NRI / LANDFIRE Pilot Project - Montana

Using National Resources Inventory (NRI) data with Forest Inventory Analysis (FIA) and other field data for mapping vegetation in LANDFIRE

2010

Executive Summary

The United States Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS) and the LANDFIRE program collaborated in a pilot project in Montana to test the utility of NRCS National Resources Inventory (NRI) program rangeland data in remapping the LANDFIRE Existing Vegetation Type (EVT) layer in a portion of that state.

NRI consists of a series of natural resource inventories conducted by the NRCS. It provides updated information on the status, condition, and trends of land, soil, water, and related resources on the Nation's non-Federal lands.

LANDFIRE is an interagency mapping program (United States Department of Interior (DOI), the USDA Forest Service, and The Nature Conservancy) that produces consistent and comprehensive maps and data describing vegetation, wildland fire and fuel characteristics at the landscape level across all 50 United States. LANDFIRE data products include geospatial layers and data of vegetation composition and structure, surface and canopy fuel characteristics, and fire regimes.

Incorporating NRI data improves the LANDFIRE process of producing a consistent suite of wall-to-wall, standardized, multi-scale spatial data layers and models, and provides NRCS and similar groups with information and data that can be used as a framework for land and conservation planning activities or be combined with other spatial data layers to support research and development.

In 2009 the LANDFIRE program completed mapping the 50 United States delivering 24 geospatial data layers (circa 2001) using data collected from many organizations and agencies across the US including the Forest Service's Forest Inventory and Analysis (FIA) program data. However the LANDFIRE data did not include the NRI data. USDA NRCS and LANDFIRE leadership collaborated on a pilot project in Montana to test the utility of the NRI data in updating and refining LANDFIRE data products. The NRI/LANDFIRE pilot project implemented a procedure to ensure confidentiality of NRI rangeland on-site data, formatted and processed the NRI data, and remapped the LANDFIRE Existing Vegetation Type (EVT) layer for study area in Montana. Results and observations from the NRI/LANDFIRE pilot project are evaluated and documented in this report.

The FIA and other data comprised a critical component in developing the LANDFIRE data products being used to classify and model output layers including the EVT layer. The NRI rangeland on-site data were viewed as being very complementary to FIA and other data sources as well as serving to fill a critical gap in grass and shrubland types where there was a lack of data. By adding a set of detailed

vegetation measurements (using NRI) from primarily grassland and shrubland environments, the NRI/LANDFIRE pilot project was used to evaluate how these data would enhance and improve the quality of the LANDFIRE data set.

Results of the pilot with the inclusion of NRI data highlighted both spatial and categorical distribution improvements in the LANDFIRE data products. These improvements included a more accurate spatial distribution of grass and shrubland types as compared to previously received feedback on the LANDFIRE National map. The inclusion of NRI data during revision of LANDFIRE EVT layers resulted in less editing time and minimized the use of ancillary data and expert opinion in post processing. Also, the addition of NRI data provided a more even data distribution among EVT mapping classes, resulting in improved accuracy of the models and final products.

The LANDFIRE data products are important for modeling fire behavior, and serve as an important data source in analyses that highlight areas of risk. Although the fire related data products are important, the land characterization products of vegetation, biophysical setting, and environmental site potential have broader potential uses that could benefit NRCS.

This report includes some observations of benefits and challenges for the future and lists some potential ideas for next steps of collaboration.

United States Department of Agriculture NRCS Natural Resources Conservation Service	Forest Service US Department of Agriculture	LANDFIRE
USDA Natural Resources Conservation Service National Resources Inventory	USDA Forest Service Forest Inventory and Analysis	USDA Forest Service US Department of the Interior The Nature Conservancy

Introduction and Background

The Natural Resources Conservation Service (NRCS) National Resources Inventory (NRI) and LANDFIRE programs collaborated in 2009 to do a pilot project in the state of Montana. The pilot project was designed to evaluate the use of NRI data in LANDFIRE mapping applications. NRI was expected to complement Forest Inventory and Analysis (FIA) and other data sources used previously in LANDFIRE, by adding a set of detailed vegetation measurements from primarily grassland and shrubland locations. The pilot project used NRI field samples collected during 2003 – 2006 in Montana.

The NRCS of USDA assesses the status, condition, and trends of soil, water, and related resources on the Nation's non-Federal lands through the National Resources Inventory (NRI). Non-Federal lands include privately owned lands, tribal and trust lands, and lands controlled by State and local governments. NRI rangeland on-site data collection is a vital component of the continuous inventory process and the on-site field data collected by NRI on nonfederal rangeland since 2003 include land cover/land use, soils, ecological site information, rangeland health, invasive plant presence, disturbance indicators, conservation practices, and plant species composition, production, canopy cover, and height. The NRI inventory design ensures a spatially balanced, representative sample of rangeland vegetation across the landscape. Confidentiality requirements for NRI data are similar to those of FIA.

LANDFIRE (also known as Landscape Fire and Resource Management Planning Tools) is an interagency vegetation, fire, and fuel characteristics mapping program, sponsored by the United States Department of the Interior (DOI) and the USDA, Forest Service (www.landfire.gov). LANDFIRE was initiated based on agencies' needs for spatial data that support landscape analysis and prioritization, planning, assessments and decision support. These data also support strategic resource management initiatives, such as the Healthy Forests Restoration Act, Community Wildfire Protection Plans, the National Fire Plan, National Cohesive Wildland Fire Management Strategy (Cohesive Strategy), fire management planning, stewardship of public and private lands, and natural resource management. Since LANDFIRE began in 2004, an expanded range of land management uses of LANDFIRE data products has surfaced. These new uses include climate change research, carbon sequestration planning, eco-regional assessments, as well as ongoing fire and natural resources management planning initiatives. LANDFIRE data products consist of over 50 spatial data layers in the form of maps and other data that support a range of land management analysis and modeling. Specific data layers include: Existing Vegetation Type, Existing Canopy Cover, and Existing Canopy Height; Biophysical Settings; Environmental Site Potential; Fire Behavior Fuel Models; Fire Regime Classes; and Fire Effects layers. These layers are produced as raster data sets at 30-meter pixel resolution. Input data used in production of the vegetation and fuel layers include Landsat imagery, terrain layers (http://edna.usgs.gov), and a suite of climatic and other biophysical gradient layers, along with an extensive, multi-source database of field plot and polygon data referred to as the LANDFIRE Reference Database (LFRDB) and events database. LANDFIRE methodologies emphasize heavy reliance on field plot data throughout the mapping process. The FIA program provides comprehensive inventory data for all public and private forested lands in the US based on a network of field plot locations with about 1 plot per 6,000 acres. FIA has collaborated with LANDFIRE since 2004 to provide plot data under a national agreement, consulting and analysis, and spatial data processing in support of LANDFIRE map production. Since FIA is legally required to maintain the confidentiality of its plot locations, an FIA liaison works full time with LANDFIRE staff to facilitate data access in accordance with established security protocols. FIA data comprise a critical component of the LFRDB. FIA plots are evenly distributed across all forested lands providing a comprehensive sample of forest vegetation types. A rich set of attributes available for each plot supports a variety of mapping applications, vegetation change modeling, canopy fuel estimation, and the development of fuel loading classifications. Consistent field methods and database format across the US support efficient data processing for national scale mapping. A limitation of FIA data is that field sampling is done only on forest lands. Lacking an FIA-like data source for grasslands and shrublands, these nonforest vegetation types have been underrepresented in the LFRDB.

Leadership between the NRCS and the LANDFIRE program collaborated in 2009 as LANDFIRE brought to a close the complete mapping of all 50 United States delivering 24 geospatial data layers. LANDFIRE leadership and technical staff recognized the need of incorporating more field data especially for non-forest vegetation types. NRI rangeland data were viewed as being very complementary to previous data that LANDFIRE had acquired and would serve to fill a critical gap in grass and shrubland types where there was a lack of data within the LANDFIRE data products. Non-forest types were underrepresented in the data collected as part of the LFRDB. Both NRCS/NRI and LANDFIRE expected that the addition of NRI plots with associated species-level data would increase the non-forest vegetation sample size thereby improving the overall quality of the LANDFIRE data products for these vegetation types. The pilot was designed to test the transfer and use of NRI program data in remapping the LANDFIRE Existing Vegetation Type (EVT) layer for the study area within the state of Montana.

The pilot evaluated the applicability of NRI rangeland data in the following ways:

(1) Adapting LANDFIRE processes to maintain the confidentiality of NRI data similar to procedures previously implemented for FIA;

(2) Identified NRI field data elements to be used in LANDFIRE mapping; and

(3) Evaluated NRI data format for ease in adapting data processing protocols used to generate the LANDFIRE EVT layer and other data products.

Pilot Study Area

The study area was in a subset of the state of Montana (figure 1 – map zone 20) where approximately 900 NRI plots sampled during 2003-2006 were used across the state for evaluation of the NRI data structure and its use within the LANDFIRE mapping process. Within map zone 20, 343 NRI plots were used in the analysis for grass and shrubland types in the pilot project. Because LANDFIRE production is organized around the Multi-Resolution Land Characteristics Consortium (MRLC) (www.mrlc.gov) National Land Cover Database (NLCD; based loosely on Omernik) mapping zones (a pre-classification stratification method for mapping), the analyses and tests of the inclusion of NRI data in the LANDFIRE mapping process were done for map zone 20.

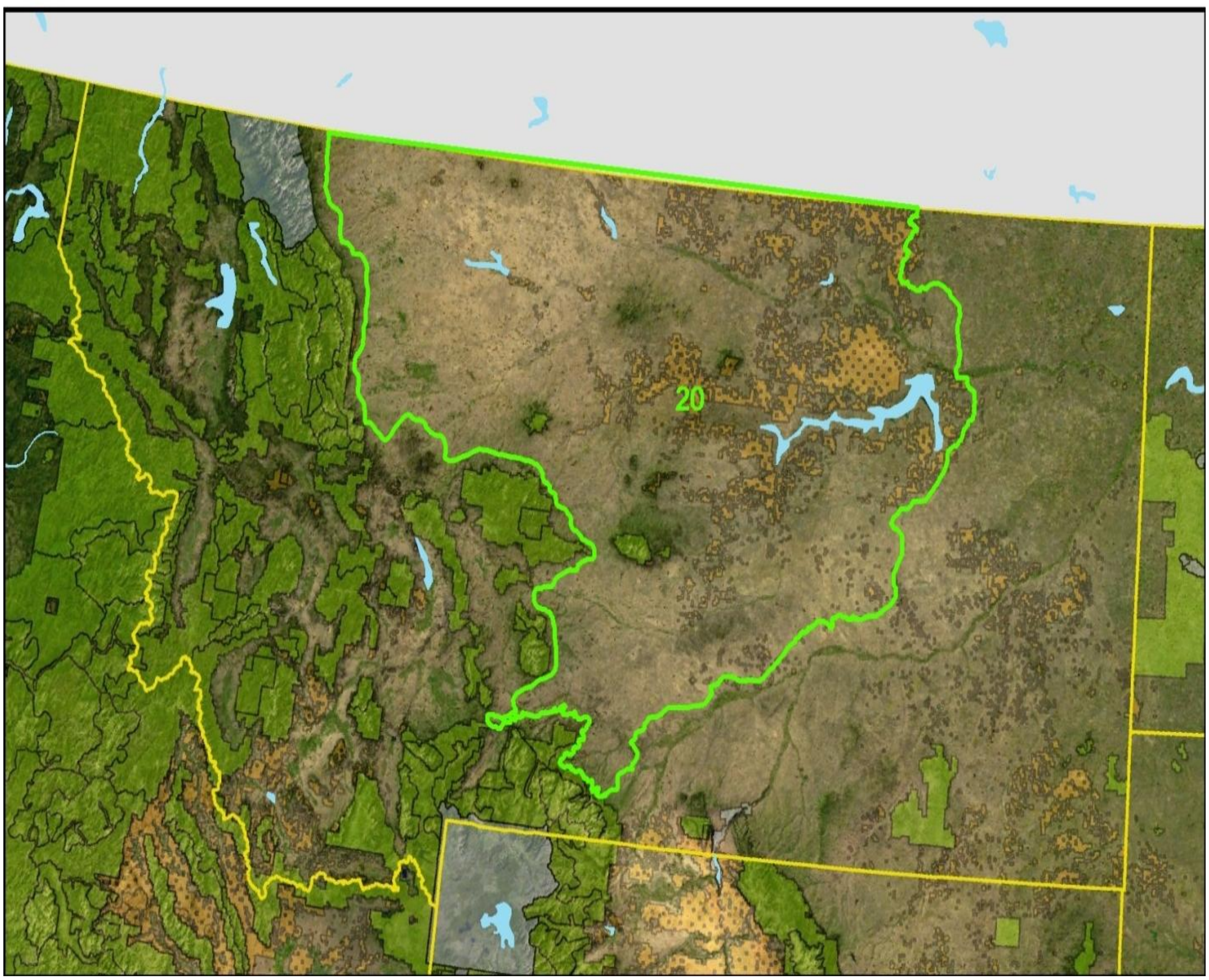

Figure 1. Montana study area (outlined in yellow) with map zone 20 (outlined in light green with the number 20 in the middle) which was used as the focus area for the NRI/LANDFIRE pilot project.

Spatial Data Processing and Confidentiality

NRI field data from 2003-2006 were provided to LANDFIRE in fixed-width format. In addition to tabular data, NRI provided close-up ground photos of each transect and high resolution aerial images of each plot location. Plot numbers, coordinates, photos, and aerial images were treated as confidential and managed by the FIA liaison within LANDFIRE according to FIA security protocols. Initial data processing for LANDFIRE was performed by the FIA liaison that had entered into a confidentiality agreement with NRCS Resource Inventory Division to access and use NRI data for the purposes outlined in the agreement. Importing of tabular data from fixed-width format into relational database format was automated using Microsoft Access templates. Unique NRI point IDs (composite of four NRI fields) were transformed into a LANDFIRE ID in order to maintain confidentiality of the original NRI IDs. All subsequent work in LANDFIRE used only the LANDFIRE ID for NRI plots, and the crosswalk between LANDFIRE IDs and the original NRI IDs was kept confidential.

Coordinates for NRI points were managed using the same protocols used for FIA plot coordinates. Predictor data were generated by overlaying plot locations on 30-meter resolution raster data sets, including terrain variables from a digital elevation model and Landsat spectral values. These predictor data were provided to LANDFIRE mapping teams by associating the derived variables with the LANDFIRE plot id only. Spatial data processing followed the same procedures used for FIA plots in LANDFIRE so that mapping teams did not need access to plot locations in order to develop predictive models. One of the benefits of LANDFIRE data layers is that they were modeled from multiple data sources. Once the modeled information was associated with the 30-meter pixels, the sample site locations could no longer be identified. The footprint of each NRI field sample was approximately the size of one 30-meter pixel, with GPS coordinates taken at the intersection of two 150-feet perpendicular transects (figure2).

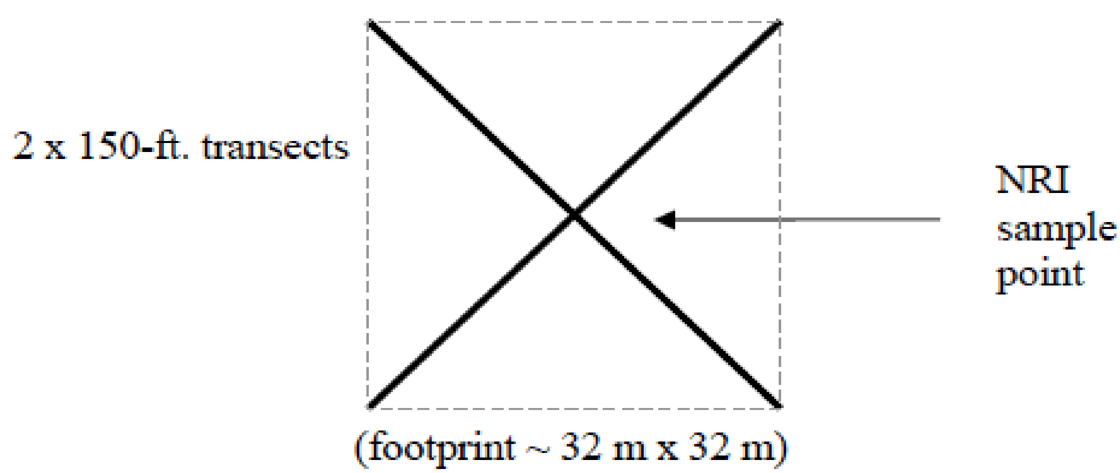

Figure 2. Plot footprint of NRI points sampled by two 150-feet transects.

Compilation into LFRDB Format

The LFRDB provided a database schema optimized for LANDFIRE mapping and vegetation modeling. It served as a common format for combining multiple data sources, e.g., NRI and FIA, into a single set of related tables. NRI data from Montana were converted into LFRDB format, assisted by documentation and consultation provided by NRCS staff with expertise in NRI field methods and database schema. Initial assessments were done to identify NRI tables and data elements applicable in LANDFIRE mapping and modeling applications (Table 1).

Table 1. NRI data elements that were assessed and evaluated for use in LANDFIRE mapping.

NRI Data Elements	Potential applications of NRI data in LANDFIRE
GPS	- Plot coordinates and measurement dates (Managed according to FIA protocols)
DISTURBANCE	- Screen plots for use in mapping - Inform and assess the vegetation transition layers used in product updates - Identify burnable areas incorrectly mapped as non-burnable
ECOSITE	- Crosscheck against LANDFIRE vegetation types assigned by automated key - Possible screening criteria to identify highly heterogeneous sites
NOXIOUS	- Inform the LANDFIRE Exotics layer, which is an intermediate layers used to map LANDFIRE succession classes and fuel characteristics
PINTERCEPT	- Derive percent canopy cover by species and lifeform, and use those values to assign vegetation types to each plot by automated floristic key
PLANTHEIGHT	- Derive average vegetation height of the stand
POINT	- Use the land cover/use data as a crosscheck against the vegetation types assigned to each plot by the automated floristic key - Identify plots useful for agricultural classification (e.g., Pasture/Hay)
PRACTICE	- Screen plots for use in mapping - Inform and assess the vegetation transitions layer used in product updates - Help identify burnable areas incorrectly mapped as non-burnable.
PRODUCTION	- Augment the list of species present as derived from the PINTERCEPT table (e.g., ensuring that certain species found in the woody plots that were not represented in the point-intercept sample are at least noted as “present” on the plot)
PTNOTE	- Support plot screening and general QAQC efforts

LANDFIRE EVT layer used NatureServe Ecological Systems as the mapping unit (http://www.natureserve.org/getData/USecologyData.jsp). Ecological Systems is a hierarchical ordering of vegetation from broad formations or biome to fine scale alliances and associations, and provides a suitable classification for mapping of ecosystems at scales relevant to many conservation and resource management applications. Plots in the LFRDB were assigned to an Ecological System using an automated rule set approach based on indicator species and thresholds of canopy cover. NRI plots performed well for automated assignment to Ecological Systems. Species-level canopy cover estimates were derived from the point intercept sample (table PINTERCEPT), and the production data (table PRODUCTION) were used to augment the list of species detected by point intercept alone. Field samples that provide full species lists with canopy cover estimates are preferred for analytical opportunities and tractable assignment to LANDFIRE vegetation types.

With automation developed in the pilot project, the turnaround time to process new NRI datasets into LFRDB format ready for modeling would be approximately 1 week.

Contribution of NRI data to the LFRDB

NRI plots in Montana were predominantly in grassland and shrubland vegetation types which have been underrepresented in general relative to forest types in the LFRDB. In the map zone 20 subset, 97 percent of NRI plots were in nonforest vegetation types (Table 2). In contrast, only 53 percent of the existing LFRDB plots used for EVT mapping were in nonforest vegetation types (including grassland, shrubland, and sparsely vegetated types) although 87 percent of the vegetated area in map zone 20 was mapped as nonforest types.

Most existing LFRDB plots in grassland/shrubland vegetation types lacked species composition data. For example, data from the Gap Analysis Program (GAP) were available in map zone 20, but only contained field calls of Ecological Systems at specific locations without any additional vegetation measurements. Species composition data permit assignment to vegetation types by automated algorithm using rule-sets designed specifically for LANDFIRE mapping. This automated algorithm provides for adjustments in a systematic and repeatable process. The underrepresentation of nonforest types was even greater within the subset of existing LFRDB plots in map zone 20 that provided species composition data (Table 2). The addition of NRI plots in map zone 20 increased by 58 percent the number of nonforest plots with associated species-level data.

Table 2. Plot counts by EVT lifeform for the LANDFIRE National data set and the NRI data set in map zone 20, compared with the percent of vegetated area mapped in each EVT lifeform.

	Herbaceous	Shrub	Tree	Sparse
Percent of vegetated area in the LANDFIRE National EVT map	63%	24%	13%	<1%
z20 LANDFIRE National EVT plots (all)	994 (22%)	1,061 (23%)	2,138(47%)	341 (8%)
z20 LANDFIRE National EVT plots having species composition data	271 (16%)	224 (13%)	1,156 (67%)	73 (4%)
z20 NRI plots	*258 (75%)*	*74 (22%)*	*11 (3%)*	*0 (0%)*

The addition of NRI data also provided a substantial increase in the number of grassland and shrubland plots on non-Federal lands (table 3). Improved representation across land ownership classes, along with the even spatial distribution provided by the NRI sample design, was expected to be beneficial for mapping.

Table 3. Plot counts for non-forest (shrub, herbaceous) vegetation types in the LANDFIRE National data set compared with the NRI data set for map zone 20, by land ownership class

	County	State	Private	BIA	Federal	Total
z20 LANDFIRE National all herbaceous and shrub EVT plots	2	166	1,367	42	469	**2,046**
z20 LANDFIRE National herbaceous and shrub EVT plots having species composition data	0	17	209	3	266	**495**
z20 NRI plots	0	34	290	16	3	**343**

Remapping of the LANDFIRE Existing Vegetation Type (EVT) Data Products

The value of adding NRI data to the LANDFIRE mapping process was partially assessed by remapping LANDFIRE EVT in map zone 20 using the NRI data available to the pilot study. An initial analysis was done by overlaying the Montana NRI plots on the LANDFIRE National EVT map, which provided information on type-specific and proportional agreement between the two data sets. Proportional agreement refers to the relative amount of each vegetation type mapped within the study area compared with the relative amount of each type on the landscape as inferred from the plot-based inventory sample. Examination of proportional agreement across the different vegetation types may suggest types that are over- or under-mapped relative to the plot data. A summary of the overlay for Montana is in the Appendix (Table 5).

Geospatial Predictor Layers and CART Modeling

The production of the LANDFIRE National products of existing vegetation mapping for Zone 20 relied on an extensive set of geospatial data layers. These spatial data included three dates of Landsat imagery (spring, leaf-on, leaf-off), a digital elevation model (DEM) and derivative products (e.g. aspect, slope, and position index), and biophysical gradient data (e.g. soil, temperature, and climate variables). Additional spatial data (e.g. GAP, National Land Cover Dataset (NLCD)) were used on a zone-by-zone basis where available to address specific issues. Extracted values for each plot were obtained and included as part of the reference database. These data were used as predictor variables for the development of decision/regression tree models. For the LANDFIRE National Zone 20 existing vegetation mapping, there were over 5,000 plots representing 36 EVTs. For the pilot project EVT remapping, we used the same set of geospatial data as predictors and added the NRI field data to the training data set.

A supervised classification and regression tree (CART) approach was used for mapping LANDFIRE National existing vegetation. Decision tree models (See5, [www.rulequest.com]) were used to model EVT and height. The accuracy of the LANDFIRE EVT product was reported as a cross validation CV value. The See5 model builder was used for the NRI/LANDFIRE pilot project remapping, as well.

Landscape Stratification

Stratification was used to assign EVTs into broad but ecologically similar groups. This simplified and improved the modeling process, by reducing the number of classes being mapped together and reducing confusion among classes. The stratification masks formed the basis of the EVT and structure maps. In the western United States, vegetation was stratified according to three major vegetation lifeforms (tree, shrub, and herbaceous) as well as three major lifezone divisions (alpine/subalpine, montane, and foothills/lowlands). In the LF National Zone 20 mapping effort, there were no alpine/subalpine lifezones modeled. The same six stratification classes were used for the NRI/LANDFIRE pilot project remapping, however, only the shrub and herbaceous lifeforms were remapped because NRI, as expected, did not contribute significantly to the plot count that comprised the tree class. Therefore, in the final remap products, areas that were within forested vegetation types were identical to those in the LANDFIRE National product for Zone 20.

Results of the Existing Vegetation Type Modeling

The remapping effort focused on adding the NRI plot data that keyed-out to shrub or herbaceous systems into the pool of plots used for model development. In the NRI/LANDFIRE pilot project, the mappable EVTs were grouped by stratification class and See5 models were developed separately for all the classes. There were 2 EVTs in the shrub-montane class, 3 in the shrub-foothills/lowlands class, 2 in the herbaceous/montane class, and 5 in the herbaceous-foothills/lowlands class. The cross validation values for the model runs using only the data used for the LANDFIRE National mapping for Zone 20 were: 91.8%, 83.7%, 63.3%, and 85.8% for the shrub-montane class, shrub-foothills/lowlands class, herbaceous/montane class, and herbaceous-foothills/lowlands class, respectively. The decision tree model for each group was then applied to the geospatial data for the whole zone to generate separate EVT classification maps for each stratification class. These individual classifications were then merged in an ERDAS model into a single EVT product using the stratification maps as templates. Several additional classes (water, urban, agriculture, and barren) were included by integrating 2001 NLCD landcover products into the final EVT map. The final pixel tallies for the LANDFIRE National EVT data product and remapped shrubland and herbaceous land (grassland, forbland, or meadow) EVTs are shown in Table 4.

Table 4. Comparison between the LANDFIRE National Existing Vegetation Types (class names – shrubland and herbaceous land (grassland, forbland, or meadow) EVTs and acres of types and percentages of types within the zone) as produced in 2009 and the remapped LANDFIRE Existing Vegetation Types using NRI data for map zone 20.

Existing Vegetation Type (EVT) Class Name*	EVT Code	LF National EVT without the use of NRI data (ac)	Percent of EVT in Map Zone 20	LF EVT remapped using NRI (ac)	Percent of EVT in Map Zone 20
Inter-Mountain Basins Big Sagebrush Shrubland	2080	319,993	1.74%	257,722	1.40%
Northwestern Great Plains Shrubland	2085	1,456,512	7.90%	1,515,100	8.22%
Northern Rocky Mountain Montane-Foothill Deciduous Shrubland	2106	217,928	1.18%	155,857	0.85%
Inter-Mountain Basins Big Sagebrush Steppe	2125	2,969,829	16.11%	2,973,512	16.13%
Inter-Mountain Basins Montane Sagebrush Steppe	2126	33,163	0.18%	95,234	0.52%
Northern Rocky Mountain Lower Montane-Foothill-Valley Grassland	2139	691,914	3.75%	640,746	3.47%
Northern Rocky Mountain Subalpine-Upper Montane Grassland	2140	122,233	0.66%	N/A	N/A
Northwestern Great Plains Mixed grass Prairie	2141	12,557,291	68.10%	12,581,957	68.23%
Rocky Mountain Subalpine-Montane Mesic Meadow	2145	34,282	0.19%	156,515	0.85%
Western Great Plains Sand Prairie	2148	10,942	0.06%	38,384	0.21%
Northern Rocky Mountain Subalpine Deciduous Shrubland	2169	5,588	0.03%	5,588	0.03%
Introduced Annual Grassland	2181	15,861	0.09%	12,941	0.07%
Introduced Perennial Grassland and Forbland	2182	3,628	0.02%	5,609	0.03%
	Total	18,439,166	100.00%	18,439,166	100.00%

* Ecological Systems names

Observations

From a mapping perspective, the results of the NRI/LANDFIRE pilot project are summarized below. In short, the addition of NRI data addresses two concerns regarding EVT mapping as benefits: the spatial and categorical distributions represented by the existing plot data. Similarly there are challenges to work through.

Benefits:

- Spatial distribution of NRI data:
  - More accurate spatial distribution represented in the draft maps
  - Less time was required for editing and revising EVT distributions using ancillary data and expert opinion
  - Fewer “artifacts” were present from the input geospatial layers that either needed to be edited out or accepted
- Categorical distribution of NRI data:
  - A more even distribution among classes provided less confusion in See5 models and greater accuracy in the models and final products
  - Higher plot counts overall increased the likelihood of mapping EVTs with otherwise low plot counts

Challenges:

- The pilot project remapped from scratch the LANDFIRE vegetation data products using the original imagery. This was a straight forward approach and enabled a comparison to be made between approaches. Incorporating NRI data in the LANDFIRE process where products have already been mapped is a challenge. However, LANDFIRE has been updating its products on a biennial basis and is working towards a decadal remap, which is scheduled to begin in 2016. LANDFIRE recognizes the potential benefits that NRI data could contribute to a decadal remap, but realizes that the infusion of a large amount of NRI data would require good coordination to facilitate this decadal remap.
- An indirect challenge that was not assessed as part of this pilot may be mapping rare vegetation classes (e.g., wetland types – North American Warm Desert Interdunal Swale Wetland, Southern Piedmont / Ridge and Valley Upland Depression Swamp, etc.). Since these vegetation classes typically have a low number of field plots, the likelihood of incorrectly mapping these types as other general vegetation classes increases. Even with additional data, mapping rare vegetation EVT classes with greater accuracy may continue to be a challenge.

Next Steps of Collaboration

As the NRI/LANDFIRE pilot was completed in 2010 and this report was pulled together, the group discussed potential next steps of collaboration with topics ranging from a transition project / national agreement, increased NRCS involvement, an evaluation of NRI plots and LANDFIRE processes in plot assignments, photographs, areas of low plot counts, support of NRCS activities, and leveraging potential NRCS agreements. Future collaboration between NRI and LANDFIRE will evaluate these topics in more detail as these programs work together.

Pilot Contributors			
National Resources Inventory (NRI) – USDA NRCS		**LANDFIRE – DOI and USDA FS**	
Julie Tesky *~	Veronica Lessard ~	Birgit Peterson*~	Chris Toney *~
Mack Barrington ~	Jeff Goebel ^	Brenda Lundberg*~	Don Long ~
		Henry Bastian ^~	
*Pilot Project Analysis ~ Report ^Pilot Project Leadership			

Appendix.

Summary results from the overlay of Montana NRI plots on LANDFIRE National (circa 2001) Existing Vegetation Type (EVT) map (Table 5).

Field definitions of Table 5:

• **NRI Plots** – The number of NRI plots identified as class "i" in the LANDFIRE Reference Data Base.

• **Mapped Plots** – The number of NRI plots mapped as class "i" at the pixel containing the plot coordinate.

• **Plots with Agreement** – The number of NRI plots in class "i" " that were mapped as class "i" at the pixel containing the plot coordinate.

• **Producer Agreement** – The percentage of NRI plots in class "i" that were mapped as Class "i". Calculated as: (Plots with Agreement) /NRI Plots) * 100.

• **User Agreement** – The percentage of NRI plots mapped as class "i" that are identified as class "i" in the reference database. Calculated as: (Plots with Agreement) / (Mapped Plots) * 100.

• **NRI Percent** - Percentage of all NRI plots in Montana that are identified as class "i" in the reference database. Calculated as: (NRI Plots) / (Total number of holdout plots) * 100.

• **Mapped Percent** – Percentage of all NRI plots in Montana that were mapped as class "i". Calculated as: (Mapped Plots) / (Total number of NRI plots) * 100.

• **DIFF** – The difference between Mapped Percent and NRI Percent. Calculated as: Mapped Percent – NRI Percent.

- If this number is positive, then there is more area of the class in the map than in the plot database (as indicated by mapped values at NRI point locations); i.e. – a sample from NRI plot locations suggests that it may be over-mapped.
- If this number is negative, then there is less area of the class in the map than in the plot database (as indicated by mapped values at NRI plot locations); i.e. – a sample from NRI plot locations suggests that it may be under-mapped.
- The value of this number suggests the degree to which the class may be over- or under-mapped.

Table 5. Type-specific and proportional agreement of mapped plots by Existing Vegetation Type (EVT) in Zone 20

		Type-specific plot agreement					Proportional agreement		
EVT Code	EVT Name	NRI Plots	Mapped Plots	Plots with agreement	Producer agreement (%)	User agreement (%)	NRI percent	Mapped percent	DIFF
17	Developed-Upland Shrubland	0	1	0		0.0	0.0	0.1	0.1
25	Developed-Roads	0	2	0		0.0	0.0	0.3	0.3
31	Barren	0	3	0		0.0	0.0	0.4	0.4
65	NASS-Close Grown Crop	0	38	0		0.0	0.0	5.5	5.5
81	Agriculture-Pasture and Hay	0	8	0		0.0	0.0	1.2	1.2
82	Agriculture-Cultivated Crops and Irrigated Agriculture	0	9	0		0.0	0.0	1.3	1.3
95	Herbaceous Wetlands	0	4	0		0.0	0.0	0.6	0.6
2007	Western Great Plains Sparsely Vegetated Systems	2	0	0	0.0		0.3	0.0	-0.3
2049	Rocky Mountain Foothill Limber Pine-Juniper Woodland	1	1	0	0.0	0.0	0.1	0.1	0.0
2050	Rocky Mountain Lodgepole Pine Forest	0	2	0		0.0	0.0	0.3	0.3
2054	Southern Rocky Mountain Ponderosa Pine Woodland	0	2	0		0.0	0.0	0.3	0.3
2062	Inter-Mountain Basins Mountain Mahogany Woodland and Shrubland	1	0	0	0.0		0.1	0.0	-0.1
2072	Wyoming Basins Dwarf Sagebrush Shrubland and Steppe	3	1	1	33.3	100.0	0.4	0.1	-0.3
2080	Inter-Mountain Basins Big Sagebrush Shrubland	6	44	2	33.3	4.5	0.9	6.4	5.5
2081	Inter-Mountain Basins Mixed Salt Desert Scrub	2	0	0	0.0		0.3	0.0	-0.3
2085	Northwestern Great Plains Shrubland	28	23	4	14.3	17.4	4.1	3.3	-0.7
2086	Rocky Mountain Lower Montane-Foothill Shrubland	5	0	0	0.0		0.7	0.0	-0.7
2106	Northern Rocky Mountain Montane-Foothill Deciduous Shrubland	10	9	1	10.0	11.1	1.4	1.3	-0.1
2115	Inter-Mountain Basins Juniper Savanna	1	0	0	0.0		0.1	0.0	-0.1
2124	Columbia Plateau Low Sagebrush Steppe	1	0	0	0.0		0.1	0.0	-0.1
2125	Inter-Mountain Basins Big Sagebrush Steppe	45	77	12	26.7	15.6	6.5	11.2	4.6
2126	Inter-Mountain Basins Montane Sagebrush Steppe	16	16	1	6.3	6.3	2.3	2.3	0.0
2127	Inter-Mountain Basins Semi-Desert Shrub-Steppe	13	2	0	0.0	0.0	1.9	0.3	-1.6
2132	Central Mixedgrass Prairie	3	0	0	0.0		0.4	0.0	-0.4
2139	Northern Rocky Mountain Lower Montane-Foothill-Valley Grassland	110	23	13	11.8	56.5	15.9	3.3	-12.6
2140	Northern Rocky Mountain Subalpine-Upper Montane Grassland	1	1	0	0.0	0.0	0.1	0.1	0.0
2141	Northwestern Great Plains Mixedgrass Prairie	312	328	224	71.8	68.3	45.2	47.5	2.3
2145	Rocky Mountain Subalpine-Montane Mesic Meadow	10	12	1	10.0	8.3	1.4	1.7	0.3
2148	Western Great Plains Sand Prairie	21	19	1	4.8	5.3	3.0	2.8	-0.3
2149	Western Great Plains Shortgrass Prairie	4	0	0	0.0		0.6	0.0	-0.6
2153	Inter-Mountain Basins Greasewood Flat	4	9	0	0.0	0.0	0.6	1.3	0.7
2154	Inter-Mountain Basins Montane Riparian Systems	1	0	0	0.0		0.1	0.0	-0.1

		Type-specific plot agreement					Proportional agreement		
EVT Code	EVT Name	NRI Plots	Mapped Plots	Plots with agreement	Producer agreement (%)	User agreement (%)	NRI percent	Mapped percent	DIFF
2159	Rocky Mountain Montane Riparian Systems	0	1	0		0.0	0.0	0.1	0.1
2160	Rocky Mountain Subalpine/Upper Montane Riparian Systems	2	2	0	0.0	0.0	0.3	0.3	0.0
2162	Western Great Plains Floodplain Systems	8	14	1	12.5	7.1	1.2	2.0	0.9
2165	Northern Rocky Mountain Foothill Conifer Wooded Steppe	2	0	0	0.0		0.3	0.0	-0.3
2169	Northern Rocky Mountain Subalpine Deciduous Shrubland	0	1	0		0.0	0.0	0.1	0.1
2179	Northwestern Great Plains-Black Hills Ponderosa Pine Woodland and Savanna	0	5	0		0.0	0.0	0.7	0.7
2180	Introduced Riparian Vegetation	1	0	0	0.0		0.1	0.0	-0.1
2181	Introduced Upland Vegetation-Annual Grassland	1	5	0	0.0	0.0	0.1	0.7	0.6
2182	Introduced Upland Vegetation-Perennial Grassland and Forbland	35	17	0	0.0	0.0	5.1	2.5	-2.6
2220	Artemisia tridentata ssp. vaseyana Shrubland Alliance	11	8	1	9.1	12.5	1.6	1.2	-0.4
2227	Pseudotsuga menziesii Forest Alliance	0	2	0		0.0	0.0	0.3	0.3
2385	Western Great Plains Wooded Draw and Ravine	9	0	0	0.0		1.3	0.0	-1.3
2495	Western Great Plains Depressional Wetland Systems	21	1	0	0.0	0.0	3.0	0.1	-2.9
	Totals **Overall agreement: 39%**	**690**	**690**	**262**					