Protecting Natural Vegetation: Comparative Analysis of Land Protection Mechanisms

Final Report

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Kai Foster, Tosha Comendant, Mike Lundin, James Strittholt

CONSERVATION BIOLOGY INSTITUTE

1. Introduction

Protected areas provide *in situ* conservation by legally setting aside land to abate ecosystem degradation and associated loss of natural habitats and species (Swaty et al. 2011, Jenkins 2006, Pressey et al. 2004, Chape et al 2005). Although some traditional fee-simple lands provide refuges for species and contribute to maintaining ecological processes where they occur, as a whole, the existing protected areas network has not been configured for optimal conservation of biodiversity (Dudley 2008). In many parts of the world including the United States, the majority of protected lands are located in areas of low productivity and often under-represent or miss sites of high conservation value. It is estimated that a portion of habitat for 95% of all federally threatened and endangered flora and fauna in the United States is located on private land (Merenlender et al. 2004) and, unfortunately, private land acquisition is often constrained by existing property ownerships patterns or other political and financial challenges (Newburn et al. 2005).

In the United States, the protected lands network consists of a combination of publically and privately held land in fee-simple ownership (~970 million acres or ~40% of the total land area in the country) and as conservation easements (~20 million acres)[1], referred to in this report as the Terrestrial Conservation Estate of the United States[2]. Fee-simple ownership is land that is commonly referred to in the literature as protected areas, this is land and water that is owned and legally designated to be set aside for the preservation of natural, cultural or recreational resources. These properties are owned and managed in-perpetuity by an individual agency or group of agencies with unlimited rights to the land and water. Traditional fee-simple land ownership has increased dramatically in the 20th century around the world, from 5 to 200 million hectares, since the first national park was established in the United States in 1872 (Reinius and Fredman 2007). These fee-simple protected areas are regarded as the cornerstone around which regional, national and international conservation strategies area developed and measured (Chape et al. 2005).

Conservation easements are a legal mechanism used in the U.S. to protect species and habitats on private lands through voluntary legal and contractual land protection agreements with individual private landowners in exchange for federal and state financial incentives (Rissman 2010). The use of easements as a conservation strategy in the United States has grown dramatically since the 1980s (Merenlender et al. 2004). Conservation easements are appealing to private land owners because they can establish a conservation purpose to protect a specific species or provide more general land conservation without the need for active management or oversight (Owley 2011). For private lands with management plans already established, such as working forests, conservation easements can be a complementary tool to environmental regulations like the

[1] The National Conservation Easement Database includes 19,805,669 acres of conservation easements, of that 17,327,087 acres are included in the spatial dataset.

[2] Terrestrial Conservation Estate of the United States dataset is available on the data sharing platform Data Basin at: http://databasin.org/galleries/43153eac63854692818e7380fb09bdd9

Endangered Species Act, Clean Water Act, or Clean Air Act. In these cases, easements allow private landowners to contribute to sustainable management of forest resources and protection of forest ecosystems through restoration and permanent protection of habitats for listed species on private lands (Wayburn 2011).

The degree to which easements contribute to threat reduction for critical species and habitat is not well understood (Merenlender et al. 2004). When conservation easements are established the terms for land use and preferences are defined based on current conditions, these terms can be detailed and prescriptive, making them inflexible to the application of new approaches, even when there is a clear conservation benefit (Rissman 2011). Some conservation easement holders recognize the need to incorporate management plans into their conservation easements because the hands-off approach does not necessarily yield the intended environmental benefits. Management plans are often limited to land trusts and government agencies that possess the necessary staff expertise to incorporate management into their conservation strategies (Owley 2011). Research shows that conservation easements are likely to conserve vegetation types that are under-represented by fee-simple properties making them an important part of overall conservation within the protected lands network (Rissman and Merenlender 2008).

The integrity of biotic communities is vital to researchers and resource managers who plan and implement stewardship in protected areas and design ecologically sustainable resource use initiatives (La Paix et al. 2009), but there is not enough research to indicate the percentage of how much of each natural vegetation type that must be protected for sufficient conservation across biotic systems. The International Union for Conservation of Nature (IUCN) chose a somewhat arbitrary, politically palatable representation target of 12% for each native community (Scott et al. 2001). The Convention on Biological Diversity 2011-2020 Strategic Plan for Aichi Biodiversity Targets states that terrestrial lands must meet a target of 17% land under protection status to improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity. Putting these targets into the U.S. context, the World Bank estimates that only 13.8% of terrestrial land in United States is currently protected but it remains unknown how these lands protect the diversity of natural communities. Furthermore, this percentage only counts protected lands larger than 1,000 hectares (2471.05 acres) and only those lands with specific designation types that are internationally recognized. In the United States, protected lands are diverse and vary in size, ownership, designation, and management. Identifying the habitats within the U.S. protected lands network provides a more complete characterization of the natural communities found within the protected landscape and those in the private lands matrix.

Here, we investigate the degree to which natural vegetation cover is protected by fee-simple lands and easements across the conterminous United States, emphasizing the contribution of conservation easements to the overall protection of habitat within the protected lands network. With the availability of recently updated spatial protected areas databases, combining PAD-US (CBI Edition) and the National Conservation Easement Database (NCED), we identify and analyze the unique types of land protection held both in fee-simple ownership and voluntary

conservation easement within the Terrestrial Conservation Estate of United States. Protected lands are often narrowly defined as lands with only the highest levels of conservation status, those lands with permanent protection that are managed to maintain a natural or nearly natural state. For this spatial analysis, we used a broader definition of protected lands to include three categories of protection: (1) lands managed to maintain a natural or nearly natural state; (2) lands that are permanently protected for predominantly natural land cover with multiple uses including some extractive uses; and (3) lands under conservation easements. These categories where defined using management designations, ownership type (i.e. federal, tribal, state, local or private conservation) and GAP conservation status codes[3] (See Appendix A). The relationship between categories is critical to a more complete understanding of natural vegetation protection status in the United States. For example a designated Wilderness Area within a National Forest is managed to maintain a natural state (Category 1), while the non-wilderness National Forest land is managed for natural cover but allows extractive uses (Category 2). The same National Forest can also have private lands within or adjacent to its boundaries that have conservation restriction or easements on them (Category 3). Dividing the landscape into these three categories allowed us to identify dominant natural vegetation and the associated level of protection of the land.

2. Materials and Methods

Two protected lands databases were integrated, the Protected Areas Database of the United States, PAD-US (CBI Edition) Version 2 and the National Conservation Easement Database (NCED) Version 3, making up the Terrestrial Conservation Estate for the United States. These data are available through the online data sharing platform Data Basin (http://databasin.org) as individual[4] or integrated datasets[5]. We evaluated and compared the distribution of natural vegetation communities in three protected land categories, including: (1) restricted-use lands (GAP Status 1 and 2), defined as permanently protected lands managed to maintain a natural or nearly natural state; (2) multiple-use lands (GAP Status 3), defined as permanently protected lands managed for conservation of predominately natural land cover with multiple uses including some extractive uses; and (3) conservation easements, defined as lands with voluntary restrictions for conservation purposes. These categories are important, because the associated land management practices with each type provides greater understanding as to the level of protection these lands contribute to each of the mapped natural communities and by extension their associated species (Chape et al. 2005, Pressey et al. 2004, Jenkins 2006). For example, the international protected lands targets stated earlier only correspond to the restricted-use lands

[3] GAP Status Codes range from 1-3 indicating the status of conservation for a individual protected area, for definitions visit http://www.gap.uidaho.edu/padus/gap_iucn.html

[4] Datasets available on Data Basin for PAD-US (CBI Edition) Version 2 at http://databasin.org/galleries/b84ac5ccebd24658bc3cfe4dfaa6c629 and the National Conservation Easement Database, Version 3 at http://databasin.org/datasets/19972be976c44e9ea2b9a9d12a32ab01

[5] Datasets available on Data Basin for the Terrestrial Conservation Estate of the United States at http://databasin.org/galleries/43153eac63854692818e7380fb09bdd9

(GAP Status 1 and 2) and do not account for multiple-use lands (GAP Status 3) and conservation easements.

Natural vegetation communities were examined using the most recent version of Existing Vegetation Type (EVT 210) released by LANDFIRE[6] for the western and eastern portions of the United States. These data were combined with the previous version EVT 110 for the central portion of the country to complete the coverage for the entire conterminous United States. The LANDFIRE EVT product is a fine-scale raster, 30-meter pixels, that has been designed to support national scale analysis. These data represent the current distribution of vegetation units derived from three classification systems (including NatureServe's Ecological Systems, National Vegetation Classification Standard (NVCS) and LANDFIRE specific types), with incorporated landscape disturbances revisions (e.g. fire, vegetation management, weather, and insects and disease). The LANDFIRE System Management Group was used in this analysis to describe the current vegetation types summarized into a manageable number of vegetation units for the conterminous United States.

To summarize natural vegetation within the three categories of protected lands, the Terrestrial Conservation Estate dataset, which included fee-simple and easement lands, was intersected with the composite LANDFIRE EVT raster using a customized Protected Vegetation Script Tool. The Protected Vegetation Script Tool (Appendix B) was developed for this project to clip the raster vegetation data using the protected land boundaries and generate tables for each of the three protected land categories. The results detail the total area and percent area for each vegetation community type according to protection category for the entire conterminous United States. The vegetation types were then sorted by natural, managed and non-vegetation (e.g. unknown, no data, snow-ice, open water, quarries, strip mines, gravel pits and barren) types. Raster datasets were generated by the Protected Vegetation Script Tool to enable visualization of the spatial extent of each natural vegetation type along with the vector Terrestrial Conservation Estate data in ArcGIS 10.1.

3. Results and Discussion

The results of this analysis show that together the three protected land categories protected a total of ~438 million acres (36.90%) of natural vegetation, 128,156,035 acres (10.80%) by restricted-use lands, 297,697,876 (25.08%) by multiple-use lands and 12,073,994 (1.02%) by conservation easements. Within the protected lands network an additional 21 million acres is on non-vegetated land (i.e. barren, unknown or no data, open water, snow-ice, quarries, strip mines and gravel pits) and 33 million acres are on land with managed vegetation. Overall the multiple-use lands protect the largest area of natural vegetation, predominantly owned by the Bureau of Land Management and the USDA Forest Service. Restricted-use lands cover the largest area of non-vegetated lands 12,893,551 acres (2.73%). The restricted-use lands (i.e. National Parks and

[6] LANDFIRE Existing Vegetation Type (EVT) data, available at http://landfire.gov/NationalProductDescriptions21.php

Wilderness Areas) often include the country's iconic mountains and high elevation areas that have very little vegetation, like Glacier National Park. Conservation Easements contribute significantly less than both restricted-use and multiple-use lands in all the vegetation classes (i.e. natural, managed and non-vegetated), but they make the greatest contribution to the protection of natural vegetation types (Appendix C).

Natural Vegetation Types with the Highest Percentage of Protection

The top ten most protected vegetation types are those with the highest total percentages of protection across the protected lands network, averaging 93.90% across all three protection categories (Figure 1). The averages for these top ten vegetation types by protected land category are restricted-use lands 44.99%, multiple-use lands 48.57% and conservation easements 0.34%. These vegetation types include: Subalpine Woodland and Parkland, Loblolly Pine Forest and Woodland, Mountain Hemlock Forest and Woodland, Loblolly Pine-Slash Pine Forest and Woodland, Dry Tundra, Mangrove, Spruce-Fir Forest and Woodland, Red Fir Forest and Woodland, Lodgepole Pine Forest and Woodland, and Western Hemlock-Silver Fir Forest.

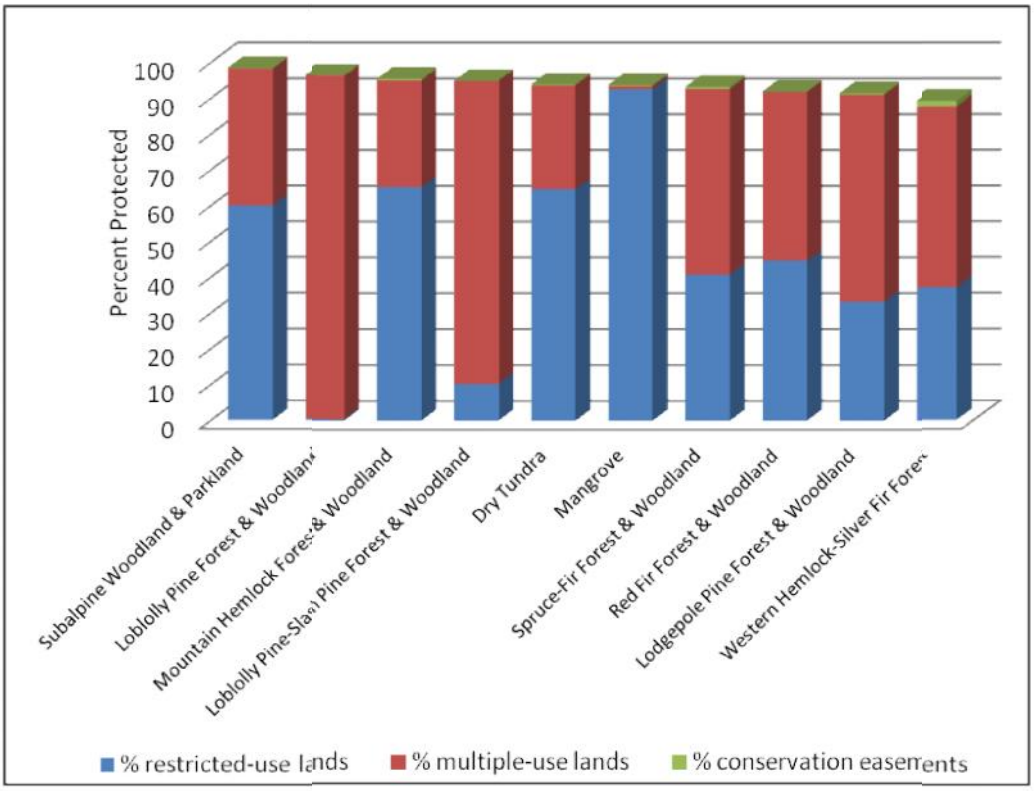

Figure 1. Top Ten Most Protected Natural Vegetation Types by total percentage of all three protected land categories.

Nearly all of these highly protected vegetation types are predominantly protected by fee-simple lands, with only 0.34% on average held in conservation easements. The fee-simple protection of each vegetation type varies between restricted-use lands and multiple-use lands.

Mangroves are predominantly protected by restricted-use lands (permanently protected and management for a natural or nearly state). The current distribution of mangroves along the southwest coast of Florida is dominated by large highly protected lands including: the Marjory Stoneman Douglas Wilderness, Rookery Bay National Estuarine Research Reserve and Florida Keys Wilderness. Mangroves have high conservation importance because of their role in driving tidal wetland ecosystem dynamics and supporting important fish and wildlife habitat (Feller et al. 2012). Within these protected areas, mangroves are protected and managed in their natural state, however populations may still be vulnerable to climate change and other natural disturbances (Osland et al. 2012).

In contrast, Loblolly Pine Forest and Woodlands along with Loblolly Pine-Slash Forest and Woodlands are almost entirely protected by multiple-use lands. The natural distribution of these vegetation type is a bit complicated because the pre-European vegetation patterns of these species had already been converted by Native American Fire practices (Knapp et al. 2011), followed by heavy deforestation in the late 1800s and early 1900s by the timber industry and finally a reforestation effort in the early 20th century expanded the range of these species beyond their natural range (Schultz 1999). In 2001, a forest inventory report compiled by the USDA Forest Service Forest Inventory and Analysis (FIA) program estimated that loblolly-shortleaf forest type covers about 54 million acres, of the southern portion (52 million acres) only 5 million acres are on public lands and about 16 million acres are on forest industry lands (Smith et al. 2002). Our results show that combined Loblolly Pine and Slash-Pine Forest and Woodlands are 95.91% protected (a total of 170,211 acres), of that total 4.03% (7,160 acres) is located on restricted-use lands, and 91.86% (163,037 acres) is located on multiple-use lands and 0.01% (14 acres) is on conservation easements. Not surprisingly the majority of multiple-use lands with Loblolly Pine and Slash-Pine Forest and Woodlands are in two National Forests, the Sumter in South Carolina and the Oconee in Georgia. The total acreage of Loblolly Pine and Slash Pine Forest and Woodlands in the conterminous United States reported by the LANDFIRE EVT 210 data as 177,477 total acres, the difference in this acreage compared to the USDA Forest Service FIA report has a great deal to do with how the vegetation types are classified and the scale to which the data are collected. The narrative of the Loblolly Pine and Slash Pine Forest and Woodlands is unique to its cultural and natural value as a timber resource. Our study captures the current management practices on land where it occurs naturally, but the details for this particular vegetation type reveal a much deeper challenge to the way forests are managed in the future.

Natural Vegetation Types with the Lowest Percentage of Protection

The ten least protected vegetation types have on average six percent protection within the protected lands network (Figure 2). Each of the three protected land categories contributes a small amount to overall protection of these vegetation types, with restricted-use lands (permanently protected and managed for a natural or nearly natural state) averaging 2.04%, multiple-use lands (permanently protected with some extractive uses) averaging 3.12%, and

conservation easements averaging just under 0.96%. For these 10 vegetation types, conservation easements make a greater contribution to overall protection within the protected lands network compared with their contribution to the vegetation types with highest levels of protection. One explanation for this may be that the least protected vegetation types are often highly fragmented and occur at lower elevations where private land ownership is more predominant.

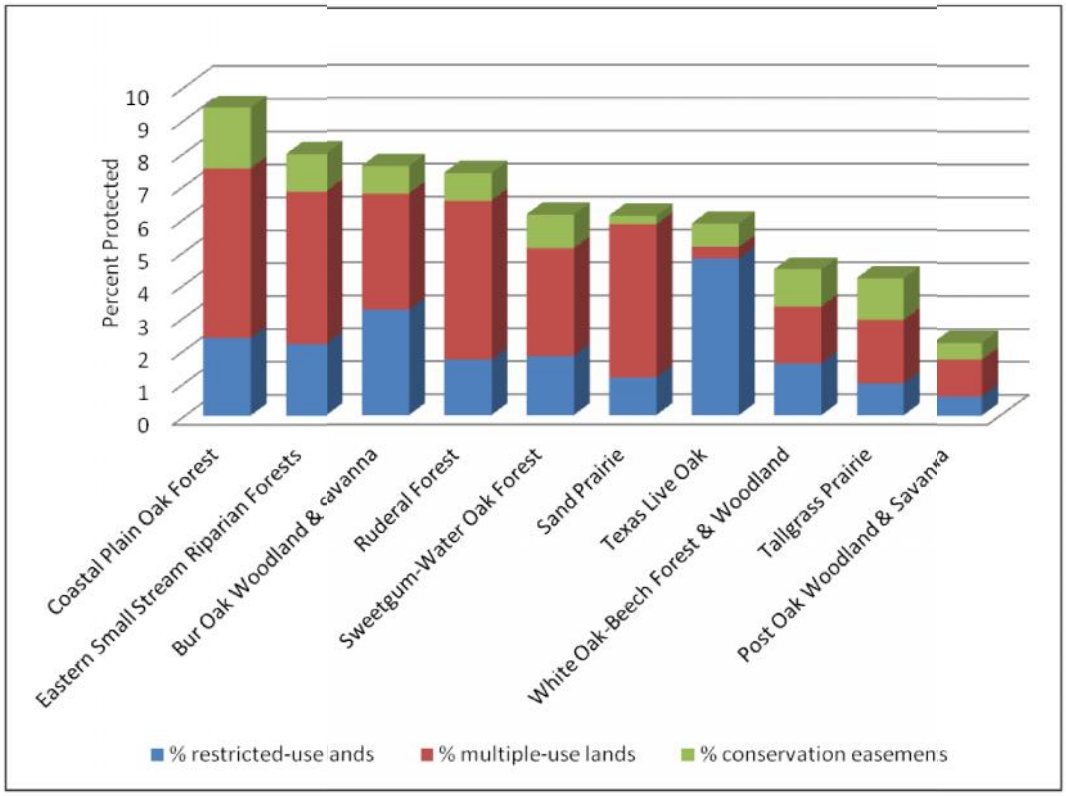

Figure 2. Ten Least Protected Natural Vegetation Types by total percentage of all three protected land categories.

In the case of Tall-grass Prairie, located in the Great Plains, agriculture has fragmented the landscape and the natural forces of fire and grazing bison no longer maintain the natural prairie ecosystem. Only 1.12% of this vegetation type is protected by conservation easements, 1.93% by multiple-use lands and only 0.98% by restricted-use lands. Efforts to increase protection for the tall-grass prairie ecosystems are currently underway using primarily conservation easements. For example, the U.S. Fish and Wildlife Service is working to establish the Dakota Tallgrass Prairie Wildlife Management Area along the border between North and South Dakota. This preserve will be comprised of 2.1 million acres, including 185,000 acres of conservation easements on private lands that are managed under the National Wildlife Refuge System (U.S. Fish and Wildlife Service 2000). To date, only a portion of land has been acquired under conservation easement, but the U.S. Fish and Wildlife Service and other easement holders have obtained several conservation easements in the area and are working to expand the land under protection.

Natural Vegetation Protection by Conservation Easement

% Protected by Conservation Easement	Total Acres of Natural Vegetation Protected by Conservation Easenents	# of Natural Vegetation Types
< 1%	4,014,745	51
1.1 to 2%	2,774,653	27
2.1 to 3%	2,074,269	12
3.1 to 4%	67,785	3
4.1 to 5%	2,102,845	3
>5%	1,003,600	3

Table 1. Summary of percent natural vegetation protected by conservation easements, the total acreage in the percentile class and the number of natural vegetation types included.

Overall, conservation easements make up a small percentage of the overall protection status of natural vegetation types compared with fee-simple lands. For the majority of natural vegetation types, easements contribute 2% or less of overall protection. However, conservation easements protect close to 12 million acres of natural vegetation under voluntary conservation restriction (Table 1), which for some vegetation types is an extremely important contribution. There are three vegetation types for which easements make the most substantial contribution to natural vegetation protection (>5%), the Spruce-Fir-Hardwood Forests 6.24% (980,213 acres), Atlantic Dunes and Grasslands 5.30% (18,217 acres) and Southern Scrub Oak 5.11% (5,170 acres). These three vegetation types are only protected on average by restricted -use lands at 15.45% and multiple-use lands at 13.38%. In this low protection scenario by restricted-use and multiple-use lands, we find that conservation easements make the largest contribution.

Conservation easements protect the largest number of acres, just over 4 million, in the <1% protection class, including fifty-one different natural vegetation types. This is nearly a third of the total acres (12,073,994) of natural vegetation protected by conservation easements in the conterminous United States. Conservation easements are often acquired on agricultural or converted lands, so it would be expected that a high number of conservation easements are found on lands with managed vegetation types (e.g. agricultural lands, introduced annual grasslands, etc.). A total of 4,969,505 acres (0.73%) of conservation easements protect managed vegetation and 679,019 acres (0.14%) protect non-vegetated land. This shows that conservation easements commonly protect managed vegetation but a larger portion of conservation easements protect lands with natural vegetation.

Spatial Extent of Natural Vegetation Types

There is variation in the spatial extent of each natural vegetation type in this study, as some vegetation types are dominant throughout a large portion of the country others are more regionally specific. Regional vegetation types or vegetation types with limited spatial extents have different protection needs than vegetation types that cover large geographic areas. Overall, the distribution of natural vegetation types protected by the protected lands network occur primarily in the western portion of the country, the Great Lakes Region, the Northeast and along

the coastline (Figure 3). This pattern is consistent with the geographic distribution of protected lands across the conterminous United States.

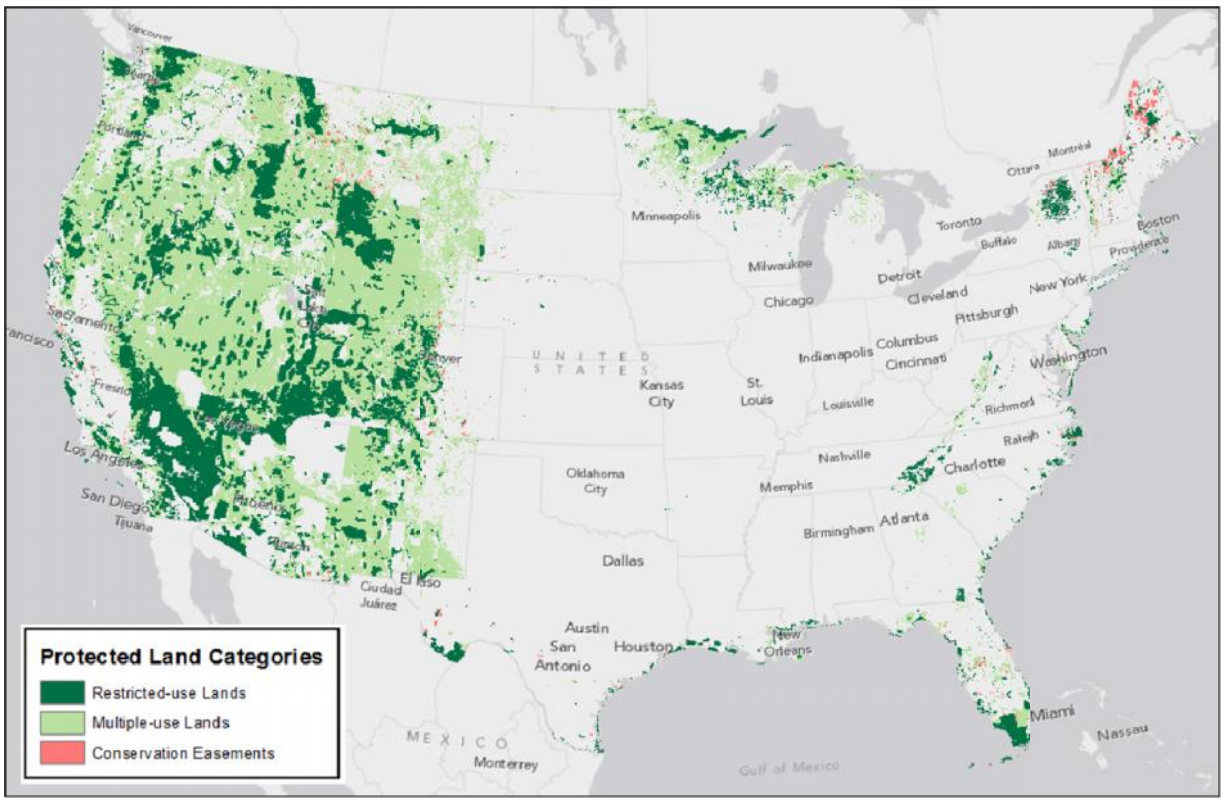

Figure 3. Spatial extent of all ninety-nine natural vegetation types, displayed by the three protected land categories.

To evaluate the protection level of the natural vegetation types by spatial extent, five size classes were created and the percent protection by each protected land category was calculated along with percent un-protected and the number of vegetation types within that class (Table 2). Our results show that spatial extent of natural vegetation types are protected by the three protected land categories differently. Restricted-use lands protect a higher percentage of vegetation types with smaller spatial extents. Multiple-use lands protect vegetation types between 35 and 14% at the various spatial extents. Conservation Easements protect vegetation types with spatial extents between 499,999 to 100,000 acres, at the highest rate of 2.44%.

The two natural vegetation types that have the greatest spatial extents (> 50 million acres) are the Big Sagebrush Shrubland and Steppe (109,201,274 acres both protected and un-protected) and the Mixed-grass Prairie (76,587,183 acres both protected and un-protected). These two vegetation types average 41.22% protection and only a small portion of that protection is in conservation easements. The largest portion of these vegetation types are protected by multiple-use lands and primarily fall within lands owned by the Bureau of Land Management or USDA Forest Service.

There are seven vegetation types that cover less than 100,000 acres of land, including: (1) Pacific Coastal Marsh (2) Hammocks (3) Loblolly Pine-Slash Forest and Woodlands (4) Western Larch Forest and Woodland (5) Great Lakes Alvar (6) Alpine-Subalpine Barrens and; (7) Heathland

Natural Vegetation Spatial Extent Classes	Percent Protected by Restricted-use Lands	Percent Protected by Multiple-use Lands	Percent Protected by Conservation Easements	Percent Un-protected	Number of Natural Vegetation Types
>50,000,000 acres	5.91%	34.66%	0.64%	58.78%	2
49,999,999 to 10,000,000 acres	10.61%	22.83%	1.05%	65.51%	37
999,999 to 500,000 acres	17.48%	26.11%	1.32%	55.09%	46
499,999 to 100,000 acres	31.68%	13.77%	2.44%	52.11%	7
<100,000 acres	28.66%	34.26%	1.80%	35.29%	7

Table 2. Summary of natural vegetation types by spatial extent classes, percent protected by restricted-use lands, percent protected by multiple-use lands, percent protected by conservation easements, percent un-protected and number of natural vegetation types.

and Grassland. These vegetation types average 64.71% protection across the protected lands network. Conservation easements protect slightly less than 2% of these vegetation types. All seven vegetation types are very regionally specific, occurring in small ecologically discreet locations. Pacific Coastal Marsh (69,436 acres both protected and un-protected) is found in limited areas around the San Francisco Bay Area of California, an area particularly vulnerable to climate change and land conversion (Hanak and Moreno 2011). Similarly the Heathland and Grassland (9,337 acres both protected and un-protected) only occur along the east coast of Massachusetts and on the island of Nantucket. Conservation easements make a relatively large contribution to the protection of Pacific Coastal Marsh (3.67%) and for the Heathland and Grassland (4.66%).

4. Conclusion

Vegetation community types are important for describing and mapping ecosystems, because they are manifestation of climate, soils, and topography and frequently correlate with faunal distribution (Crumpacker 1988). This analysis of natural vegetation types across the protected lands network provides a measure of representation of in-situ conservation. In this study, we considered three categories of land protection that reflect different types of management practices in the United States. In the case of conservation easements, this analysis showed the

degree to which these voluntary restrictions on private lands contribute to protecting natural vegetation types along with fee-simple lands.

Multiple studies show that protected lands in the United States are falling short of conservation goals or are inadequately measured across fee-simple lands (Swaty et al 2011, Parrish et al 2003, Dietz 2004, Scott et al 2001, Crumpacker et al 1988). Several solutions have been proposed in the literature include selling under-performing protected lands to purchase new more targeted lands, expanding the network through acquisition, and placing greater emphasis on biodiversity in multiple-use lands (Aycrigg 2013, Kareiva 2010). Each of these alternatives has a set of political, financial, social and biological challenges that this study does not directly address. However, this analysis showed that on average all ninety-nine natural vegetation types occur at a higher percentage within multiple-use lands than restricted-use lands, the more narrow definition of protected lands. We included both restricted-use lands and multiple-use lands in this study to compare and evaluate their contribution to the overall protection of natural vegetation types in the conterminous United States. Characterizing the full set of protected lands within the network provides researchers and managers a foundational resource to ask additional questions about how to plan for future management at each level of protection in ways that will improve outcomes for species and habitats.

Private lands are thought to be critical to achieving conservation goals across the protected lands network at a landscape-scale and conservation easements are uniquely designed to place privately held lands under protection (Owley 2011, Locke and Rissman). Although the amount of land protected in easements is significantly lower than fee-simple holdings, easements contribute lands that help fill the representation gaps in the system. These lands also can provide critical connectivity between other conservation easements and fee-simple lands to abate forest fragmentation and species habitat loss (Locke and Rissman 2012). The condition of vegetation on these lands and landowner priorities may represent areas of high natural value, but the lack of legal protection placed on them means the persistence of these values over time is unknown. Our results show that conservation easements make the largest contribution to protection of natural vegetation in those types with spatial extents less than 500,000 acres. Conservation easements are more concentrated in densely populated areas and occur at a higher frequency in the eastern portion of the United States. The vegetation types with the highest percentages of conservation easements follow this spatial pattern, occurring in states east of the Rocky Mountains and primarily near highly populated areas. In certain cases, conservation easements may be the only option for protection of certain vegetation types that occur on small privately held lands. Continued investigation into conservation easements, their purposes, management plans, and vegetation types may yield additional patterns.

Knowing the current protected status of natural vegetation is critical to understanding what is happening on the landscape at present. This understanding provides a basis for understanding possible future conditions under different climate model scenarios. For example, key vegetation types like grasslands have been identified as one of the terrestrial habitats most vulnerable to

climate change (Owley 2011) and our results showed that grasslands are an under-protected natural vegetation type by all three land protection categories. Future research on highly vulnerable vegetation types like grasslands can build from this analysis to evaluate potential climate impacts that can inform management and acquisition strategies in the protected lands network. Other vegetation types such as maple, beech and birch forest in the Appalachian region and the red-pine spruce forests of the Northeast are threatened with extinction by climate change, because they are unlikely to keep up with conditions that will require migration at a rate of one to three miles a year (Owley 2011). Future climate model scenarios can be used to identify additional vegetation types that are under the greatest threat. Research suggests that conservation easements and fee-simple lands should be better coordinated in the future to ensure the protection and conservation of ecosystem as climate change and land-conversion pressures increase (Rissman 2011). Further research into how these shifts in vegetation will change the character of the protected lands network is needed to inform and the future management of existing or newly acquired protected lands.

This study evaluates the protection of natural vegetation types across the conterminous United States utilizing the most current spatial databases available to characterize the state of natural vegetation within the protected lands network. These data show that protection levels vary widely and are specific to the context of the region of the country as well as the spatial extent of the vegetation type. All three protected land categories play a specific role within the network and protect a portion of natural vegetation along with associated species and habitats. In the future, a more coordinated system of protected lands, both fee-simple and easement, is critical to planning for future adaptation strategies and management as climate change and land conversion pressures increase. As a result of this analysis foundational data is available on the current protection of natural vegetation types that can be used as a resource to better understand and find solutions to these challenging problems. By including a wider definition of protected lands to include both multiple-use lands and conservation easements, we were able to portray a broader representation of land protection. Expanding understanding of the current protection status of biotic communities within these protected lands is critical to developing solutions that enhance or improve species habitat and biodiversity within the protected lands network.

Citations

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Appendix A - Crosswalk of Management Designations, GAP Status Codes in each Analysis Category

Management Designation Types	GAP Status Code	Analysis Category
Ecological Study Area	1	Category 1- Restricted Use Lands
National Outstanding Natural Area	1	Category 1- Restricted Use Lands
National Park General Public Land	1	Category 1- Restricted Use Lands
National Preserve	1	Category 1- Restricted Use Lands
National Primitive Area	1	Category 1- Restricted Use Lands
National Reserve	1	Category 1- Restricted Use Lands
National River & Wild & Scenic Riverway (identified as "Wild")	1	Category 1- Restricted Use Lands
Natural Area	1	Category 1- Restricted Use Lands
Nature Preserve	1	Category 1- Restricted Use Lands
Research Natural Area	1	Category 1- Restricted Use Lands
Research or Demonstration Area	1	Category 1- Restricted Use Lands
Scientific & Natural Area	1	Category 1- Restricted Use Lands
Special Resources Area/Research Natural Area	1	Category 1- Restricted Use Lands
State Natural Area	1	Category 1- Restricted Use Lands
State Nature Preserve/Reserve	1	Category 1- Restricted Use Lands
State Wild or Scenic River	1	Category 1- Restricted Use Lands
Wilderness Area	1	Category 1- Restricted Use Lands
ANILCA: Alaska National Interest Lands Conservation Act	2	Category 1- Restricted Use Lands
Arboretum or Botanical Area	2	Category 1- Restricted Use Lands
Archaeological Area	2	Category 1- Restricted Use Lands
Area of Critical Environmental Concern	2	Category 1- Restricted Use Lands
Backcountry Prescription	2	Category 1- Restricted Use Lands
Biosphere Reserve	2	Category 1- Restricted Use Lands
Botanical Area	2	Category 1- Restricted Use Lands
Botanical Reserve	2	Category 1- Restricted Use Lands
Brown Bear Core Area	2	Category 1- Restricted Use Lands
City Forest	2	Category 1- Restricted Use Lands
City Park	2	Category 1- Restricted Use Lands
Conservation Land Holder	2	Category 1- Restricted Use Lands
County Forest	2	Category 1- Restricted Use Lands
County Park	2	Category 1- Restricted Use Lands
County Water District Parks	2	Category 1- Restricted Use Lands
County Watershed Lands	2	Category 1- Restricted Use Lands

Management Designation Types	GAP Status Code	Analysis Category
County Watershed Open Space	2	Category 1- Restricted Use Lands
Ecological Reserve	2	Category 1- Restricted Use Lands
Environmental Study Area	2	Category 1- Restricted Use Lands
Experimental Forest	2	Category 1- Restricted Use Lands
Exxon Valdez Oil Spill Fee	2	Category 1- Restricted Use Lands
Fish and Wildlife Conservation Area	2	Category 1- Restricted Use Lands
Fish, Wildlife and Recreation Prescription	2	Category 1- Restricted Use Lands
Forest Restoration	2	Category 1- Restricted Use Lands
Fossil Area	2	Category 1- Restricted Use Lands
Geological Area	2	Category 1- Restricted Use Lands
Globally Important Bird Area	2	Category 1- Restricted Use Lands
Habitat Protection Area	2	Category 1- Restricted Use Lands
Historical Area	2	Category 1- Restricted Use Lands
Interstate Park	2	Category 1- Restricted Use Lands
Inventoried Roadless Area	2	Category 1- Restricted Use Lands
Late Successional Reserve	2	Category 1- Restricted Use Lands
LUD: Land Use Designation II	2	Category 1- Restricted Use Lands
Marine National Monument	2	Category 1- Restricted Use Lands
Municipal Watershed	2	Category 1- Restricted Use Lands
National Conservation Area	2	Category 1- Restricted Use Lands
National Estuarine Research Reserve	2	Category 1- Restricted Use Lands
National Game Refuge	2	Category 1- Restricted Use Lands
National Historic Site	2	Category 1- Restricted Use Lands
National Historic Trail	2	Category 1- Restricted Use Lands
National Historical Park	2	Category 1- Restricted Use Lands
National Lakeshore	2	Category 1- Restricted Use Lands
National Marine Sanctuary	2	Category 1- Restricted Use Lands
National Memorial	2	Category 1- Restricted Use Lands
National Monument	2	Category 1- Restricted Use Lands
National Natural or Historic Landmark	2	Category 1- Restricted Use Lands
National Parkway	2	Category 1- Restricted Use Lands
National Recreation Area	2	Category 1- Restricted Use Lands
National Scenic Research Area	2	Category 1- Restricted Use Lands
National Seashore	2	Category 1- Restricted Use Lands
National Trail	2	Category 1- Restricted Use Lands
National River & Wild & Scenic Riverway (identified as "Scenic")	2	Category 1- Restricted Use Lands

Management Designation Types	GAP Status Code	Analysis Category
National Wildlife Refuge	2	Category 1- Restricted Use Lands
Old Growth Habitat	2	Category 1- Restricted Use Lands
Recreation Area	2	Category 1- Restricted Use Lands
Regional Conservation Area	2	Category 1- Restricted Use Lands
Regional Park	2	Category 1- Restricted Use Lands
Regional Preserve	2	Category 1- Restricted Use Lands
Regional Water District Parks	2	Category 1- Restricted Use Lands
Regional Watershed Conservancy Land	2	Category 1- Restricted Use Lands
Regional Watershed Open Space	2	Category 1- Restricted Use Lands
Regional Wilderness Area	2	Category 1- Restricted Use Lands
Remote or Semi-Remote Recreation	2	Category 1- Restricted Use Lands
Scenic Area	2	Category 1- Restricted Use Lands
Scenic Viewshed	2	Category 1- Restricted Use Lands
Significant Cave & Cave System	2	Category 1- Restricted Use Lands
Special Biological Areas	2	Category 1- Restricted Use Lands
Special Interest Area	2	Category 1- Restricted Use Lands
Special Management Area	2	Category 1- Restricted Use Lands
Special or Extensive Recreation Management Area	2	Category 1- Restricted Use Lands
Special Recreation Management Area	2	Category 1- Restricted Use Lands
State Aquatic Preserve	2	Category 1- Restricted Use Lands
State Area of Critical Environmental Concern	2	Category 1- Restricted Use Lands
State Beach	2	Category 1- Restricted Use Lands
State Bird Sanctuary	2	Category 1- Restricted Use Lands
State Coastal Reserve	2	Category 1- Restricted Use Lands
State Conservation Area or Park	2	Category 1- Restricted Use Lands
State Conservation Land	2	Category 1- Restricted Use Lands
State Critical Habitat Area	2	Category 1- Restricted Use Lands
State Cultural/Historic Area	2	Category 1- Restricted Use Lands
State Ecological Reserve	2	Category 1- Restricted Use Lands
State Estuary Reserve	2	Category 1- Restricted Use Lands
State Forest Natural Area	2	Category 1- Restricted Use Lands
State Forest Nursery	2	Category 1- Restricted Use Lands
State Game or Wildlife Sanctuary	2	Category 1- Restricted Use Lands
State Habitat Area	2	Category 1- Restricted Use Lands
State Heritage Preserve	2	Category 1- Restricted Use Lands
State Marine Park	2	Category 1- Restricted Use Lands
State Natural Heritage Site	2	Category 1- Restricted Use Lands

Management Designation Types	GAP Status Code	Analysis Category
State Natural Monument	2	Category 1- Restricted Use Lands
State Nature or Environmental Education Center	2	Category 1- Restricted Use Lands
State Park	2	Category 1- Restricted Use Lands
State Recreation Area	2	Category 1- Restricted Use Lands
State Recreation River	2	Category 1- Restricted Use Lands
State Research Area	2	Category 1- Restricted Use Lands
State Stewardship Trust Land	2	Category 1- Restricted Use Lands
State Tidal Land	2	Category 1- Restricted Use Lands
State Wetland Conservation Area	2	Category 1- Restricted Use Lands
State Wild or Scenic River	2	Category 1- Restricted Use Lands
State Wilderness Area	2	Category 1- Restricted Use Lands
State Wildlife Refuge	2	Category 1- Restricted Use Lands
Stream Bank	2	Category 1- Restricted Use Lands
Tribal Wilderness Buffer Zone	2	Category 1- Restricted Use Lands
Watershed Municipal	2	Category 1- Restricted Use Lands
Wilderness Study Area	2	Category 1- Restricted Use Lands
Wildlife Habitat Area	2	Category 1- Restricted Use Lands
Wildlife Preserve	2	Category 1- Restricted Use Lands
Wildlife Protection Area	2	Category 1- Restricted Use Lands
Wildlife Reserve	2	Category 1- Restricted Use Lands
Wildlife/Recreation Management Area	2	Category 1- Restricted Use Lands
World Heritage & Biosphere Site	2	Category 1- Restricted Use Lands
Zoological Area	2	Category 1- Restricted Use Lands
Bankhead-Jones Land Use Land	3	Category 2 - Multiple Use Lands
Bureau of Land Management General Public Land	3	Category 2 - Multiple Use Lands
City Access Area	3	Category 2 - Multiple Use Lands
City Beach	3	Category 2 - Multiple Use Lands
City Aquatic Area	3	Category 2 - Multiple Use Lands
City Fish Hatchery	3	Category 2 - Multiple Use Lands
City Lake	3	Category 2 - Multiple Use Lands
City Open Space	3	Category 2 - Multiple Use Lands
City Preserve or Natural Area	3	Category 2 - Multiple Use Lands
City Recreation Area	3	Category 2 - Multiple Use Lands
City Wildlife Refuge or Management Area	3	Category 2 - Multiple Use Lands
Conservation Easement Holder	3	Category 2 - Multiple Use Lands
Conservation Reserve Program Land	3	Category 2 - Multiple Use Lands
County Access Area	3	Category 2 - Multiple Use Lands

Management Designation Types	GAP Status Code	Analysis Category
County Beach	3	Category 2 - Multiple Use Lands
County Fish Hatchery	3	Category 2 - Multiple Use Lands
County Open Space	3	Category 2 - Multiple Use Lands
County Preserve or Natural Area	3	Category 2 - Multiple Use Lands
County Recreation Area	3	Category 2 - Multiple Use Lands
County Recreation Area	3	Category 2 - Multiple Use Lands
County Wildlife Refuge or Management Area	3	Category 2 - Multiple Use Lands
Experimental Range	3	Category 2 - Multiple Use Lands
Federal Fish Hatchery	3	Category 2 - Multiple Use Lands
Federal Forest Reserve	3	Category 2 - Multiple Use Lands
International Historic Site	3	Category 2 - Multiple Use Lands
Managed Hunting Area	3	Category 2 - Multiple Use Lands
Military Reservation	3	Category 2 - Multiple Use Lands
Mitigation Area	3	Category 2 - Multiple Use Lands
National Battlefield Parks/Site	3	Category 2 - Multiple Use Lands
National Forest General Public Land	3	Category 2 - Multiple Use Lands
National Grassland General Public Land	3	Category 2 - Multiple Use Lands
National Military Park	3	Category 2 - Multiple Use Lands
National Natural Landmark	3	Category 2 - Multiple Use Lands
National Petroleum Reserve	3	Category 2 - Multiple Use Lands
National River & Wild & Scenic Riverway (identified as "Recreation")	3	Category 2 - Multiple Use Lands
Natural Area with Extractive Uses	3	Category 2 - Multiple Use Lands
Natural areas with extractive uses	3	Category 2 - Multiple Use Lands
Open Space	3	Category 2 - Multiple Use Lands
Public Fishing Area	3	Category 2 - Multiple Use Lands
Recreation Trail	3	Category 2 - Multiple Use Lands
Regional Forest	3	Category 2 - Multiple Use Lands
Regional Open Space	3	Category 2 - Multiple Use Lands
Regional Recreation Area	3	Category 2 - Multiple Use Lands
Regional Shoreline	3	Category 2 - Multiple Use Lands
Reservoir Retained Land	3	Category 2 - Multiple Use Lands
River Corridor	3	Category 2 - Multiple Use Lands
Scenic Area	3	Category 2 - Multiple Use Lands
Scenic Byway	3	Category 2 - Multiple Use Lands
State Access Area	3	Category 2 - Multiple Use Lands

Management Designation Types	GAP Status Code	Analysis Category
State Archaeological Site	3	Category 2 - Multiple Use Lands
State Buffer Preserve	3	Category 2 - Multiple Use Lands
State Education Forest	3	Category 2 - Multiple Use Lands
State Fish Hatchery	3	Category 2 - Multiple Use Lands
State Fishing or Hunting Unit	3	Category 2 - Multiple Use Lands
State Forest	3	Category 2 - Multiple Use Lands
State Forest Education Center	3	Category 2 - Multiple Use Lands
State Forest Research or Demonstration Area	3	Category 2 - Multiple Use Lands
State Game Land	3	Category 2 - Multiple Use Lands
State Greenway	3	Category 2 - Multiple Use Lands
State Horse Park	3	Category 2 - Multiple Use Lands
State Lake or Reservoir	3	Category 2 - Multiple Use Lands
State Mitigation Area	3	Category 2 - Multiple Use Lands
State Range Area	3	Category 2 - Multiple Use Lands
State Reforestation Area	3	Category 2 - Multiple Use Lands
State Research Forest	3	Category 2 - Multiple Use Lands
State Restricted Area	3	Category 2 - Multiple Use Lands
State Rustic Park	3	Category 2 - Multiple Use Lands
State Scenic Reserve	3	Category 2 - Multiple Use Lands
State Trust Land	3	Category 2 - Multiple Use Lands
State Waterfowl Production Area	3	Category 2 - Multiple Use Lands
State Wildlife Management Area	3	Category 2 - Multiple Use Lands
State Wildlife Recreation Area	3	Category 2 - Multiple Use Lands
Waterfowl Production Area	3	Category 2 - Multiple Use Lands
Wetland Reserve Program Land	3	Category 2 - Multiple Use Lands
State Wild, Scenic and Recreation River (identified as "Recreation")	3	Category 2 - Multiple Use Lands
Wildlife Habitat Incentive Program Land	3	Category 2 - Multiple Use Lands
Wildlife Habitat Restoration Area	3	Category 2 - Multiple Use Lands
Wildlife Management Area	3	Category 2 - Multiple Use Lands
Conservation Easement Holder	Unknown	Category 3- Conservation Easement
Agricultural Research Center	Unknown	Not included in Analysis
Alaska Native Regional Corporations	Unknown	Not included in Analysis

Management Designation Types	GAP Status Code	Analysis Category
American Indian Reservations-Federally Recognized Tribal Entities	Unknown	Not included in Analysis
Army Corps of Engineers	Unknown	Not included in Analysis
Ceded Lands	Unknown	Not included in Analysis
City Cemetery	Unknown	Not included in Analysis
City Facility	Unknown	Not included in Analysis
City Historic Site	Unknown	Not included in Analysis
City Zoo	Unknown	Not included in Analysis
County Cemetery	Unknown	Not included in Analysis
County Facility	Unknown	Not included in Analysis
County Historic Area	Unknown	Not included in Analysis
Department of Energy	Unknown	Not included in Analysis
Military Recreation Area	Unknown	Not included in Analysis
National Cemetery	Unknown	Not included in Analysis
National Gateway	Unknown	Not included in Analysis
National Heritage Corridor	Unknown	Not included in Analysis
National Wildlife Refuge Overlay	Unknown	Not included in Analysis
Native Allotment	Unknown	Not included in Analysis
Native American Reservation	Unknown	Not included in Analysis
Other Federal/State/Local Lands	Unknown	Not included in Analysis
Other Private Protected Lands	Unknown	Not included in Analysis
Private Lands	Unknown	Not included in Analysis
Regional Facility	Unknown	Not included in Analysis
Select Appropriate Management Designation	Unknown	Not included in Analysis
Select Appropriate Management Designation	Unknown	Not included in Analysis
State Managed Conservation Easements	Unknown	Not included in Analysis
State Military Reservation	Unknown	Not included in Analysis
State Offshore & Other Submerged Land	Unknown	Not included in Analysis
State Resort Park	Unknown	Not included in Analysis
State Right of Way	Unknown	Not included in Analysis
State Sovereign Land	Unknown	Not included in Analysis
State University Land	Unknown	Not included in Analysis
State Wayside (a rest area)	Unknown	Not included in Analysis
Tribal Park	Unknown	Not included in Analysis
Tribal Primitive Area	Unknown	Not included in Analysis
Tribal Scientific or Natural Area	Unknown	Not included in Analysis

Appendix B - Protected Vegetation Script Tool Description

The Protected Vegetation Script Tool is made up of two python scripts that utilize the arcpy geoprocessing libraries to analyze data. The goal of the tool is to create region-based rasters and summary reports that merge together PAD-US (CBI Edition) Version 2 and the National Conservation Easement Database (NCED) Version 3 data with vegetation data provided by LANDFIRE. The reports indicate what percentage of area is protected for each vegetation type identified in the field labeled System Management Group.

The first script that is run by the tool is a script that simply breaks out the LANDFIRE data by region. This needs to be done as a raster for the entire conterminous U.S. would be too much data to process at one time. The script takes the shapefiles that define the individual regions (e.g. states, eco-regions or LCCs) and steps through each of the raster files. If the LANDFIRE data overlaps the shapefile, the script clips the LANDFIRE data to the shape. Once the script has identified all the LANDFIRE data that intersects the shape, it joins all the intersecting raster files into one raster that covers the region.

The second script is then run for each of the comparison files (PAD-US CBI Edition or NCED). The script goes through each region (state, eco-region or LCC) and clips the comparison file to that region. It then gathers the attribute data from the comparison file and holds that, while it generates a raster from the clipped data. It combines that raster with the LANDFIRE raster and then feeds the metadata back into that file. This allows the script to go through the data and consolidate it based on owner type and vegetation type. Once the combined rasters are generated, individual region reports are created using the consolidated metadata. As the script goes through each region, it also keeps track of the grand totals for each vegetation type, allowing for the creation of a full report for the conterminous U.S..

Appendix C - Full results table

Vegetation Type - System Management Group	Total Acres of Vegetation Type	Acres Protected by Restricted-use Land s	% Protected by Restricted-use Lands	Acres Protected by Multiple-use Lands	% Protected by Multiple-use Lands	Acres Protected by Conservation Easements	% Protected by Conservation Easements	% Protected by the Protected Lands Network
Natural Vegetation Type								
Alpine-Subalpine Barrens	15,479	10,081	65.13	1,633	10.55	611	3.95	79.63
Aspen Forest, Woodland, and Parkland	8,165,840	2,018,366	24.72	3,512,670	43.02	80,304	0.98	68.72
Aspen-Birch Forest	4,240,744	331,032	7.81	1,170,309	27.6	38,132	0.9	36.30
Aspen-Mixed Conifer Forest and Woodland	4,983,404	1,507,268	30.25	2,336,196	46.88	28,469	0.57	77.70
Atlantic Coastal Marsh	6,749,473	1,978,727	29.32	1,104,950	16.37	278,737	4.13	49.82
Atlantic Dunes and Grasslands	343,739	85,712	24.94	14,923	4.34	18,217	5.3	34.58
Atlantic Swamp Forests	21,271,419	1,865,785	8.77	3,233,927	15.2	519,211	2.44	26.42
Beech-Maple-Basswood Forest	39,219,193	1,802,843	4.6	2,577,359	6.57	254,972	0.65	11.82
Big Sagebrush Shrubland and Steppe	109,201,274	9,784,885	8.96	54,490,541	49.9	738,014	0.68	59.54
Bigtooth Maple Woodland	643,673	204,518	31.77	79,787	12.4	8,731	1.36	45.53
Black Oak Woodland and Savanna	3,602,935	202,236	5.61	193,254	5.36	30,037	0.83	11.81
Blackbrush Shrubland	4,773,630	1,625,581	34.05	1,805,853	37.83	1,248	0.03	71.91
Bur Oak Woodland and Savanna	864,969	27,728	3.21	30,634	3.54	7,153	0.83	7.57
California Mixed Evergreen Forest and Woodland	5,077,731	876,603	17.26	1,767,577	34.81	45,134	0.89	52.96
Chaparral	13,899,382	1,939,194	13.95	3,979,086	28.63	267,245	1.92	44.50
Chestnut Oak Forest and Woodland	22,733,353	1,255,673	5.52	2,272,416	10	120,558	0.53	16.05
Chestnut Oak-Virginia Pine Forest and Woodland	20,988,364	818,881	3.9	1,757,472	8.37	380,797	1.81	14.09
Coastal Plain Oak Forest	10,764,018	254,845	2.37	555,828	5.16	198,785	1.85	9.38
Conifer-Oak Forest and Woodland	5,973,998	508,469	8.51	1,338,990	22.41	60,687	1.02	31.94
Creosotebush Desert Scrub	26,700,250	9,979,850	37.38	5,414,588	20.28	15,699	0.06	57.72

Vegetation Type - System Management Group	Total Acres of Vegetation Type	Acres Protected by Restricted-use Land s	% Protected by Restricted-use Lands	Acres Protected by Multiple-use Lands	% Protected by Multiple-use Lands	Acres Protected by Conservation Easements	% Protected by Conservation Easements	% Protected by the Protected Lands Network
Natural Vegetation Type								
Cypress	1,271,511	287,096	22.58	259,224	20.39	33,495	2.63	45.60
Deciduous Shrubland	9,552,097	1,507,187	15.78	3,159,917	33.08	195,530	2.05	50.91
Depressional Wetland	4,712,325	103,574	2.2	332,592	7.06	105,149	2.23	11.49
Desert Scrub	45,771,156	10,905,367	23.83	10,524,451	22.99	69,940	0.15	46.97
Douglas-fir Forest and Woodland	16,465,616	2,273,465	13.81	9,415,459	57.18	287,728	1.75	72.74
Douglas-fir-Grand Fir-White Fir Forest and Woodland	15,609,709	2,410,248	15.44	8,565,306	54.87	79,005	0.51	70.82
Douglas-fir-Ponderosa Pine-Lodgepole Pine Forest and Woodland	19,285,408	2,217,272	11.5	9,841,940	51.03	124,867	0.65	63.18
Douglas-fir-Western Hemlock Forest and Woodland	12,539,740	860,458	6.86	5,072,866	40.45	81,354	0.65	47.96
Dry Tundra	547,031	353,528	64.63	158,576	28.99	1,350	0.25	93.86
Eastern Floodplain Forests	28,368,110	1,613,051	5.69	2,191,719	7.73	587,039	2.07	15.48
Eastern Small Stream Riparian Forests	10,458,513	228,907	2.19	484,036	4.63	120,679	1.15	7.97
Glades and Barrens	1,835,530	66,492	3.62	148,268	8.08	17,277	0.94	12.64
Grassland	30,711,534	3,796,398	12.36	10,006,506	32.58	255,277	0.83	45.77
Grassland and Steppe	17,173,856	1,402,085	8.16	4,995,964	29.09	94,649	0.55	37.81
Greasewood Shrubland	12,027,362	851,823	7.08	6,604,191	54.91	33,749	0.28	62.27
Great Lakes Alvar	17,727	1,205	6.8	1,029	5.81	13	0.07	12.68
Hammocks	66,379	46,443	69.97	5,592	8.42	931	1.4	79.79
Hardwood Flatwoods	376,474	20,708	5.5	13,504	3.59	5,209	1.38	10.47
Heathland and Grassland	9,337	3,916	41.94	254	2.72	435	4.66	49.33
Inland Marshes and Prairies	5,738,843	457,271	7.97	971,551	16.93	167,573	2.92	27.82
Jack Pine Forest	2,806,222	373,169	13.3	869,055	30.97	25,296	0.9	45.17
Juniper Woodland and Savanna	2,348,778	265,082	11.29	1,081,266	46.04	3,276	0.14	57.46
Juniper-Oak	12,872,806	248,250	1.93	812,973	6.32	166,654	1.29	9.54

Vegetation Type - System Management Group	Total Acres of Vegetation Type	Acres Protected by Restricted-use Land s	% Protected by Restricted-use Lands	Acres Protected by Multiple-use Lands	% Protected by Multiple-use Lands	Acres Protected by Conservation Easements	% Protected by Conservation Easements	% Protected by the Protected Lands Network
Natural Vegetation Type								
Limber Pine Woodland	840,024	194,250	23.12	360,055	42.86	15,211	1.81	67.80
Loblolly Pine (Slash Pine) Forest and Woodland	177,477	7,160	4.03	163,037	91.86	14	0.01	95.91
Loblolly Pine Forest and Woodland	114,854	674	0.59	110,122	95.88	10	0.01	96.48
Longleaf Pine Woodland	11,391,252	415,619	3.65	1,012,185	8.89	115,576	1.01	13.55
Low Sagebrush Shrubland and Steppe	18,009,655	2,501,529	13.89	11,599,227	64.41	21,401	0.12	78.41
Mangrove	399,635	370,064	92.6	3,531	0.88	993	0.25	93.73
Maritime Forest	421,000	100,903	23.97	16,156	3.84	11,630	2.76	30.57
Mesquite Woodland and Scrub	39,386,033	399,145	1.01	3,263,091	8.28	66,520	0.17	9.47
Mixedgrass Prairie	76,587,183	1,204,423	1.57	9,905,885	12.93	459,433	0.6	15.11
Montane Oak Forest	740,879	288,778	38.98	158,666	21.42	13,247	1.79	62.18
Mountain Hemlock Forest and Woodland	1,371,220	893,887	65.19	409,075	29.83	6,551	0.48	95.50
Mountain Mahogany Woodland and Shrubland	2,147,526	617,063	28.73	931,010	43.35	11,173	0.52	72.61
Pacific Coastal Marsh	69,436	8,579	12.36	11,482	16.54	2,545	3.67	32.56
Pacific Coastal Scrub	1,444,938	239,202	16.55	76,699	5.31	38,645	2.67	24.54
Peatland Forests	7,775,525	821,092	10.56	3,146,774	40.47	98,044	1.26	52.29
Pine Flatwoods	9,465,771	675,375	7.13	1,489,152	15.73	229,134	2.42	25.29
Pine-Hemlock-Hardwood Forest	19,792,299	1,150,182	5.81	3,243,455	16.39	378,616	1.91	24.11
Pinyon-Juniper Woodland	41,592,145	8,444,306	20.3	19,651,960	47.25	79,319	0.19	67.74
Pitch Pine Woodlands	817,109	94,173	11.53	236,936	29	11,245	1.38	41.90
Pocosin	1,088,451	423,543	38.91	60,613	5.57	28,467	2.62	47.10
Ponderosa Pine Forest, Woodland and Savanna	22,635,898	1,838,628	8.12	11,200,288	49.48	119,898	0.53	58.13
Post Oak Woodland and Savanna	17,139,305	102,745	0.6	192,402	1.12	87,537	0.51	2.23

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Natural Vegetation Type								
Prairies and Barrens	1,538,329	24,086	1.57	152,766	9.93	28,431	1.85	13.34
Red Alder Forest and Woodland	2,499,751	105,379	4.22	380,196	15.21	35,645	1.43	20.85
Red Fir Forest and Woodland	2,613,146	1,168,453	44.71	1,234,019	47.22	388	0.01	91.95
Red Pine-White Pine Forest and Woodland	2,319,771	279,301	12.04	560,793	24.17	25,449	1.1	37.31
Redwood Forest and Woodland	1,841,152	308,438	16.75	80,992	4.4	64,630	3.51	24.66
Ruderal Forest	26,531,269	447,126	1.69	1,284,388	4.84	222,528	0.84	7.37
Salt Desert Scrub	24,066,754	1,751,268	7.28	13,370,598	55.56	26,227	0.11	62.94
Sand Prairie	21,554,721	249,554	1.16	1,002,984	4.65	57,050	0.26	6.08
Sand Shrubland	12,604,521	435,977	3.46	972,086	7.71	64,336	0.51	11.68
Shortgrass Prairie	39,889,865	193,444	0.48	4,382,371	10.99	239,907	0.6	12.07
Shortleaf Pine Woodland	5,675,215	204,932	3.61	476,810	8.4	7,082	0.12	12.14
Shortleaf Pine-Oak Forest and Woodland	6,260,631	158,493	2.53	1,363,175	21.77	7,912	0.13	24.43
Sitka Spruce Forest	1,738,192	102,359	5.89	409,797	23.58	12,797	0.74	30.20
Southern Scrub Oak	101,147	8,331	8.24	19,650	19.43	5,170	5.11	32.77
Sparse Vegetation	19,450,648	7,864,234	40.43	5,483,636	28.19	18,673	0.1	68.72
Spruce-Fir Forest and Woodland	17,072,146	6,990,333	40.95	8,838,201	51.77	79,080	0.46	93.18
Spruce-Fir-Hardwood Forest	15,699,905	2,066,386	13.16	2,568,926	16.36	980,213	6.24	35.77
Subalpine Woodland and Parkland	4,823,119	2,902,556	60.18	1,847,933	38.31	4,044	0.08	98.58
Succulent Desert Scrub	2,006,034	268,324	13.38	85,146	4.24	8,224	0.41	18.03
Sweetgum-Water Oak Forest	9,896,266	179,100	1.81	323,707	3.27	101,816	1.03	6.11
Tallgrass Prairie	13,549,841	132,258	0.98	262,025	1.93	170,834	1.26	4.17
Texas Live Oak	979,960	46,754	4.77	3,467	0.35	6,915	0.71	5.83
Virginia Pine Forest	1,211,181	44,794	3.7	95,238	7.86	7,205	0.59	12.16
Western Hemlock-Silver Fir Forest	4,424,999	1,654,984	37.4	2,233,966	50.49	66,503	1.5	89.39

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Natural Vegetation Type								
Western Herbaceous Wetland	498,429	128,141	25.71	132,629	26.61	13,836	2.78	55.09
Western Larch Forest and Woodland	36,667	2,859	7.8	22,205	60.56	449	1.22	69.58
Western Oak Woodland and Savanna	2,447,241	455,368	18.61	827,999	33.83	25,079	1.02	53.47
Western Red-cedar-Western Hemlock Forest	1,682,601	366,177	21.76	594,476	35.33	26,590	1.58	58.67
Western Riparian Woodland and Shrubland	18,576,947	2,548,657	13.72	4,178,713	22.49	253,647	1.37	37.58
White Oak-Beech Forest and Woodland	4,608,705	73,101	1.59	79,891	1.73	51,478	1.12	4.44
White Oak-Red Oak-Hickory Forest and Woodland	39,572,724	1,621,410	4.1	4,378,071	11.06	269,352	0.68	15.84
Yellow Birch-Sugar Maple Forest	39,547,759	4,720,244	11.94	5,425,056	13.72	1,823,673	4.61	30.26
Non-Vegetation Type								
Barren	22,748,608	8,623,071	37.91	5,020,616	22.07	140,283	0.62	60.59
No Data	188,688,889	20,693	0.01	14,984	0.01	198	0	0.02
Open Water	76,145,003	3,870,387	5.08	2,399,485	3.15	535,372	0.7	8.94
Quarries-Strip Mines-Gravel Pits	1,007,015	13,954	1.39	104,703	10.4	3,043	0.3	12.09
Snow-Ice	428,969	363,426	84.72	57,857	13.49	113	0.03	98.23
Unknown	183,901,107	2,021	0	424	0	11	0	0.00
Managed Vegetation Type								
Agricultural-Aquaculture	4,003	30	0.74	14	0.36	2	0.04	1.14
Agricultural-Bush fruit and berries	136,421	1,891	1.39	751	0.55	4,081	2.99	4.93
Agricultural-Close Grown Crop	16,566,785	122,802	0.74	204,914	1.24	198,986	1.2	3.18
Agricultural-Fallow/Idle Cropland	20,154,119	103,941	0.52	485,409	2.41	121,817	0.6	3.53
Agricultural-Orchard	3,961,489	23,883	0.6	68,909	1.74	22,809	0.58	2.92
Agricultural-Pasture and Hayland	46,256,645	341,426	0.74	852,337	1.84	821,999	1.78	4.36
Agricultural-Row Crop	77,225,271	144,133	0.19	287,548	0.37	615,052	0.8	1.36

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Managed Vegetation Type								
Agricultural-Row Crop-Close Grown Crop	814,990	2,077	0.25	3,448	0.42	15,327	1.88	2.56
Agricultural-Vineyard	645,380	1,577	0.24	8,906	1.38	2,731	0.42	2.05
Agricultural-Wheat	42,352,876	65,618	0.15	400,800	0.95	81,909	0.19	1.29
Agriculture-Cultivated Crops and Irrigated Agriculture	144,414,499	554,766	0.38	625,509	0.43	1,186,993	0.82	1.64
Agriculture-General	1,643	28	1.69	0		8	0.46	2.15
Agriculture-Pasture and Hay	73,855,028	238,898	0.32	392,879	0.53	228,295	0.31	1.16
Developed-High Intensity	3,044,690	13,294	0.44	8,840	0.29	786	0.03	0.75
Developed-Low Intensity	22,492,767	250,938	1.12	234,596	1.04	60,902	0.27	2.43
Developed-Medium Intensity	8,027,431	62,795	0.78	39,232	0.49	6,163	0.08	1.35
Developed-Open Space	22,269,286	287,670	1.29	390,247	1.75	61,741	0.28	3.32
Developed-Roads	28,170,885	505,748	1.8	1,128,035	4	129,879	0.46	6.26
Developed-Upland Deciduous Forest	5,883,144	131,428	2.23	100,447	1.71	106,536	1.81	5.75
Developed-Upland Evergreen Forest	2,675,867	73,235	2.74	150,225	5.61	23,475	0.88	9.23
Developed-Upland Herbaceous	36,227,517	376,142	1.04	734,681	2.03	357,261	0.99	4.05
Developed-Upland Mixed Forest	1,808,167	55,079	3.05	67,725	3.75	10,933	0.6	7.40
Developed-Upland Shrubland	11,292,608	224,486	1.99	423,038	3.75	158,845	1.41	7.14
Introduced Annual and Biennial Forbland	2,842,946	254,542	8.95	1,551,169	54.56	3,092	0.11	63.62
Introduced Annual Grassland	21,007,458	2,444,982	11.64	7,471,955	35.57	93,581	0.45	47.65
Introduced Herbaceous Wetland Vegetation	115,012	5,030	4.37	19,400	16.87	12,448	10.82	32.06
Introduced Perennial Grassland and Forbland	10,089,435	486,111	4.82	1,409,057	13.97	176,277	1.75	20.53

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Managed Vegetation Type								
Introduced Riparian Vegetation	718,422	154,814	21.55	164,294	22.87	2,710	0.38	44.80
Introduced Upland Vegetation-Shrub	39,776	990	2.49	1,171	2.94	289	0.73	6.16
Introduced Upland Vegetation-Treed	241,316	29,619	12.27	14,566	6.04	8,113	3.36	21.67
Introduced Wetland Vegetation	52,803	9,042	17.12	4,611	8.73	3,519	6.66	32.52
Introduced Woody Wetland Vegetation	303,951	685	0.23	1,868	0.61	103	0.03	0.87
Managed Tree Plantation	39,745,346	603,964	1.52	1,999,410	5.03	253,286	0.64	7.19
Modified-Managed Prairie Grassland	18,576,519	107,816	0.58	249,927	1.35	121,821	0.66	2.58
Transitional Forest Vegetation	1,550	161	10.4	125	8.04	65	4.17	22.61
Transitional Herbacous Vegetation	7,297,435	261,863	3.59	513,536	7.04	74,581	1.02	11.65
Transitional Shrub Vegetation	205,399	4,689	2.28	4,126	2.01	3,093	1.51	5.80