	**0**	0	0	0	0	0	0	0	0	0	0
2	0	**45**	5	0	78	0	0	0	7	0	0
3	0	0	**43**	5	9	0	0	0	0	11	0
4	0	0	0	**0**	0	0	0	0	0	0	0
5	0	0	0	0	**96**	0	0	7	0	0	24
6	0	5	0	0	23	**9**	0	8	0	0	3
7	0	0	0	0	3	0	**0**	0	0	0	0
8	0	0	0	0	0	0	0	**0**	0	0	0
9	0	4	0	0	19	0	0	0	**11**	0	0
10	0	0	8	0	7	0	0	0	0	**7**	0
11	0	3	0	0	17	0	0	0	0	0	**31**
12	0	0	0	0	0	0	0	0	0	0	11
14	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0
17	0	0	1	4	9	0	0	7	0	3	0
18	0	0	0	0	0	0	0	2	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	4	0	0	2	0	0	15
24	0	0	0	0	0	0	0	0	0	0	0
25	0	6	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	6	0
31	0	0	0	0	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0	0	0	0	14

33	0	0	0	0	1	0	0	0	0	0	0
38	0	0	0	0	0	0	0	0	0	0	0
40	0	0	6	0	1	0	0	0	0	0	0
41	0	0	0	0	9	0	0	0	0	0	0
42	0	0	0	0	0	0	0	0	0	0	0
44	0	0	0	0	10	0	0	1	0	0	1
50	0	0	0	0	2	0	0	0	0	0	0
51	0	0	0	0	0	0	0	0	0	0	0
52	0	0	0	0	0	0	0	0	0	0	0
55	0	0	0	0	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	0	0	0
71	0	0	0	0	0	0	0	0	0	0	0
81	0	0	0	0	0	0	0	0	0	0	0
82	0	0	0	0	0	0	0	0	0	0	0
Total	0	63	63	9	288	9	0	27	18	27	99
Class	**12**	**14**	**15**	**17**	**18**	**20**	**21**	**22**	**24**	**25**	**26**
1	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	9	0	0	0	0	0	0	0
3	0	0	0	6	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	9	0	0	0	1	0	7	0
6	0	0	0	4	0	0	0	2	0	0	0
7	0	0	0	1	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	9	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0
11	8	0	0	8	2	1	0	4	0	0	0
12	**129**	0	0	0	62	0	0	8	0	44	0
14	0	**0**	0	0	0	0	0	0	0	0	0
15	0	0	**0**	0	0	0	0	0	0	0	0
17	5	0	0	**687**	11	0	0	86	0	12	0
18	0	0	0	13	**101**	0	0	13	0	0	0
20	0	0	0	0	3	**29**	0	31	0	85	0
21	0	0	0	0	0	0	**0**	0	0	0	0
22	26	0	0	47	32	112	0	**715**	0	278	0
24	0	0	0	0	0	0	0	0	**0**	0	0
25	55	0	0	0	24	49	0	44	0	**462**	0
26	0	0	0	0	0	0	0	0	0	0	**0**
27	0	0	0	0	0	0	0	0	0	0	0

28	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0
31	0	0	0	0	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0	0	0	0	0
33	0	0	0	8	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	106	0	16	0	46	0	9	0
41	0	0	0	25	1	12	0	59	0	22	0
42	0	0	0	0	0	0	0	0	0	2	0
44	9	0	0	0	0	0	0	0	0	4	0
50	0	0	0	0	0	0	0	0	0	0	0
51	0	0	0	0	0	0	0	0	0	0	0
52	0	0	0	0	0	0	0	0	0	0	0
55	0	0	0	6	0	0	0	0	0	0	0
60	29	0	0	8	16	6	0	58	0	29	0
70	0	0	0	0	0	0	0	0	0	0	0
71	0	0	0	8	0	0	0	40	0	0	0
81	0	0	0	0	0	0	0	0	0	0	0
82	0	0	0	0	0	0	0	0	0	0	0
Total	261	0	0	954	252	225	0	1107	0	954	0
Class	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**38**	**40**	**41**	**42**
1	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	25	0	0
3	0	0	0	0	0	0	0	0	4	0	0
4	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	18	0	0	11	0
6	0	0	0	0	0	0	0	0	7	3	6
7	0	0	0	0	0	0	0	0	9	0	0
8	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	14	0	0
10	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	5	0	0	24	9
12	0	0	0	0	0	0	0	0	0	12	2
14	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	11	0	0	0	0	301	183	0
18	0	0	0	6	0	0	0	0	20	0	0
20	0	0	0	0	0	0	0	0	6	15	0
21	0	0	0	0	0	0	0	0	0	0	0

22	0	0	0	0	0	0	4	0	43	280	0
24	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	5	3	0
26	0	0	0	0	0	0	0	0	0	0	0
27	**0**	0	0	0	0	0	0	0	0	0	0
28	0	**0**	0	0	0	0	0	0	0	0	0
29	0	0	**0**	0	0	0	0	0	0	0	0
30	0	0	0	**0**	0	0	0	0	9	0	0
31	0	0	0	0	**0**	0	0	0	0	0	0
32	0	0	0	0	0	**0**	0	0	0	0	1
33	0	0	0	0	0	0	**0**	0	8	12	0
38	0	0	0	0	0	0	0	**0**	0	0	0
40	0	0	0	0	0	0	0	0	**427**	23	0
41	0	0	0	1	0	0	0	0	40	**569**	0
42	0	0	0	0	0	0	0	0	0	0	**0**
44	0	0	0	0	0	0	0	0	21	23	0
50	0	0	0	0	0	0	0	0	3	0	0
51	0	0	0	0	0	0	0	0	0	0	0
52	0	0	0	0	0	0	0	0	0	0	0
55	0	0	0	0	0	0	0	0	0	3	0
60	0	0	0	0	0	0	0	0	0	8	0
70	0	0	0	0	0	0	0	0	0	10	0
71	0	0	0	0	0	0	0	0	3	0	0
81	0	0	0	0	0	0	0	0	0	0	0
82	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	18	0	0	27	0	945	1179	18
Class	**44**	**50**	**51**	**52**	**55**	**60**	**70**	**71**	**81**	**82**	
1	0	0	0	0	0	0	0	0	0	0	
2	0	0	0	0	6	0	0	0	0	0	
3	5	0	0	0	0	0	0	4	0	0	
4	0	0	0	0	0	0	0	0	0	0	
5	1	0	0	0	31	6	23	0	0	0	
6	0	0	0	0	9	0	0	0	0	0	
7	0	0	0	0	0	0	0	0	0	0	
8	0	0	0	0	0	0	0	0	0	0	
9	4	0	0	0	9	0	0	0	0	0	
10	0	0	0	0	0	0	0	0	0	0	
11	9	0	0	0	0	0	0	1	0	1	
12	0	0	0	0	0	0	0	0	0	0	
14	0	0	0	0	0	0	0	0	0	0	

15	0	0	0	0	0	0	0	0	0	0	
17	11	0	0	0	22	24	0	21	0	0	
18	0	0	0	0	0	0	0	9	0	0	
20	2	0	0	0	0	13	0	8	0	0	
21	0	0	0	0	0	0	0	0	0	0	
22	28	0	0	0	7	114	0	2	0	8	
24	0	0	0	0	0	0	0	0	0	0	
25	12	0	0	0	0	0	0	12	0	0	
26	0	0	0	0	0	0	0	0	0	0	
27	0	0	0	0	0	0	0	0	0	0	
28	0	0	0	0	0	0	0	0	0	0	
29	0	0	0	0	0	0	0	0	0	0	
30	0	0	0	0	0	0	0	0	0	0	
31	0	0	0	0	0	0	0	0	0	0	
32	0	0	0	0	0	0	0	0	0	0	
33	0	0	0	0	0	0	0	0	0	0	
38	0	0	0	0	0	0	0	0	0	0	
40	19	0	0	0	6	26	0	3	0	0	
41	56	0	0	0	0	17	0	12	0	0	
42	0	0	0	0	0	0	0	0	0	0	
44	**296**	0	0	0	0	0	0	0	0	0	
50	0	**9**	0	0	0	0	0	9	0	0	
51	0	0	**0**	0	0	0	0	0	0	0	
52	0	0	0	**0**	0	0	0	0	0	0	
55	0	0	0	0	**0**	0	0	0	0	0	
60	0	0	0	0	0	**34**	0	0	0	0	
70	7	0	0	0	0	0	**4**	0	0	0	
71	0	0	0	0	0	0	0	**0**	0	0	
81	0	0	0	0	0	0	0	0	**0**	0	
82	0	0	0	0	0	0	0	0	0	**0**	
Total	450	9	0	0	90	234	27	81	0	9	

Classification Matrix (%):											
Class	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	**71.4**	7.9	0.0	27.1	0.0	0.0	0.0	38.9	0.0	0.0
3	0.0	0.0	**68.3**	55.6	3.1	0.0	0.0	0.0	0.0	40.7	0.0
4	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	**33.3**	0.0	0.0	25.9	0.0	0.0	24.2
6	0.0	7.9	0.0	0.0	8.0	**100.0**	0.0	29.6	0.0	0.0	3.0
7	0.0	0.0	0.0	0.0	1.0	0.0	**0.0**	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0
9	0.0	6.3	0.0	0.0	6.6	0.0	0.0	0.0	**61.1**	0.0	0.0
10	0.0	0.0	12.7	0.0	2.4	0.0	0.0	0.0	0.0	**25.9**	0.0
11	0.0	4.8	0.0	0.0	5.9	0.0	0.0	0.0	0.0	0.0	**31.3**
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.1
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	1.6	44.4	3.1	0.0	0.0	25.9	0.0	11.1	0.0
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.4	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	1.4	0.0	0.0	7.4	0.0	0.0	15.2
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	0.0	9.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	22.2	0.0
31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.1
33	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0
38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	0.0	0.0	9.5	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0
41	0.0	0.0	0.0	0.0	3.1	0.0	0.0	0.0	0.0	0.0	0.0
42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0	3.5	0.0	0.0	3.7	0.0	0.0	1.0
50	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0
51	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
52	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
71	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
81	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
82	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	0	100	100	100	100	100	0	100	100	100	100
Class	**12**	**14**	**15**	**17**	**18**	**20**	**21**	**22**	**24**	**25**	**26**
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.1	0.0	0.7	0.0
6	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.2	0.0	0.0	0.0
7	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	3.1	0.0	0.0	0.8	0.8	0.4	0.0	0.4	0.0	0.0	0.0
12	**49.4**	0.0	0.0	0.0	24.6	0.0	0.0	0.7	0.0	4.6	0.0
14	0.0	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	1.9	0.0	0.0	**72.0**	4.4	0.0	0.0	7.8	0.0	1.3	0.0
18	0.0	0.0	0.0	1.4	**40.1**	0.0	0.0	1.2	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	1.2	**12.9**	0.0	2.8	0.0	8.9	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0	0.0
22	10.0	0.0	0.0	4.9	12.7	49.8	0.0	**64.6**	0.0	29.1	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0
25	21.1	0.0	0.0	0.0	9.5	21.8	0.0	4.0	0.0	**48.4**	0.0
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
33	0.0	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	0.0	0.0	0.0	11.1	0.0	7.1	0.0	4.2	0.0	0.9	0.0
41	0.0	0.0	0.0	2.6	0.4	5.3	0.0	5.3	0.0	2.3	0.0
42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0
44	3.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0

50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
51	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
52	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
60	11.1	0.0	0.0	0.8	6.3	2.7	0.0	5.2	0.0	3.0	0.0
70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
71	0.0	0.0	0.0	0.8	0.0	0.0	0.0	3.6	0.0	0.0	0.0
81	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
82	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	100	0	0	100	100	100	0	100	0	100	0
Class	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**38**	**40**	**41**	**42**
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.6	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	66.7	0.0	0.0	0.9	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.3	33.3
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	18.5	0.0	0.0	2.0	50.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	11.1
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	61.1	0.0	0.0	0.0	0.0	31.9	15.5	0.0
18	0.0	0.0	0.0	33.3	0.0	0.0	0.0	0.0	2.1	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	1.3	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	0.0	14.8	0.0	4.6	23.7	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.3	0.0
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	0.0	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	0.0	0.0	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0	0.0	1.0	0.0	0.0
31	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0	0.0	5.6
33	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	0.8	1.0	0.0

38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0
40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**45.2**	2.0	0.0
41	0.0	0.0	0.0	5.6	0.0	0.0	0.0	0.0	4.2	**48.3**	0.0
42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.2	2.0	0.0
50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0
51	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
52	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0
60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0
70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0
71	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0
81	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
82	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	0	0	0	100	0	0	100	0	100	100	100
Class	**44**	**50**	**51**	**52**	**55**	**60**	**70**	**71**	**81**	**82**	
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
2	0.0	0.0	0.0	0.0	6.7	0.0	0.0	0.0	0.0	0.0	
3	1.1	0.0	0.0	0.0	0.0	0.0	0.0	4.9	0.0	0.0	
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
5	0.2	0.0	0.0	0.0	34.4	2.6	85.2	0.0	0.0	0.0	
6	0.0	0.0	0.0	0.0	10.0	0.0	0.0	0.0	0.0	0.0	
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
9	0.9	0.0	0.0	0.0	10.0	0.0	0.0	0.0	0.0	0.0	
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
11	2.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.0	11.1	
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
17	2.4	0.0	0.0	0.0	24.4	10.3	0.0	25.9	0.0	0.0	
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.1	0.0	0.0	
20	0.4	0.0	0.0	0.0	0.0	5.6	0.0	9.9	0.0	0.0	
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
22	6.2	0.0	0.0	0.0	7.8	48.7	0.0	2.5	0.0	88.9	
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
25	2.7	0.0	0.0	0.0	0.0	0.0	0.0	14.8	0.0	0.0	
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
33	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
40	4.2	0.0	0.0	0.0	6.7	11.1	0.0	3.7	0.0	0.0	
41	12.4	0.0	0.0	0.0	0.0	7.3	0.0	14.8	0.0	0.0	
42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
44	**65.8**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
50	0.0	**100.0**	0.0	0.0	0.0	0.0	0.0	11.1	0.0	0.0	
51	0.0	0.0	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
52	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	
55	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0	0.0	0.0	
60	0.0	0.0	0.0	0.0	0.0	**14.5**	0.0	0.0	0.0	0.0	
70	1.6	0.0	0.0	0.0	0.0	0.0	**14.8**	0.0	0.0	0.0	
71	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	
81	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	
82	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	
Total	100	100	0	0	100	100	100	100	0	100	

Alliance Level: Focal Majority

Alliance Level: Focal Majority			
1	Maple-Basswood Forest	27	Salt Marsh/Prairie
2	Oak-Hickory Forest	28	Spikerush Playa Lake
3	Post Oak-Blackjack Oak Forest	29	Playa Lake
4	Pecan Floodplain Forest	30	Low or Wet Prairie
5	Ash-Elm-Hackberry Floodplain Forest	31	Freshwater Marsh
6	Cottonwood Floodplain Forest	32	Bulrush Marsh
7	Mixed Oak Floodplain Forest	33	Cattail Marsh
8	Bur Oak Floodplain Woodland	38	Forb Playa Lake
9	Mixed Oak Ravine Woodland	40	Non-native Grassland
10	Post Oak-Blackjack Oak Woodland	41	CRP (Conservation Reserve Program)
11	Cottonwood Floodplain Woodland	42	Salt Cedar or Tamarisk Shrubland
12	Sandsage Shrubland	44	Cropland
14	Willow Shrubland	50	Deciduous Forest-Mined Land
15	Buttonbush (Swamp) Shrubland	51	Maple Floodplain Forest
17	Tallgrass Prairie	52	Evergreen Forest-Disturbed Land
18	Sand Prairie	55	Deciduous Woodland
20	Western Wheatgrass Prairie	60	Mixed Prairie-Disturbed Land
21	Sandstone Glade/Prairie	70	Weedy Marsh
22	Mixed Prairie	71	Weedy Upland
24	Alkali Sacaton Prairie	81	Urban
25	Shortgrass Prairie	82	Water
26	Grass Playa Lake		

Accuracy Information	
Overall	51.7%
Kappa	0.46

	1	2	3	4	5	6	7	8	9	10	11
Commission Accuracy	na	26.3%	46.2%	na	41.4%	12.5%	0.0%	na	40.0%	33.3%	30.8%
Omission Accuracy	na	71.4%	85.7%	0.0%	37.5%	100.0%	0.0%	0.0%	100.0%	33.3%	36.4%
	12	**14**	**15**	**17**	**18**	**20**	**21**	**22**	**24**	**25**	**26**
Commission Accuracy	51.6%	na	na	47.6%	61.1%	15.8%	na	44.4%	na	66.2%	na
Omission Accuracy	55.2%	na	na	73.6%	39.3%	12.0%	na	70.2%	na	44.3%	na

	27	28	29	30	31	32	33	38	40	41	42
Commission Accuracy	na	na	na	0.0%	na	0.0%	0.0%	na	69.1%	76.4%	na
Omission Accuracy	na	na	na	0.0%	na	0.0%	0.0%	na	44.8%	51.9%	0.0%
	44	**50**	**51**	**52**	**55**	**60**	**70**	**71**	**81**	**82**	
Commission Accuracy	81.0%	0.0%	na	na	na	0.0%	0.0%	0.0%	na	na	
Omission Accuracy	68.0%	100.0%	na	na	0.0%	19.2%	0.0%	0.0%	na	0.0%	

Classification Matrix (Raw):											
Class	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1	**0**	0	0	0	0	0	0	0	0	0	0
2	0	**5**	0	0	10	0	0	0	0	0	0
3	0	0	**6**	1	1	0	0	0	0	1	0
4	0	0	0	**0**	0	0	0	0	0	0	0
5	0	0	0	0	**12**	0	0	1	0	0	2
6	0	1	0	0	3	**1**	0	1	0	0	0
7	0	0	0	0	0	0	**0**	0	0	0	0
8	0	0	0	0	0	0	0	**0**	0	0	0
9	0	0	0	0	1	0	0	0	**2**	0	0
10	0	0	1	0	1	0	0	0	0	**1**	0
11	0	0	0	0	2	0	0	0	0	0	**4**
12	0	0	0	0	0	0	0	0	0	0	1
14	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	1	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0	0	2
24	0	0	0	0	0	0	0	0	0	0	0
25	0	1	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0	0	0
27	0	0	0	0	0	0	0	0	0	0	0
28	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	1	0
31	0	0	0	0	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0	0	0	0	2

33	0	0	0	0	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	0	0	0	0	0	0	0	0
41	0	0	0	0	1	0	0	0	0	0	0
42	0	0	0	0	0	0	0	0	0	0	0
44	0	0	0	0	1	0	0	0	0	0	0
50	0	0	0	0	0	0	0	0	0	0	0
51	0	0	0	0	0	0	0	0	0	0	0
52	0	0	0	0	0	0	0	0	0	0	0
55	0	0	0	0	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0	0	0	0	0
70	0	0	0	0	0	0	0	0	0	0	0
71	0	0	0	0	0	0	0	0	0	0	0
81	0	0	0	0	0	0	0	0	0	0	0
82	0	0	0	0	0	0	0	0	0	0	0
Total	0	7	7	1	32	1	0	3	2	3	11
Class	**12**	**14**	**15**	**17**	**18**	**20**	**21**	**22**	**24**	**25**	**26**
1	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	1	0
3	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	1	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0
11	1	0	0	0	0	0	0	2	0	0	0
12	**16**	0	0	1	0	0	0	2	0	6	0
14	0	**0**	0	0	0	0	0	0	0	0	0
15	0	0	**0**	0	0	0	0	0	0	0	0
17	0	0	0	**78**	2	0	0	6	0	0	0
18	6	0	0	2	**11**	0	0	4	0	3	0
20	0	0	0	0	0	**3**	0	13	0	6	0
21	0	0	0	0	0	0	**0**	0	0	0	0
22	1	0	0	12	1	2	0	**87**	0	4	0
24	0	0	0	0	0	0	0	0	**0**	0	0
25	6	0	0	1	0	11	0	33	0	**47**	0
26	0	0	0	0	0	0	0	0	0	0	**0**
27	0	0	0	0	0	0	0	0	0	0	0

28	0	0	0	0	0	0	0	0	0	0	0
29	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	2	0	0	0	0	0	0	0
31	0	0	0	0	0	0	0	0	0	0	0
32	0	0	0	0	0	0	0	0	0	0	0
33	0	0	0	0	0	0	0	0	0	0	0
38	0	0	0	0	0	0	0	0	0	0	0
40	0	0	0	35	3	1	0	4	0	1	0
41	1	0	0	22	0	1	0	28	0	0	0
42	0	0	0	0	0	0	0	0	0	0	0
44	0	0	0	2	0	0	0	3	0	1	0
50	0	0	0	0	0	0	0	0	0	0	0
51	0	0	0	0	0	0	0	0	0	0	0
52	0	0	0	0	0	0	0	0	0	0	0
55	0	0	0	2	0	0	0	1	0	0	0
60	0	0	0	3	0	0	0	13	0	0	0
70	0	0	0	0	0	0	0	0	0	0	0
71	0	0	0	3	1	1	0	0	0	2	0
81	0	0	0	0	0	0	0	0	0	0	0
82	0	0	0	0	0	0	0	1	0	0	0
Total	31	0	0	164	18	19	0	197	0	71	0
Class	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**38**	**40**	**41**	**42**
1	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	2	0	0
3	0	0	0	0	0	0	0	0	1	0	0
4	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	2	0	0	2	0
6	0	0	0	0	0	0	0	0	0	0	1
7	0	0	0	0	0	0	0	0	1	0	0
8	0	0	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	1	0	0
10	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	1	0	0	2	1
12	0	0	0	0	0	0	0	0	0	1	0
14	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	2	0	0	0	0	35	22	0
18	0	0	0	0	0	0	0	0	3	0	0
20	0	0	0	0	0	0	0	0	1	1	0
21	0	0	0	0	0	0	0	0	0	0	0

22	0	0	0	0	0	0	0	0	4	28	0
24	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	1	0	0
26	0	0	0	0	0	0	0	0	0	0	0
27	**0**	0	0	0	0	0	0	0	0	0	0
28	0	**0**	0	0	0	0	0	0	0	0	0
29	0	0	**0**	0	0	0	0	0	0	0	0
30	0	0	0	**0**	0	0	0	0	1	0	0
31	0	0	0	0	**0**	0	0	0	0	0	0
32	0	0	0	0	0	**0**	0	0	0	0	0
33	0	0	0	0	0	0	**0**	0	1	1	0
38	0	0	0	0	0	0	0	**0**	0	0	0
40	0	0	0	0	0	0	0	0	**47**	1	0
41	0	0	0	0	0	0	0	0	4	**68**	0
42	0	0	0	0	0	0	0	0	0	0	**0**
44	0	0	0	0	0	0	0	0	3	3	0
50	0	0	0	0	0	0	0	0	0	0	0
51	0	0	0	0	0	0	0	0	0	0	0
52	0	0	0	0	0	0	0	0	0	0	0
55	0	0	0	0	0	0	0	0	0	0	0
60	0	0	0	0	0	0	0	0	0	1	0
70	0	0	0	0	0	0	0	0	0	1	0
71	0	0	0	0	0	0	0	0	0	0	0
81	0	0	0	0	0	0	0	0	0	0	0
82	0	0	0	0	0	0	0	0	0	0	0
Total	0	0	0	2	0	0	3	0	105	131	2
Class	**44**	**50**	**51**	**52**	**55**	**60**	**70**	**71**	**81**	**82**	
1	0	0	0	0	0	0	0	0	0	0	
2	0	0	0	0	1	0	0	0	0	0	
3	1	0	0	0	0	0	0	0	0	0	
4	0	0	0	0	0	0	0	0	0	0	
5	0	0	0	0	4	1	3	0	0	0	
6	0	0	0	0	1	0	0	0	0	0	
7	0	0	0	0	0	0	0	0	0	0	
8	0	0	0	0	0	0	0	0	0	0	
9	0	0	0	0	1	0	0	0	0	0	
10	0	0	0	0	0	0	0	0	0	0	
11	1	0	0	0	0	0	0	0	0	0	
12	0	0	0	0	0	0	0	0	0	0	
14	0	0	0	0	0	0	0	0	0	0	

15	0	0	0	0	0	0	0	0	0	0	
17	2	0	0	0	2	3	0	3	0	0	
18	0	0	0	0	0	0	0	1	0	0	
20	0	0	0	0	0	0	0	1	0	0	
21	0	0	0	0	0	0	0	0	0	0	
22	3	0	0	0	1	13	0	0	0	1	
24	0	0	0	0	0	0	0	0	0	0	
25	1	0	0	0	0	0	0	2	0	0	
26	0	0	0	0	0	0	0	0	0	0	
27	0	0	0	0	0	0	0	0	0	0	
28	0	0	0	0	0	0	0	0	0	0	
29	0	0	0	0	0	0	0	0	0	0	
30	0	0	0	0	0	0	0	0	0	0	
31	0	0	0	0	0	0	0	0	0	0	
32	0	0	0	0	0	0	0	0	0	0	
33	0	0	0	0	0	0	0	0	0	0	
38	0	0	0	0	0	0	0	0	0	0	
40	1	0	0	0	0	3	0	0	0	0	
41	6	0	0	0	0	1	0	1	0	0	
42	0	0	0	0	0	0	0	0	0	0	
44	**34**	0	0	0	0	0	0	0	0	0	
50	0	**1**	0	0	0	0	0	1	0	0	
51	0	0	**0**	0	0	0	0	0	0	0	
52	0	0	0	**0**	0	0	0	0	0	0	
55	0	0	0	0	**0**	0	0	0	0	0	
60	0	0	0	0	0	**5**	0	0	0	0	
70	1	0	0	0	0	0	**0**	0	0	0	
71	0	0	0	0	0	0	0	**0**	0	0	
81	0	0	0	0	0	0	0	0	0	0	
82	0	0	0	0	0	0	0	0	0	0	
Total	50	1	0	0	10	26	3	9	0	1	

Classification Matrix (%):											
Class	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
1	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	**71.4**	0.0	0.0	31.2	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	**85.7**	100.0	3.1	0.0	0.0	0.0	0.0	33.3	0.0
4	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	**37.5**	0.0	0.0	33.3	0.0	0.0	18.2
6	0.0	14.3	0.0	0.0	9.4	**100.0**	0.0	33.3	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	3.1	0.0	0.0	0.0	**100.0**	0.0	0.0
10	0.0	0.0	14.3	0.0	3.1	0.0	0.0	0.0	0.0	**33.3**	0.0
11	0.0	0.0	0.0	0.0	6.2	0.0	0.0	0.0	0.0	0.0	**36.4**
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.1
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33.3	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.2
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	0.0	14.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33.3	0.0
31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	18.2
33	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
41	0.0	0.0	0.0	0.0	3.1	0.0	0.0	0.0	0.0	0.0	0.0
42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	0.0	0.0	0.0	0.0	3.1	0.0	0.0	0.0	0.0	0.0	0.0
50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
51	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
52	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
71	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
81	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
82	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	0	100	100	100	100	100	0	100	100	100	100
Class	**12**	**14**	**15**	**17**	**18**	**20**	**21**	**22**	**24**	**25**	**26**
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.0	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.9	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	3.4	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
12	**55.2**	0.0	0.0	0.0	21.4	0.0	0.0	0.8	0.0	5.7	0.0
14	0.0	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	3.4	0.0	0.0	**73.6**	7.1	0.0	0.0	9.7	0.0	0.9	0.0
18	0.0	0.0	0.0	1.9	**39.3**	0.0	0.0	0.8	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	**12.0**	0.0	1.6	0.0	10.4	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0	0.0
22	6.9	0.0	0.0	5.7	14.3	52.0	0.0	**70.2**	0.0	31.1	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0
25	20.7	0.0	0.0	0.0	10.7	24.0	0.0	3.2	0.0	**44.3**	0.0
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
33	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40	0.0	0.0	0.0	10.4	0.0	4.0	0.0	2.4	0.0	0.9	0.0
41	0.0	0.0	0.0	0.9	0.0	4.0	0.0	4.0	0.0	0.9	0.0
42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44	3.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
51	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
52	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
60	6.9	0.0	0.0	0.9	7.1	4.0	0.0	4.0	0.0	4.7	0.0
70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
71	0.0	0.0	0.0	0.9	0.0	0.0	0.0	3.2	0.0	0.0	0.0
81	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
82	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	100	0	0	100	100	100	0	100	0	100	0
Class	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**38**	**40**	**41**	**42**
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.9	0.0	0.0
3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
5	0.0	0.0	0.0	0.0	0.0	0.0	66.7	0.0	0.0	1.5	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	50.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0	33.3	0.0	0.0	1.5	50.0
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	100.0	0.0	0.0	0.0	0.0	33.3	16.8	0.0
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.9	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.8	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.8	21.4	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
27	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
28	0.0	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
29	0.0	0.0	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
30	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0	0.0	1.0	0.0	0.0
31	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0
32	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0	0.0	0.0
33	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	1.0	0.8	0.0

38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0
40	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**44.8**	0.8	0.0
41	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.8	**51.9**	0.0
42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**
44	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.9	2.3	0.0
50	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
51	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
52	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
60	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0
70	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0
71	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
81	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
82	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	0	0	0	100	0	0	100	0	100	100	100
Class	**44**	**50**	**51**	**52**	**55**	**60**	**70**	**71**	**81**	**82**	
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
2	0.0	0.0	0.0	0.0	10.0	0.0	0.0	0.0	0.0	0.0	
3	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
5	0.0	0.0	0.0	0.0	40.0	3.8	100.0	0.0	0.0	0.0	
6	0.0	0.0	0.0	0.0	10.0	0.0	0.0	0.0	0.0	0.0	
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
9	0.0	0.0	0.0	0.0	10.0	0.0	0.0	0.0	0.0	0.0	
10	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
11	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
14	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
15	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
17	4.0	0.0	0.0	0.0	20.0	11.5	0.0	33.3	0.0	0.0	
18	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.1	0.0	0.0	
20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.1	0.0	0.0	
21	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
22	6.0	0.0	0.0	0.0	10.0	50.0	0.0	0.0	0.0	100.0	
24	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
25	2.0	0.0	0.0	0.0	0.0	0.0	0.0	22.2	0.0	0.0	
26	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
27	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
28	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	

29	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
30	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
31	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
32	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
33	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
38	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
40	2.0	0.0	0.0	0.0	0.0	11.5	0.0	0.0	0.0	0.0	
41	12.0	0.0	0.0	0.0	0.0	3.8	0.0	11.1	0.0	0.0	
42	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
44	**68.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
50	0.0	**100.0**	0.0	0.0	0.0	0.0	0.0	11.1	0.0	0.0	
51	0.0	0.0	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
52	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0	0.0	0.0	0.0	
55	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0	0.0	0.0	
60	0.0	0.0	0.0	0.0	0.0	**19.2**	0.0	0.0	0.0	0.0	
70	2.0	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	0.0	
71	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	0.0	
81	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0	
82	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	**0.0**	
Total	100	100	0	0	100	100	100	100	0	100	